Implication of 4th Industrial Revolution on Tax Revenue Collection in Tanzania:

A Case of Manufacturing Industries

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TABLE OF CONTENTS

LIST OF TABLES

ABSTRACT

The study assessed the implication of the Fourth Industrial Revolution (4IR) on tax revenue collection in Tanzania. Specifically, the study sets out to establish the causality of investment in 4IR technologies, on manufacturing industries' Value Added Tax (VAT); determine the influence of investment in 4IR technologies on manufacturing industries' Corporate Tax and examine the effects of investment in 4IR technologies on manufacturing industries' Employment Tax (PAYE). To achieve the research objectives, the study used a quantitative descriptive design to generate the required data. Moreover, the study used structured questionnaires for cross-sectional survey, administered with 225 production managers of manufacturing industries in Tanzania. It used probability sampling in the form of cluster sampling. Additionally, the study used the Least Square method to analyse the objectives of the study in addition to testing the hypotheses. The study found a positive and statistically significant causal effect between investment in modern technology, VAT, Corporate tax and Employment Tax (PAYE) of manufacturing firms in Tanzania, for the period under study. Implicitly, the emergence of 4IR does not necessarily occasion a decline in tax revenue collections (VAT, PAYE, and Corporate Tax) on the part of manufacturing firms in developing countries endowed with resources, like Tanzania, but rather complements and accelerates its growth. Thus, the study calls on the Tanzania Government to review and improve its Sustainable Industrial Development Policy of 2020 and the Integrated Industrial Development Strategy of 2025 to embrace, promote and support not only resource-based industries, but also technological based industries, to speed up industrialisation within the country and ultimately improve and increase tax revenue collection. The government should also improve its investment policies and align them with technological changes brought by 4IR, to attract more foreign direct investments, importation and adaptation of 4IR technologies from developed countries that enhance productivity, turnover and tax revenue collections from the manufacturing sector.

CHAPTER ONE
INTRODUCTION

1.1 Introduction and Background

Tanzania has been emphasising industrialisation since independence in 1961. Initially, from 1961-1967, Tanzania was under a mixed system economy and the economy was led by the private sector. Industries in Tanzania were occupied from colonial power and most of them were focused on the production of consumer goods and processing industries, which set for raw materials preparation to satisfy the needs of the industries in Europe (Wangwe et al. 2014). The industrial sector in Tanzania has passed through various stages since independence in 1961, to-date. During that period, there have been industrialisation and deindustrialisation phases, which necessitate the government to form structural adjustment programmes as well as conduct some policy reforms to ensure development of the sector. However, manufacturing industries remain vulnerable to growth problems and poorly contribute to tax revenue collections by the government (Msami and Wangwe 2016).

The new era of the manufacturing industry is manifested by the formation and implementation of the Sustainable Industrial Development Policy 2020 (SIDP), with the aim of steering the industrial sector towards the attainment of sustainable economic growth, through increase in tax revenue collections, job creation, human development, economic transformation and equitable development (Ministry of Industry and Trade, 1996). SIDP was implemented in three phases, Phase I (1996-2000), which was a short-term phase aimed at consolidating and rehabilitating present industries through restructuring and capital financing. Phase II (2000-2010), which was a medium-term phase aimed to own newly-established machinery industries, promote export manufacturing, consider emerging technological innovation to exploit the country's natural resources and have intermediate light capital goods and intermediate goods, and Phase III (2010-2020), which was the long-term phase, aimed to consolidate industries that came into being during phases one and two, and provide major investment in basic capital goods (Msami and Wangwe 2016).

From the Sustainable Industrial Development Policy of 2020, Tanzania developed the Integrated Industrial Development Strategy of 2025. Its main goals were to deliver double digit, broad-based economic growth within the second decade of the 21st Century, and it depends on the transformation of agriculture to raise productivity to global levels and kick-start a dynamic process of agriculture-led and resource-based industrialisation. The strategy was to develop integrated agricultural production systems that include modern

and commercialised agricultural production, backward linkages to production and supply of inputs and forward linkages to agro-processing, packaging and marketing. Stakeholders include domestic smallholder producers linked with large international firms through contract farming procedures that ensure access to state-of-the-art production technologies, integration of domestic markets and linkages to international markets.

The Integrated Industrial Development Strategy (IIDS) of 2025 responds to the need for a dynamic strategy aimed at guiding the process of resource-based industrialisation. IIDS reflects the difficulties Sub-Sahara African countries contend with in attracting and retaining labour intensive industries as a growth strategy, considering higher labour costs and lower skill levels than those prevailing in competing Asian economies. Measures to change this adverse situation include undertaking initiatives for extending the outreach and raising the quality of social services in the education and health sectors. Other initiatives include investments aimed at facilitating the delivery of cost-effective and reliable infrastructural services in the transportation, power and energy sectors with a view to building a conducive investment climate. Yet, all this did not bear fruit as planned, since governments have failed to properly prepare and invest in infrastructure to withstand, sustain and harvest benefits of the technological revolution. Particularly, the emergence of the Fourth Industrial Revolution technologies has made it cheaper to produce with modern technologies rather than depending on cheap labour and resources (Lee 2019).

Industries in developing countries such as Tanzania are labour-intensive, with little recourse for the utilisation of technology. Most significantly, due to the unpreparedness to embrace technological advancement, the emergence of 4IR in developing countries tends to reverse the growth catch-up theory as promulgated by Lee et al. (2019) and Postelnicu and Cales (2019). Production costs increasingly drop with technology than resources endowment or using of cheap labour. Second, the deepening of human and physical capital tends to raise tax revenue collections and GDP per capita in the short-run, but the law of diminishing returns suggests that as an economy continues to increase its human and physical capital, with the marginal gains to economic growth diminishing in the long-run, except for where technological advancement comes into the picture.

Industrial development has been an integral part of Tanzania's development strategies in the post-independence era. Policymakers ought to lead the process of transforming the country's economy from low productivity and low growth to high productivity and dynamic economy, associated with structural change and sustained growth in tax revenue (Wangwe et al 2014). However, the share of the manufacturing sector relative to the GDP and its growth rate has remained relatively stagnant over past decades. For policy purposes and to draw relevant lessons, this study aimed to examine the causal effect and relationship between industrial investment in modern technologies (particularly the 4th industrial revolution technologies) and tax revenue collection (Value Added Tax, Employment Tax and Corporate Tax) by the government. According to national tax statistics from TRA in 2022, the proportion of these types of taxes contributes more than 75 percent of all the tax revenue collected by the government from manufacturing industries in Tanzania.

Scholars of 4IR, such as Lee (2019), Cales (2019), Falco (2019) and Schwab (2016) focused on developed and advanced economies and how they could develop and acquire skill sets targeting and matching the requirements of the new technology and how they would accommodate structural adjustment challenges as workers lose their jobs and businesses fail to remain competitive, with none of them paying any attention to the possible effects of the 4IR on less developed economies such as Tanzania. This study has bridged this gap. A few scholars such as Ayentimi and Burgess (2019), Uleanya and Yu Ke (2019) have discussed the relevance of 4IR in Sub-Saharan Africa and Africa in general. However, none of them have critically analysed the ultimate effects of 4IR on countrys' tax revenue generation from the manufacturing sector, which this study has strived to cover.

1.2 Problem Statement

The emergence of the Fourth Industrial Revolution (4IR) technologies has triggered a shift of manufacturing industries from poor countries like Tanzania, to rich countries with

cheap technology (Schwabs, 2016). The Tanzania Industrial Integrated Development Strategy, which is based on low-cost labour, becomes irrelevant as innovation cuts down the cost of automation, with smart productivity boosting production. Thus, an outward shift of manufacturing industries from Tanzania to developed countries due to 4IR can cause massive decline in Corporate Tax, Value Added Tax and Employment Tax from manufacturing firms. This argument has found ready support in previous scholars (Lee et al 2019, Schwabs 2016, Postelnicu and Cales 2019, Falco 2019, Ayentimi and Burgess 2019).

Regardless of the emergence of 4IR, the tax statistics of manufacturing firms gathered from Tanzania Revenue Authority for the period under study (2012-2021), portray a different trend from what has been expected. Corporate Tax has increased from TZS1.09 trillion in 2011 to TZS5.1 trillion in 2021. Employment Tax (PAYE) has increased from TZS727 billion in 2011 to TZS2 trillion in 2021. Value Added Tax has increased from TZS2.5 trillion in 2011 to TZS5.8 trillion in 2021. This abnormal trend calls for an investigation aimed at comprehending the effects of 4IR on tax revenue collection (Corporate Tax, PAYE, VAT) in the Tanzania manufacturing sector.

Recent studies on the digital and technological revolution in Tanzania and outside Tanzania (i.e., Newman et al. (2016), Kweka (2018), Salam et al. (2018), Diyamett & Makundi (2012), Maskaeva et al. (2018), have emphasised how technological advancement has affected the performance of manufacturing industries and impaired the ability of revenue collecting authorities to collect tax revenues from digital businesses.
This study focused on the emergence of 4IR technologies and their effects on the amount of tax revenue collected (Corporate Tax, Value Added Tax and Employment Tax) from manufacturing firms in Tanzania.

1.3 Objectives

1.3.1 General Objective

To assess the implication of the 4th IR on tax revenue collection in Tanzania.

1.3.2 Specific Objectives

Specifically, the study set out to:

1. Establish the causality of investment in 4IR technologies on manufacturing industries' Value Added Tax (VAT).
2. Determine the influence of investment in 4IR technologies on manufacturing industries' Corporate Tax.

3. Examine effects of investment in 4IR technologies on manufacturing industries' Employment Tax (PAYE).

1.4 Hypotheses

1. There is relationship between Value Added Tax collections and investment in 4IR technologies in Tanzania's manufacturing industries.
2. There is relationship between Employment Tax (PAYE) collections and investment in 4IR technologies in Tanzania's manufacturing industries.
3. There is relationship between Corporate Tax collections and investment in 4IR technologies in Tanzania's manufacturing industries.

1.5 Significance of the Study

The Current study will assist both government and institutions (public and private), in terms of preparing policies and strategies to encounter the outcome of the Fourth Industrial Revolution. In-depth analysis and recommendations on how to embrace the Fourth Industrial Revolution, since it is inevitable. Moreover, the study provides in-depth insight into the effects of 4IR in the Tanzania industrial sector.

The expectations were to reveal to what extent investment in 4IR technologies has affected manufacturing industries in Tanzania, in terms of their contribution and payment behaviour of corporate tax, VAT and PAYE. The study makes recommendations on how the Tanzania Government can improve the focus on its Integrated Industrial Development Strategy (2025) from resource-based industries to technology-based industries. This thrust can assist the country to exploit both technology (by imitation and adaptation) and resources (both human and physical), with which it is endowed, to attract FDI, do away with re-shoring investment to wealthier nations, and maximise its productivity and tax revenue collection. This study provides insight into the Tanzania Revenue Authority on prospects of revenue collection in the country. As such, the Fourth Industrial Revolution can bring about a number of adverse effects, especially to countries that are technologically backward, such as Tanzania. Such effects include a decline in investments, production and exports, skills mismatch, job dislocation and mass unemployment. Such development translates to massive decline in revenue collection. The current study can also serve as secondary data for future studies on related research problems. It also contributes to the body of knowledge on the relevance and impact of the Fourth Industrial Revolution, particularly in less developed countries, such as Tanzania.

CHAPTER TWO
LITERATURE REVIEW

2.1 Definition of Key Terms

2.1.1 Fourth Industrial Revolution

This revolution is a digital transformation that pervasively impacts all walks of life across the globe (Schwab, 2016). It is characterised by key technologies such as genetics, artificial intelligence, cloud computing, nanotechnology, biotechnology, and 3-D printing.

2.1.2 Tax Revenue

Tax revenue refers to government revenues collected from taxes on income and profits, social security contributions, taxes levied on goods and services, payroll taxes, taxes on the ownership and transfer of property as well as other taxes (OECD 2020).

2.2 Theoretical Literature Review

Of the theories that relate to economic catch-up, two theories—the product cycle theory developed by Posner (1961) and Vernon (1966) and the profit cycle theory developed by Markusen (1985)—informed the study.

2.2.1 Product Cycle Theory

The product cycle theory argues that products like human beings have a life cycle or stages: introduction – maturity – standardisation; the theory also states that the production cost is a critical factor of comparative advantage that explains the shift of the production of a product from developed economies to developing economies, along its life cycle. This well-known theory, however, only partially explains why changes in industrial leadership occurred. Mowery and Nelson (1999, pp. 11, 13), provide three reasons. First, the theory is applied to products, rather than countries and industries, which are generally populated by a number of various products. In addition, a single "life cycle" of a given product or technology focuses on this theory; most countries and industries have multiple technological generations in historical development. Lastly, the theory does not consider sufficiently the interaction of industrial and institutional elements in causing changes in industrial leadership.

2.2.2 Profit Cycle Theory

The profit cycle theory by Markusen (1985) is built to explain the evolution of an industry and its regional shifts in the United States. It emphasises Schumpeterian and Marxist work on innovation and capitalist dynamics, product cycle theories and theories of oligopolistic behaviour, and

suggests five stages of a sector: zero profit, super profit, normal profit, normal-plus or normal-minus profit, and negative profit. Two major reasons make this theory unable to explain changes in industrial leadership between advanced and less developed economies. First, it is more natural to treat profit as the outcome of business activities in industries, rather than as a source of any changes in industries. Second, this theory emphasises the impact of oligopoly on the evolution of industries, but when considering industries at the global rather than country level, oligopoly has weaker power to explain the course of the emergence of industries in other places in the world.

2.2.3 Catch-up Theory

The core mechanisms of the catch-up theory, according to Liu et al. (2017), are the diverse sources of technological improvements among developed and developing economies. The technological progress of developed economies is primarily based on trial-and-error, or innovation. The costly and risky innovation results in moderate long-term growth. However, developing economies can achieve technological progress through technology adoption and imitation, which costs much less than research and development (R&D), as there is a large technological gap between developing and developed economies. Therefore, in the early stage of catch-up, the technological growth rate of developing economies is much higher than that of developed economies. Only when the technology gap between latecomer economies and advanced economies narrows, does the technology growth rate begin to slow down. The income growth rate is, thus, brought down.

In its simplest form, as Abramovitz (1986) explains, the catch-up hypothesis states that a country should grow more rapidly if it is initially backward in its economic development level. This assumption stems from the premise that a country lagging in technology carries greater potential for rapid growth with imitation and adoption of technology, than already advanced countries. This catch-up can take place through capital-embodied technical progress. Countries that are lagging possess an older, less modern capital stock. Discarding of this stock and its replacement by more modern equipment, is accompanied by large productivity gains, larger than those achieved by countries that possessed up-to-date equipment from the outset.

The most popular explanations for developing economies high rate of economic growth, as compared to advanced economies, are low labour costs, demographic dividends, low land costs and low environment costs, among others, Liu et al. (2017). Even though developed economies such as the US, enjoyed similar elements in their initial stages of development, they never experienced a high-speed growth phase. The reason is clear: Latecomer economies can adopt and imitate technology at a lower cost. This key condition enabled countries such as China to maintain a growth rate of nearly 10 percent for 30 years. Moreover, during the high-speed phase, the rapid accumulation of capital does not lead to a significant decrease in capital efficiency,

since the diminishing marginal return to capital effect is offset by the rapid catching-up of technology (Kehoe and Prescott, 2002; Zhu, 2012).

After the high-speed phase, the transition from high to medium/low economic growth is attributable to the narrowing of the technological gap between developing and advanced economies. Consequently, developing economies' advantages decrease, and the speed of technological progress is insufficient to offset the diminishing marginal returns of capital. Therefore, the rate of economic growth begins to decrease. It is worth noting that during the growth transition, a series of changes occur slowdown of technological advancement, economic growth and investment growth, a change from technology imitation to R&D and a decrease in capital returns. As the technology gap shrinks, these changes continue until the developing economies complete the catch-up process and converge with developed economies (Midrigan and Xu, 2014). This theory guided the current study.

2.2.3.1 Industry 4.0

The world has experienced four industrial revolutions. The first revolution employed the use of steam engines for mechanical production; the second utilised electricity and the concept of division of labour for mass production; the third (which grew in the middle of the last century) introduced information technology and automated production processes; and, finally, came the fourth revolution or 4IR. This revolution has ushered in a digital transformation that pervasively impacts every walk of life, across the globe (Schwab, 2016).

The economic and technological changes over the past few centuries represent three major industrial revolutions: (1) mechanical production in the late 18th century; (2) usage of electricity for mass industrial production in the later 19th century and (3) personal computers and the internet in the 1960s (Frey and Osborne, 2013). Current changes in the world of work are frequently depicted as the Fourth Industrial Revolution, or Industry 4.0 (Schwab, 2016), which is characterised by key technologies such as genetics, artificial intelligence, cloud computing, nanotechnology, biotechnology and 3-D printing, among others. Brynjolfsson and McAfee (2014) described 4IR as the second machine age. They argued that the key difference from preceding industrial revolutions is that current technology is no longer aimed at replacing physical labour and supporting humans in doing their work, but rather at replacing cognitive work and human workers altogether. Proponents of this view have stressed that technological progress is advancing with exponential speed; we are at the beginning of fundamental changes and technological breakthroughs that will occur in the next few decades (Brynjolfsson and McAfee, 2014; Ford, 2015). One prominent fear emerging from these envisioned changes is that automation and robots would gradually take over much of the work performed by humans (Ford, 2015).

Guidelines for Industry 4.0 implementation, in general, are driven by government programmes, such as Germany – 'High Tech Strategy 2020' and 'Industry 4.0', Kagerman et al. (2013); United Kingdom – 'Future of Manufacturing', Foresight (2013); United States – 'Advanced Manufacturing Partnership', President's Council of Advisors on Science and Technology (2014); France – 'La Nouvelle France Industrielle', Conseil National de L'industrie (2016); European Commission – 'Factories of the Future' and 'Horizon 2020' ,European Commission (2016); Japan – 'Super Smart Society' Keqiang (2015); Sweden – 'Smart Industry' and 'Produktion 2030' Ministry of Enterprise and Innovation (2016).

Schwab (2016) contends that 4IR opens the possibilities of having billions of people connected via smart devices, with extraordinary processing power and access to data, with algorithms used to foretell cultural interests or even software applied to discover new medications. 4IR further creates a gap between the "West" and the "Rest". This gap is not only a technological one, but also touches on almost every area of human development and agency.

In the West, genetic sequencing is now unbelievably cheap and humans and machines augment and assist each other with knowledge and skills. Meanwhile, there are four billion people in the "Third World" who tend to lack reliable internet access. For Africa, the second industrial revolution is yet to be fully experienced, as nearly 1.3 billion people lack access to electricity. The problem rests not with the "failure" of the "Third World" to "catch up" to 4IR, but it is how 4IR raises concerns around issues of power asymmetry, security and the resulting threats of inequality, disempowerment and exploitation.

Schwab is convinced that since it took almost 120 years for the Spindle (the hallmark of the First Industrial Revolution) to spread outside Europe, but it took less than a decade for the Internet to permeate across the globe, then perhaps the gap between both worlds could close faster. According to him, however, this will only happen if governments, public institutions and the private sector do their part, and if citizens accept the Internet's long-term benefits (Schwab 2016).

From a human rights lens, many questions have arisen. With respect to the future of jobs, for example, if it will take 118 years before economic gender parity is achieved around the world (Schwab, 2018). Will 4IR improve or compound conditions? How will 4IR reduce these projected years, shrink this gap, or affect the role that women will play in new digital workplaces? Automation has caused massive job losses in male dominated sectors (such as manufacturing and construction), due to substitution by machines. On the other hand, however, some female-dominated sectors cannot be machine-substituted, as they rely on intrinsically human traits, such as empathy and compassion to thrive (e.g., psychology, nursing and event planning). Because men still tend to dominate STEM fields (Science, Technology, Engineering and Mathematics), this increasing demand for specialized technical skills can exacerbate gender inequalities. Furthermore, as doctors in the West are "trending" towards telemedicine and lawyers move towards "tele-lawyering," telecommunications expertise and related information technology skills are now a need-add, including in the provision of clinical legal education.

2.3 Empirical Evidence

2.3.1 Africa and the Fourth Industrial Revolution

Africa remains the world's largest (in terms of number of countries) continent with 54 countries. It is the second biggest and most populous continent in the world. It remains a key region on the global map with significant natural resource endowment, including human capital, compared to any region of the world (African Development Bank, 2016). According to the Africa Competitiveness Report (2017), economic growth in several countries in the sub-Saharan region has slowdown due to prolonged low commodity prices and reduced growth in many advanced and emerging economies, particularly China. Primarily, the commodity boom in sub-Saharan Africa may be over, with falling commodity prices over the last few years. However, the continent's market size of 1.2 billion people, which is characterised by a significant young population, still holds huge economic potential as an important investment destination (The Africa Competitiveness Report, 2017).

Sub-Saharan Africa has a demographic opportunity as the world's youngest region, with more than 60 percent of its population under the age of 25, Naudé (2017) and World Economic Forum (2016). It is estimated that more than one quarter of the world's under-25 populations would be found in the region by 2030 (World Economic Forum, 2017). Yet as 4IR progresses, specific capabilities and jobs that are supposed to be performed by humans, are gradually drifting away with the help of robotics and automation technologies (World Economic Forum, 2017). The fear of the consequences of 4IR has deepened, particularly among many developing economies in Sub-Saharan Africa because of its impact on job dislocation, skill disruption, combined with existing mass unemployment and skill shortages already undermining economic transformation and sustained growth (Naudé, 2017; World Economic Forum, 2016).

The double-breasting dilemma to be triggered by 4IR within the Sub-Saharan African context raises several questions, particularly on how individuals, governments and corporations will react to and accommodate these developments. We denote the 'double-breasting dilemma' to represent 4IR influence on skill disruptions and job dislocations, combined with existing mass unemployment and the general lack of a highly skilled workforce. We envisage the double-breasting dilemma may deepen the unemployment situation in the region.

The fear of 4IR has deepened among many Sub-Saharan African economies. However, many of the discussions about 4IR and its impacts focus on developed and advanced economies, and how they would develop skill sets to match the requirements of the new technology and how they could accommodate structural adjustment challenges, as workers lose their jobs and businesses no longer remain competitive (Runde, 2016).

The key element in understanding how the burden and benefits of 4IR will affect economies across Sub-Sahara Africa, which is contextually unique, has not received any significant research

attention or policy discourse. Even though 4IR has already contributed to job redundancy, skill disruption and massive job dislocations, many countries in Sub-Saharan Africa are already struggling with mass unemployment, talent and skill shortages (Debrah et al, 2018; Millington, 2017). These constraints have largely been fuelled by the dominance of informal economic activities characterised by slow growth, limited and poor public infrastructure, low levels of education and skills formation, small/family businesses, low advancement in technology and innovation, as narrated by Akanle and Adésìnà (2018), Ogundari and Awokuse (2018), and the World Economic Forum (2017). In addition, several economies in Sub-Saharan Africa are comparatively over-exposed to disruptions in their labour markets, characterised by skill mismatch and under-education (Ogwo, 2018; Naudé, 2017).

Ayentimi et al (2018), highlight tribalism, political instability, religious and ethnic divisions, corruption, the clash of modern and traditional cultures, as entrenched societal issues that have, over the years, undermined economic and social restructuring in Sub-Saharan Africa. This catalogue of challenges potentially compromises and weakens Africa's potential to accommodate structural adjustment within the 4IR economic space. Significantly, as Sub-Saharan African economies struggle with skilled labour shortages and mass unemployment, governments and businesses must prepare for the imminent jobs and skills disruptions expected from 4IR, augmented by the new wave of technological revolution through manufacturing and service automation (Naudé, 2017).

Within this context, what are the limitations and prospects of 4IR for emerging and less developed economies in Sub-Saharan Africa? More specifically, to what extent is 4IR relevant to sub-Saharan Africa, where there is a large informal economy, limited and poor public infrastructure, where technical skills and education levels are low (Oluwatayo and Ojo, 2018), and advanced technology can be found in only a few sectors (Salahuddin and Gow, 2016) that are dominated by foreign multinational companies and staffed by expatriate workers? What is the relevance of policy development towards the 4IR in the region, given its young population profile (The Africa Competitiveness Report, 2017), the growing low interest in investment in education and training, emerging skill shortages in key sectors and the importance of new technologies in supporting export industries and domestic economies?

2.3.2 Prospects of 4IR to Emerging Economies in Sub-Saharan Africa

Development and investment scholars, including international and local policy think-tanks across Africa, have recognised the significant natural resource endowment and human capital opportunities as drivers of development, as pointed out by Cleeve et al (2015) and The Africa Competitiveness Report (2017). Yet many emerging and less developed economies in Sub-Saharan Africa are generally characterised by over-reliance on rain-fed agriculture and primary production (Bachewe et al., 2018; Adekunle, 2016).

Limited and poor public infrastructure, low investment in education, mass unemployment, low applications of science, technology and innovation, weaknesses in institutional structures and mismanagement and wide-spread corruption, Ayentimi (2018). Whereas the first industrial revolution (1IR) replaced manual labour with the application of machines, the second industrial revolution (2IR) was characterised by mass production through the growth of manufacturing, communication technology and transportation (Makridakis, 2017; Kim, 2018). Digitalisation and growth in electronics and technology constituted the main driver of the third industrial revolution [3IR] (Naudé, 2017).

However, the advent of the 4IR is distinctively driven by advancement in genetics, biotechnology, nanotechnology, robotics, 3D printing and artificial intelligence, stimulated by the growth in different capabilities and technologies (World Economic Forum, 2017; Naudé, 2017). This technological evolution is arguably the underpinning driver of social and economic growth and is expected to drive economic and social transformation across the globe (World Economic Forum, 2017).

4IR is expected to improve living standards, boost productivity and enhance consumption and per capita income, Makridakis (2017). 4IR will also influence societal structures and work systems across all sectors and industries (Naudé, 2017).

Technological change and the application of technological progress have been the driving force of productivity growth in most developed or advanced economies, resulting in significant breakthrough and improvement in socio-economic development (World Economic Forum, 2017). However, technological change and its application in Sub-Saharan Africa has been uneven, hence resulting in limited improvement in socio-economic transformation (The Africa Competitiveness Report, 2017), throughout past industrial revolutions. 4IR would drive the evolution of purpose technologies to support productivity increase in different sectors and industries (World Economic Forum, 2017). Researchers have acknowledged that growth in general purpose technologies requires corresponding changes in institutional and physical infrastructure, in addition to organisational and behavioural (social) change (Santarius and Soland 2018; Foroudi et al., 2018).

A wide range of conditions and factors have been identified as important determinants of influencing the swiftness of technological application and transfer into an economy (Osabutey et al., 2014; Lee et al., 2018). These include an enabling regulatory environment, economic and social environment and cost (Hensengerth, 2018; Olawuyi, 2018). In addition, the capability of risk-takers (entrepreneurs) to drive radical innovation to bring technology into the market for the growth of industries, is an important element of 4IR (Naudé, 2017). The expansion of Information & Communications Technology (ICT) during the digitalisation of technology in 3IR, is an important foundation conditioning the launching of 4IR. 4IR is strongly built on the

advancement of ICT capabilities, hence allowing a combination of computational power and new technologies (Makridakis, 2017; Naudé, 2017).

This combination of computational power and new technologies can potentially transform societal structures, work systems and labour markets (Schiuma, 2017). 4IR supports transformative technologies to drive automation and robotics, resulting in the benefits of returns-to-scale across different industries of the economy (Schiuma, 2017). Naudé (2017), argued that the fundamental transformative power strengthening economic systems within 4IR, is artificial intelligence.

In a similar vein, the pioneers championing 4IR highlight the growing capabilities of artificial intelligence and automation as historic developments and the mainstay, which is contributing to the transformative power of 4IR (World Economic Forum, 2016).

The transformation of manufacturing processes was central during 2IR (World Economic Forum, 2017). In fact, the emergence of 3D technologies started driving a new and distinct technological system aimed at transforming modern manufacturing by significantly altering the production processes and mode of resultant physical goods (Despeisse et al., 2017; Norman et al., 2017). Primarily, 3D technologies offer unlimited advantages and profitability, compared to traditional manufacturing technologies. For example, 3D technologies can quickly customise, change designs and make complex items (Makridakis, 2017).

In addition, while significant progress in genetics is transforming human health within the healthcare service delivery system, robotics and artificial intelligence are transforming the capture, storage and sharing of patients' data between different care providers and patients (Despeisse et al (2017). The healthcare system in many African countries is characterised by poor physical infrastructure, and poor recordkeeping (Odekunle and Shankar 2017). Meanwhile, there is a problem of low upskilling of health professionals to reflect the dynamics of modem health diagnosis and clinical decisions (Defor et al., 2017).

In this regard, the application of electronic health (e-health) records, provides vital support for clinical and diagnostic decisions, which can enhance the quality of healthcare service delivery in emerging and less developed economies in Sub-Saharan Africa (Odekunle and Shankar, 2017). 4IR support technology advancement aims to address healthcare inefficiencies across nation states. Sub-Saharan Africa can leverage health data to benefit through reduced infection risks, while minimising human and preventable errors. More significantly, artificial intelligence has already demonstrated to be transformative in healthcare service delivery in Japan, Australia, the US and many other developed economies (World Economic Forum, 2017). Moreover, 4IR will, arguably, help to improve the spread and quality of services, especially to rural areas. Meanwhile, education, nursing and medical services can be delivered online, thanks to technological advances. Despite gaining independence more than six decades ago, many countries in Sub-

Saharan Africa continue to rely on the agricultural sector, which remains the major employment sector (Adenle et al., 2018).

Even though the service sector is progressively absorbing the Sub-Saharan African workforce, the region's employment prospects remain largely concentrated in the agricultural sector (Larson et al., 2016). In fact, the agricultural sector employs an average of 54 percent of the total working population in many countries in Africa (New Partnership for African Development report, 2013). Implicitly, the advent of 4IR could drive agricultural mechanisation through the application of robotics, genetics and automation, to generate large productivity gains (van Rooyen et al., 2017; Bachewe et al., 2018). This development could eventually lead to a significant decline in agricultural employment and force surplus agricultural workers to drift to urban centres in search of jobs; it can also potentially support economic restructuring around industrialisation (Naudé, 2017).

Technological developments in the agricultural sector would not be effective without strong upstream and downstream linkages in the commodity supply chain, so that the gains in agricultural productivity are supported by integrated linkages to processing, packaging, storage, logistics and distribution to local, national, regional and international markets, Hansen et al (2009). One of the distinct features of emerging and developing economies in Sub-Saharan Africa, which differs from developed or advanced economies, is the presence and dominance of the informal economy or informal sector, which is generally characterised by small and micro enterprises, such as petty-trading, food-sellers, craftsmanship, small-holder farming and small agro-processing businesses (Potts, 2008; Osei-Boateng and Ampratwum, 2011; Herrera et al., 2012).

According to the International Labour Organisation, the average size of the informal economy in Sub-Sahara Africa, as a percentage of GDP, is estimated at 41 percent and represents between 72 percent and 80 percent of total employment, and about three-quarters of non-agricultural employment in the region (Potts, 2008). For example, the informal economy in the region ranges from under 30 percent of economic activities in South Africa, Africa's largest economy, to 60 percent in Ghana, Zimbabwe, Sierra Leone, Tanzania and many other countries in the region, (ILO, 2016). Consequently, the informal economy in Sub-Saharan Africa has emerged as the potential source of employment creation (Cangul, 2017; Debrah, 2007). Therefore, one major concern for emerging and developing economies in Africa is the effects of 4IR on the informal economy, which is the main employment source for the youth and women in the region (Potts 2008).

The African Development Fund Report (2008), highlights that a large percentage of women in many in Sub-Saharan African countries, tends to operate in the informal economy, which is traditionally characterised by low-income and low-growth potential. Fundamentally, it is important to consider the argument to the effect that the impact of 4IR on the informal economy

in Africa depends on the pace of technological adoption, aimed at reorganising small and micro enterprises, as well as agro-processing businesses. This reorganisation of the informal economy may be constrained by lack of human resource capabilities, lack of supporting infrastructure (e.g., transportation and communication) and a low innovative and entrepreneurial culture within the business environment, across the region (Amankwah-Amoah, 2018; Oketch, 2014).

However, the rapid pace in the adoption of the technological progress under 4IR aimed at reorganising and structuring products and services in small and micro enterprises and agro-processing businesses, may contribute to the demise of the informal economy, as Casey and Hughes (2016), and van Rooyen et al. (2017), point out. This development might in turn result in a shift in the regularisation of the informal sector into the mainstream economy, which can boost government revenue through taxation (Medina et al., 2017). In fact, the undocumented nature of the informal economy thus far, has contributed to poor government revenue mobilisation efforts across the region. In addition, the application of ICT can potentially support the reorganisation and expansion of the production scale of small and micro enterprises and agro-processing businesses, in addition to the creation of new enterprises (Naudé, 2017; Amankwah-Amoah et al. 2018).

Furthermore, Casey and Hughes (2016), argued that 4IR provides an important platform for applying basic technology, particularly for rural communities to access markets and reduce post-harvest losses, while increasing farm and household incomes. The long-term effects of the application of ICT within the informal economy can contribute to the decline of the informal economy by bringing more people into the formal employment sector (Casey and Hughes, 2016Naudé et al., 2017). Relevant areas of big developments include energy generation and storage. Harnessing the sun, wind and battery technology can, for example, help rural areas become self-sufficient in energy and link to satellites for ICT, to access. Moreover, water purification and recycling can provide safe and accessible water supplies. As such, potential abounds to overcome current infrastructure deficits through the application of new technology.

Finally, 4IR creates an important opportunity for small-holder farmers in the informal economy in rural Africa, to deploy basic technologies to scale up productivity and support the formalisation of the agricultural employment sector (Bachewe et al. 2018; Larson et al, 2016). Small businesses can also be integrated into supply chains and have access to marketing information – commodity prices, as well as demand and supply information (Adenle et al., 2018).

2.3.3 Relevance of 4IR to Sub-Saharan Africa

4IR has the potential of impacting all industries that all nations, regardless of their location or state of development, can embrace and harness. The new wave of technological breakthrough can potentially improve social structures and labour markets in Africa, Millington (2017). It can also heighten and scale up production and productivity, create new markets and products and

rejuvenate growth in the informal employment sector (Amankwah-Amoah et al., 2018; Adenle, 2018; Larson et al., 2016). Furthermore, 4IR provides unlimited opportunities for Africa's economic restructuring, particularly the informal economy, which has, hitherto been dominated by small and micro enterprises and agro-processing businesses.

Given Sub-Saharan Africa's untapped market potential, Naudé (2017), contends that 4IR potentially positions this gigantic region to pursue its failed industrialisation agenda, driven by exporting digital services and supporting intra-regional trade (collaborative economy) to nurture new business models across the region. 4IR further provides an opportunity to scale up small and micro manufacturing enterprises, with the application of basic technologies, to become competitive (The Africa Competitiveness Report, 2017; Millington, 2017). This development can form a vital component of the strategy to pursue the (re) industrialisation agenda in Africa. The debate on Africa's readiness for 4IR can be divided between those that see a negative scenario of skill disruption, coupled with large-scale job losses, on the one hand, and those who vouch for an optimistic view of new jobs, skills development, service improvement, all strengthened by the young population demographic profile (Millington, 2017; Naudé, 2017).

Africa's readiness for 4IR is highly contextual and specific to the region (country), industry and occupations, combined with capability and policy development advanced by stakeholders to manage technological changes brought by 4IR.

The contextual distinctiveness on the vast continent is also generated by the uneven development and the diverse cultural and institutional dissimilarities, partially occasioned by colonialisation and decolonialisation (Ayentimi et al., 2018). Researchers have argued that a distinct feature of 4IR, compared to previous industrial revolutions, is the high speed at which the new wave of technological progress is replacing lower-skilled workers with higher skilled ones (Naudé (2017). One challenging concern or fear is whether Sub-Saharan Africa can fully participate in the activities of 4IR, considering the lack of requisite skill sets for meeting skill demands, as Ogundari and Awokuse (2018), Millington (2017) have proffered.

In fact, Africa is already home to many of the low-skilled jobs across industries, particularly in manufacturing and agriculture. The situation is compounded by the prevailing low investment in education and training, as pointed out by Ogwo (2018) and Oketch (2014), and emerging skill shortages in key sectors across the region that can further aggravate the inability of the region to fully participate in 4IR. In this regard, researchers estimate that widespread automation may trigger mass unemployment and social disruption, as 66 percent of all jobs are under threat in developing economies (Millington, 2017; Frey and Osborne, 2017), with the most affected economies being the relatively poor countries in Sub-Saharan Africa (Naudé, 2017).

Another challenge is limited government investment and involvement in technology adoption, as explained by Debrah et al. (2018) and Jensen (2002). Historically, government policies in Sub-

Saharan Africa have failed to chart innovation and technology trajectories (Amankwah-Amoah et al., 2018). The lack of innovation as well as the lack of the prioritisation of technology in national development policy frameworks, potentially threatens the readiness of the region to participate fully in 4IR, which is deeply underpinned by technological progress (World Economic Forum, 2017). In addition, the ICT sector has, over the years, demonstrated the most vitality under the third industrial revolution and the current industrial revolution, hence supporting the creation of a diverse variety of employment opportunities. Nevertheless, ICT penetration in Africa has remained low and its share of total employment remains generally low in the Sub-Saharan region (Asongu and Nwachukwu, 2018; Jensen, 2002; Ponelis and Holmner, 2015).

Despite the significant efforts many countries in the region have made in a bid to increase ICT penetration and utilisation, government investment in ICT infrastructure (particularly high-speed internet), ICT training and development, and ICT research remain low (Jensen, 2002; Asongu and Nwachukwu, 2018; Millington, 2017). The general lack of access to high-speed internet across the continent may not support increased efficiency of business processes and access to information, which is critical for the revitalisation of the services sector, particularly in business services, finance and computer systems design in Africa (Asongu and Nwachukwu, 2018).

The pessimistic perspective of the technological revolution supports the argument to the effect that the current pace of 4IR may pose challenges for many countries in Sub-Saharan Africa, to develop the appropriate physical, social and economic infrastructure, backed by appropriate regulatory frameworks to participate fully 4IR inspired activities. Notwithstanding, we acknowledge the numerous potentials of the region that could make many counties in Sub-Saharan Africa exploit 4IR to restructure their economies and drive economic transformation through the application of ICT to formalise the informal economy, mechanise the agricultural sector and revitalise the failed industrialisation agenda.

2.3.4 Policy Developments as a Response Tool to 4IR in Sub-Saharan Africa

The right institutional arrangements and development policy mix can support developing countries, particularly less developed countries from Sub-Saharan Africa, to benefit meaningfully from 4IR. However, the fear of Africa falling by the wayside under the 4IR strain may be real, due to the risk of government policy inaction, particularly in the technology and innovation trajectories (Amankwah-Amoah et al., 2018; Ogwo, 2018). And yet, such a foray and policy action are critical to participating in the new wave of the technological insurgency spinning across the globe. Fundamentally, there are two policy dimensions— 'proactive' policy and 'reactive' policy— for addressing the policy inactions around technology and innovation trajectories in Sub-Saharan Africa. Whereas proactive policy represents a deliberate strategy, a reactive policy strategy emerges in response to a specific societal problem (Lauridsen, 2010). Significantly, developing both 'proactive' and 'reactive' policies revolving around technology and innovation

trajectories in Sub-Sahara Africa, explicitly provides an important lens for addressing key issues surrounding 4IR.

Policy development plays a critical role in promoting Africa, in addition to setting the institutional and regulatory frameworks aimed to influence the actions of key stakeholders (Amankwah-Amoah et al., 2018; Badiane et al., 2018), which could signal a positive reinforcement of the region's readiness for 4IR. As a matter of fact, an effective policy framework should facilitate the building of institutional, economic and regulatory confidence, which is an essential ingredient in positioning Africa strategically as a future investment destination.

Notwithstanding the potential benefits accruing from 4IR in Sub-Saharan Africa, it may generate mass unemployment by fuelling the demise of low-cost labour as a tool for attracting foreign direct investment (FDI) or due to what Naudé (2017, p.4) calls 'the redundancy of the model of industrialisation through attracting FDI based on low-cost labour in assembly-type manufacturing.' The threat of 4IR in Sub-Saharan Africa is that low labour costs may soon not be considered a sufficient determinant for attracting foreign direct investment into the region. Thus, even though tax incentives under Special Economic Trade Zones remain the most widely applicable strategy for attracting FDI into Sub-Saharan Africa, as Ayentimi et al. (2016), Johnson and Toledano (2013), and Ngowi (2000) have surmised, the presence of low labour cost is increasingly and comparatively becoming an important driver of FDI attraction into the Sub-Sahara region.

However, with the aid of robotics and automation, multinational enterprises from developed economies may re-shore manufacturing and assembling operations to high-skilled developed regions, to the disadvantage of low-wage labour in developing countries across Africa (The Africa Competitiveness Report, 2017; Naudé (2017). Drawing from historical trends, the failure of many Sub-Saharan African countries to move forward with industrialisation agenda during the second and third industrial revolutions were, arguably, due, at least in part, to 'policy inaction' in addition to cultural and institutional barriers such as corruption, ethnic and tribal divisions, political instability, mismanagement and poor leadership, which could resurface under 4IR. Significantly, Africa can serve as the nerve centre of 4IR, which can support development and contribute to the reduction of abject poverty and mass unemployment.

4IR also presents huge potential for community, service and infrastructure transformation, which in turn will generate long-term benefits. Therefore, appropriate policy direction, social and economic infrastructure and regulatory environments can allow the Sub-Sahara region to tap into the unlimited potential of 4IR, in a bid to formalise the informal economy to leverage Africa's industrialisation and development agenda. Such an appropriate policy framework should help build institutional, economic and regulatory confidence, which is an essential ingredient in efforts geared towards positioning Africa as a future investment destination, by formalising the informal economy (Badiane et al., 2018; Amankwah-Amoah, 2018).

2.3.5 Tanzania Industrialisation and Technology

The Tanzanian economy is heavily based on agriculture, which accounts for 46.1 percent of the GDP in 2005 (World Bank 2007), whereas industry accounts for only 16.9 percent of the GDP. After gaining its independence in 1961, the country introduced a strong socialist, centrally planned economy with large state participation, following the 1967 Arusha Declaration. This ideological thrust of 'Ujamaa,' based on an African brand of socialism, was hostile to private business. Economic activity occurred in state-owned firms, with 425 established by the mid-1980s (Bagachwa and Mbele, 2013). This formation of state-owned firms was the largest concentration by a state in the world.

The poor performance of this development policy finally ushered in a period of reforms, from1985 onwards, that put the country on a trajectory towards a more liberal, market-based economy (Bagachwa and Mbele, 2013). In the 1990s, a large-scale privatisation programme was implemented (Temu and Due, 2000), which reduced state participation in industrial firms, mainly in favour of foreign participation. In this process, FDI had increased sharply since 1992, making Tanzania one of the top African FDI recipient countries (UNCTAD, 2011). An important share of this foreign investment was concentrated in manufacturing, especially in the food and beverages industry. The expectation was for FDI to translate into technological upgrading and transfer of technology, skills and superior management techniques. Portelli and Narula's (2006), case study of two privatised firms, shows that productivity and technological upgrading increased sharply after foreign multinational investments into the local economy. Unfortunately, the government is not prepared to embrace modern technological revolutions.

With the emergence of 4IR, it is cheaper for manufacturing firms to rely on technology rather than cheap labour and materials. This fact has recently led to an outward shift of FDI back to rich countries, due to cheap technology and deteriorating of manufacturing firms' contribution to tax revenue collection.

At the other end of this spectrum, the industrial private sector is still characterised by a majority of small local businesses, many of which operate mainly outside the formal economy, with very few establishments registered in manufacturing (NBS 2015). Moreover, they are characterised by weak inter-firm linkages and low levels of technological capability. Furthermore, there is a strong group of ethnic minority Tanzanian entrepreneurs of Asian (Indian) origin, with a dominant position in light manufacturing and import/export trade, benefiting from a strong ethnic network (Hewitt and Wield, 1997; Biggs and Shah, 2006).

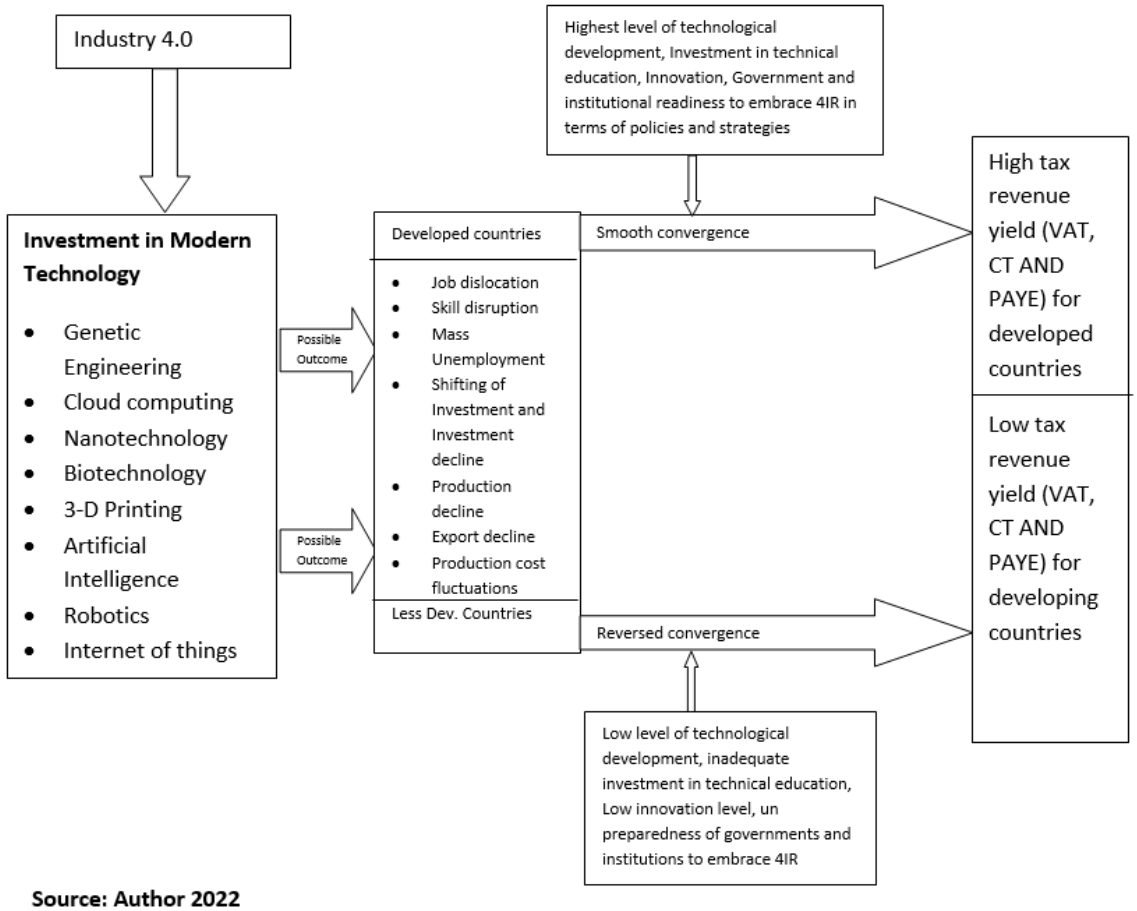
This industrial structure and performance also historically resulted from a broader policy that did not support the development of private local firms. Domestic research capability was built in public research centres, doing research in priority areas, determined by the Tanzania Commission for Science and Technology (COSTECH). The choice of sectors and research areas was supply-

driven, rather than based on an analysis of technological needs and problems of productive private enterprises. Even though some state-owned technology-support institutions were established, they were hardly aware of private sector needs and resources and lacked the motivation to carry out their mandate successfully (Bongenaar and Szirmai, 2006). The linkages between industry, university and research institutions are also weak (Bangens, 2014).

Low levels of human capital also hamper technological upgrading. Although past education policies registered considerable achievements in basic education and literacy, the educational and training systems had been insufficiently oriented towards fostering science and engineering that could generate managerial and technical skills. As a result, there was low technology adoption and slow technological learning from imported technologies, hence the unpreparedness and inability to embrace modern technologies, which inevitably let to deficient performance and dwindling revenue collections (Wangwe 2017).

2.4 Conceptual Framework

The conceptual framework (presented below) explains the relationship between the Fourth Industrial Revolution and the country's tax revenue collection. From the framework, investment in modern technologies such as genetic engineering, cloud computing, nanotechnology, biotechnology and 3-D printing, artificial intelligence, internet of things serves as the explanatory variable to predict the country's tax revenue.



Source: Author 2022

Depending on the technological development levels of a country, investment in technical education, innovation and the preparedness of governments and institutions to embrace the Fourth Industrial Revolution, in terms of policies and strategies, the introduction of industry 4.0, may positively or negatively affect job locations, skills, employment, investment, production and export. Most likely, developed countries will smoothly converge and lead to high tax revenue yields, whereas less developed countries are likely to experience reversed convergence and tax revenue declines.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Overview

This chapter describes the ideology, methods, techniques and processes the researcher used to achieve the research objectives and test the hypotheses. The study adopted the positivism philosophy, and specifically deployed a quantitative descriptive design and a cross-sectional survey. The primary data from manufacturing industries in Tanzania was collected using structured questionnaires, whose sample was generated using probabilistic sampling (cluster sampling technique). Finally, the study used descriptive statistics and the bivariate regression method to analyse and present the resultant data.

3.2 Research Philosophy

This study adopted the quantitative paradigm as a way of looking at the social reality or the world that is composed of certain philosophical assumptions that guide and direct thinking and actions, as pointed out by Mertens (1998) and Milliken (2001). According to Johnston (2014), a research approach is usually influenced by ontological and epistemological assumptions or stances of the researcher. Morgan and Sklar (2012) contend that, ontology refers to what constituted reality, whereas epistemology has to do with how to establish reality. Within social sciences, a long-standing debate on the most appropriate philosophical positions has ensued between positivism and phenomenology, and from which to derive research methods (Milliken, 2001). Positivists, who advocate for natural science, reject subjectivity in research, based on the assumption that an objective world exists independently of the researcher and that one can uncover universal laws of human nature and social reality (Patton and Appelbaum, 2003). On the other hand, a phenomenologist researcher believes that the world and reality are subjective and not exterior, but they are socially constructed and given meaning by social actors (Milliken, 2001). The current study has embraced the positivism ideology. The approach adopted in this study (positivism) aims to utilise hypotheses to test existing theories for generalisation purposes in different settings.

3.3 Research Design

The study used quantitative descriptive design. Specifically, it deployed quantitative and statistical aspects of data organisation, presentation and analysis through figures, numbers and tables. It used deductive reasoning, whereby the researcher formed a hypothesis, collected data during the investigation of the research problem, and then subjected the data from the

investigation to analysis before drawing inferences and logical conclusions. Moreover, the study proved the hypotheses true or false. A survey strategy was opted for the above design.

3.4 Area of the Study

The study was carried out in Tanzania. In all, 61,110 manufacturing industries were involved in the study. The number represents the sum of manufacturing industries in Tanzania by June 2020. A sample size was then drawn from such a population, since it was unrealistic to reach every manufacturer.

3.5 Data Collection Methods

The study employed different data collection methods. Both primary and secondary data were collected. Structured questionnaires for the survey were administered with production managers of manufacturing industries to collect primary data. A questionnaire is a set of systematically structured questions a researcher uses to get necessary information from respondents. Questionnaires have been termed differently, including surveys, schedules, indexes/indicators, profiles, checklists, scales, inventories, forms, inter alia. They are any written research instruments that present respondents with a series of questions or statements to which they react, either by writing out their answers or selecting from among existing pre-determined answers (Brown, 2001).

The questionnaire may be self-administered, posted or presented in an interview format. It is the main data collection method in surveys and yields quantitative data (Dornyei, 2007), when close-ended questions are used or qualitative data when open-ended questions are posed. The study also used secondary data to complement primary data. The main sources were documentary review of various official documents and reports (i.e., manufacturing industries' survey reports from the National Bureau of Statistics [NBS], the Tanzania Investment Reports from the Tanzania Investment Centre (TIC), relevant to the research problem.

3.6 Population and Sampling

The targeted population was all manufacturing industries in the country by June 2020. The targeted sampling unit were production managers or chief plant engineers of manufacturing industries. Since the study population was known with reliability and sampling frame easily determinable, the study adopted a probabilistic sampling method. Specifically, the study used the cluster sampling technique. A sample of 225 manufacturing industries was used in the current study to generate the required data. This study allowed the variability results of 5% (margin error), at 90% confidence interval always, using the Cochran Formula for sample calculation (Cochran, 1977).

3.7 Pre-Testing of Questionnaire

Pre-testing was conducted in circumstances that were similar to the actual data collection and on population members in the likeness of those sampled. Pre-testing of questionnaires using a total of 26 production managers of manufacturing industries, which was almost 10% of the total sample size, preceded the actual manufacturing industries survey. Sudman (1983) suggested the use of 20-50 cases during pre-tests as sufficient for discovering major errors in a questionnaire and ensure data validity.

3.8 Data Analysis

3.8.1 Descriptive Statistics

Primary data was analysed quantitatively. Measures of central tendencies, skewness and kurtosis of data covering the study period (2012 to 2021), were conducted using descriptive statistics.

3.8.2 Estimation Approach

The Least Square method was used to analyse the research objectives of the study, in addition to testing the associated hypotheses. The model helped to estimate changes in dependent variables (VAT, Corporate Tax and PAYE) amidst an independent variable change (Investment in 4IR technologies). Regression analysis describes the relationship between variables by fitting a line to the data observed. Prior to regression analysis, stationarity of time series properties was tested using Augmented Dickey Fuller (ADF), to understand the behaviour and patterns of the data.

To establish the effects of 4IR on tax revenue collection, the following estimation model was used:

$Y_t = \beta_o + \beta_1 X_t + e_t$ **1**

Where;

Y_t Stands for the outcome variables (VAT, Corporate Tax and Employment Tax) and X_t stands for investment in 4IR technologies. β_0 is the constant term and β_1 is the coefficient relating the explanatory variable of interest, and e_t stands for error term.

3.9 Description of Variables

Dependent Variables (Y)

Value Added Tax

It has been measured as the actual Value Added Tax collected from manufacturing industries in Tanzania during the period under review. The aggregate value of this variable represents tax charged at each stage of the manufacturing process where value is added.

Corporate Tax

In this study, Corporate Tax represents the amount of tax collected from manufacturing firms after accounting for all the costs associated with the manufacturing process, and the depreciation of capital assets. Corporate Tax captured in this study has been charged at 30 percent, as directed in the Income Tax Act.

Pay as You Earn

This refers to an employment tax collected from full time employees in the Tanzania manufacturing sector, for the period under review.

Independent Variable (X)

Investment in Modern Technology

This variable captures an investment made/spending by manufacturing firms in Tanzania for all the components of the 4th Industrial Revolution (artificial intelligence, nanotechnology, genetic engineering, biotechnology, 3-D printing, internet of things and cloud computing), with regard to the modernisation of manufacturing techniques.

CHAPTER FOUR
PRESENTATION OF FINDINGS AND DISCUSSION
4.0 INTRODUCTION

This chapter presents empirical findings and their interpretations. Before analysing the degree of causality between investments in modern technology together with their effects on tax, it is important to, first, report the specifics of the estimate findings and test statistics. All the descriptive statistics were done using STATA 14.

4.1 Descriptive Statistics

This section presents summary data regarding the study's variables of interest, that is, the mean, standard deviation, minimum and maximum values, as well as the normality of all the variables the study has utilised. Summary statistics provide a quick overview of how the variables of interest behave.

Table 1: Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max	Skewness	Kurtosis
lninvestment	10	26.9537	0.01948	26.9252	26.9746	-.2417558	1.572224
lnct	10	28.4276	0.36946	27.9038	29.2602	1.042797	3.826202
lnpaye	10	27.9984	0.35664	27.4947	28.3825	-.3325885	1.517996
lnvat	10	29.1991	0.1844	28.8678	29.5012	-.3138891	2.664341
lntotaltax	10	29.7753	0.24523	29.3593	30.185	.097684	2.436422

Source: Field Data (2022)

Statistics from Table 1 show that, the average capital invested in modern technology for the period under review was TZS 26.9537 billion, and it ranged from TZS 26.9252 billion with a maximum of TZS 26.9746 billion.

The maximum Corporate Tax collected from the manufacturing firms after their investment in modern technology had an average of TZS 28.4276 billion, with a minimum of TZS 27.9038 billion and a maximum of TZS 29.2602 billion. Pay-As-You-Earn (PAYE) ranged from a minimum of TZS 27.4947 billion to a maximum of TZS 28.3825 billion, with an average of TZS 27.9984 billion. Value Added Tax collected from the manufacturing firms after their investment in modern technology ranged from a minimum of TZS 28.8678 billion to a maximum of TZS 29.5012 billion. However, the total tax collection from the manufacturing firms during the same period under review ranged from a minimum of TZS 29.3593 billion and a maximum of TZS 30.185 billion, with an average of TZS 29.7753 billion.

The study also used mean-based coefficient of Skewness and Kurtosis to test the normality of the study variables. Skewness measures symmetry of probability distribution of a variable about its mean, and its normality. Skewness results show that Corporate Tax (CT), and total tax collection from the manufacturing firms, are positive and normally distributed, whereas PAYE, VAT and investment in modern technology are negative, but also normally distributed. In relation to Kurtosis, all the variables in the model are seen to be positive and normally distributed.

4.2 Correlation Analysis

The purpose of correlation analysis is to illustrate the magnitude and direction of the link between investment in modern technology and Corporate Tax, Pay-As-You-Earn and Value Added Tax. The correlation between these variables is as summarised in Table 2:

Table 2: Summary of variables' correlation

Variable	Investment	Corporate Tax	PAYE	VAT	Total
Investment	1				
Corporate Tax	0.6308	1			
PAYE	0.9733	0.5792	1		
VAT	0.882	0.6581	0.8399	1	
Total	0.8877	0.8878	0.8517	0.9178	1

Source: Field Data (2022)

Results from Table 2 show that Corporate Tax, PAYE, Value Added Tax and total tax collection from the manufacturing firms, positively correlate with the independent variable, investment in modern technology done by the manufacturing firms in Tanzania. These study findings differ from those of previous studies by Naudé et al. (2017), who had found that many occupations and jobs had already been significantly transformed because of the intensification of the current technological revolution, with some jobs and occupations growing rapidly and undergoing changes in capabilities and skill sets requirements, whereas other occupations and jobs became threatened by redundancies, massive job dislocations and skills disruption. Current study findings indicate a strong positive correlation between investment in modern technologies and Employment Tax (PAYE). Implicitly, regardless of technological developments in most manufacturing industries, these firms are not fully-fledged capital intensive: They are still employing people and engaging human capital in their productive activities.

Lee et al. (2019), and Postelnicu and Cales (2019), also pointed out that, as a result of the Fourth Industrial Revolution, production becomes cheaper with technology rather than with cheap labour and resources. This study's finding also reveal a different perspective from previous scholars, whereby manufacturing industries kept on employing people even after investing heavily in modern technologies. Besides, Lee et al. (2019) and Schwab (2016), suggested that the emergence of the Fourth Industrial Revolution in Sub-Saharan Africa caused an investment shift

from poor countries to rich countries. Their findings suggest a decline in both Corporate Tax and VAT from manufacturing industries, because of a drastic drop in investment. This study's findings indicate different facts. For example, despite manufacturing industries investing in modern technologies, both Corporate Tax and VAT kept on increasing at an incremental rate. Even though there might be other factors, investment in modern technology did not substantively entice a migration of investment to rich countries.

4.3 Time Series Properties

Results from the stationarity test obtained using the Augmented Dickey Fuller (ADF) Test presented in Table 3, show that investment in modern technology, VAT and Corporate Tax are stationary at order one, whereas PAYE is stationary after second differencing:

Table 3: Augmented Dickey Fuller test results

Variable	Level	First difference	Second difference
In Investment	-1.081	-3.09**	
In VAT	-1.804	-4.092***	
In Corporate Tax	-0.021	-2.932**	
In PAYE	-1.284	-1.445	-3.494***

Where:

** indicate significant at 5% level

*** indicate significant at 1% level

4.4 Regression Results

Table 4: Pay-As-You-Earn (PAYE) as a Dependent Variable

	Number of obs = 10
	F(1, 8) = 600.84
	Prob > F = 0
	R-squared = 0.947
	Root MSE = 0.08705

lnpaye	Coef.	Robust Std. Err.	t	P>t	[95% Conf. interval	
In investment in technology	17.81658	0.726847	24.51	0	16.14047	19.4927
_cons	-452.224	19.60046	-23.07	0	-497.423	-407.025

As Table 4 illustrates, investment in technology is statistically significant in influencing Employment Tax (PAYE) collections in Tanzania. Specifically, a percentage increase of investment in 4IR technologies by manufacturing firms in Tanzania, resulted in a 17.8 percent increase in collections of PAYE.

Implicitly, manufacturing industries' investments in the Fourth Industrial Revolution technologies in Tanzania led to an increase in employment and related benefits and, ultimately, revenue collections from Employment Tax rather than cause mass unemployment and a tax revenue decline.

However, these findings are quite contrary to what has been proposed by 4IR scholars, such as Naude (2017), Lee et al. (2019), and Schwabs (2016). These scholars proclaimed that robotics and automation would cause multinational enterprises from developed economies to re-shore manufacturing and assembling operations to high-skilled developed regions, because of the disadvantage of low-wage labour found in developing countries in Africa, and lead to a massive decline in productivity and mass unemployment. Since all taxes collected by governments from manufacturing industries, including PAYE, were expected to decline, the current study suggests that manufacturing industries in Tanzania are not re-shoring to developed countries; instead, there is still a demand for more workers, even with the emergence of 4IR. Impliedly, technology has been unable to replace cheap resources in Tanzania. As such, the Tanzania Government should improve investment policies and attract more investors in the manufacturing sector. Such a move would invariably increase investment, employment and revenue collection from Employment Tax.

Table 5: Corporate Tax as a Dependent Variable

				Number of obs = 10		
				F(1, 8) = 6.23		
				Prob > F =0.0372		
				R-squared = 0.4989		
				Root MSE = 0.2774		
lnct	Coef.	Robust Std. Err.	t	P>t	[95% Conf.	Interval]

ln investment in technology	13.39595	5.368254	2.5	0.037	1.016736	25.77517
_cons	-332.642	144.653	-2.3	0.051	-666.213	0.928122

As data in Table 5 illustrates, investment in technology is statistically significant in influencing Corporate Tax Collections in Tanzania. Specifically, a percentage increase of investment in 4IR technologies by manufacturing firms in Tanzania resulted in a 13.4 percent rise in collections of corporate taxes. Impliedly, despite tremendous growth in technology, investments in manufacturing are increasing in Tanzania rather than declining and, therefore, the Corporate Tax revenue collected from manufacturing firms' increases with the growth in technology.

As such, the Tanzania Government should set up and improve policies that would allow growth of technical education as well as adaptation and imitation of modern technology and more investment in research and development. Such a move would expedite the technological growth within the country, growth in manufacturing investments and Corporate Tax revenue collections from manufacturing firms.

However, these findings do not support the prepositions made by Bangens (2014), Bongenaar and Szirmai (2006), to the effect that deficient performance of the manufacturing sector in Tanzania resulted from the country's failure to keep up with the pace of technological growth. Current study findings evidenced exemplary performance of the manufacturing sector in Tanzania, in terms of profitability, which resulted in an increment in Corporate Tax going into government coffers. All these incremental gains have been driven by the growth of investment in 4IR technologies.

Table 6: VAT as a Dependent Variable

				Number of obs = 10		
				F(1, 8) = 29.52		
				Prob > F = 0.0006		
				R-squared = 0.8032		
				Root MSE = 0.08676		
lnvat	Coef.	Robust Std. Err.	t	P>t	[95% Conf.	Interval]
ln investment in technology	8.48384	1.561584	5.43	0.001	4.882822	12.08486

_cons	-199.472	42.08357	-4.74	0.001	-296.516	-102.427

The results in Table 6 indicate that investment in technology is statistically significant in influencing VAT collections in Tanzania. Specifically, a percentage increase of investment in technology by manufacturing firms in Tanzania resulted in an 8.5 percent increase in collections of corporate taxes. Lee et al. (2019), and Ayentimi et al. (2016), in their analyses of the effects of 4IR, concluded that the existing mode of economic catch-up would encounter many challenges with the arrival of 4IR technologies. To begin with, 4IR is rewriting the rules of manufacturing because investment would follow cheap technology, thus facilitating re-shoring of manufacturing back to the developed world.

Their analyses did not project witnessing significant growth of either VAT, Corporate Tax or PAYE from the manufacturing sector in developing economies, such as Tanzania. Instead, they expected to witness investment declines, since investment tends to follow cheap and modern technology (found in developed countries), rather than cheap labour and materials (found in many developing countries).

Current study findings reveal significant growth in VAT, Corporate Tax and PAYE from manufacturing firms in Tanzania, which implies growth in the manufacturing sector's productivity that has been expedited by the investment growth in 4IR technologies, as one of the many important factors. These results complement the correlation analysis findings to the effect that investment in modern technology strongly and positively influences VAT, Corporate Tax and PAYE. The implication of these findings is that, as opposed to developed countries, the emergence of 4IR in developing countries that are endowed with cheap resources, such as Tanzania does not necessarily trigger an outward shift of investments and manufacturing to developed countries with cheap technology, as suggested by Lee et al. (2019), Schwabs (2016), and Postelnicu and Cales (2019). Instead, it complements cheap materials and labour, accelerates growth of investments, manufacturing and, ultimately, tax revenue collections from the manufacturing sector, for public financing. Therefore, 4IR technologies do not necessarily replace cheap resources in developing countries but rather they complement them. These findings support the first, second and third hypotheses of this study, hence making them acceptable. In short, the findings validate these hypotheses.

5. CONCLUSION

The main objective of this study was to assess the causality between an investment in modern technology of manufacturing firms in Tanzania and tax revenue collection (Value Added Tax (VAT), Corporate Tax (CT) and Pay-As-You-Earn (PAYE) for the 2012 – 2021 period. The study used primary annual data for the 2012 - 2021 period to estimate the degree of causality and capture the effects of investment on modern technology done by manufacturing firms, and their effects on Corporate Tax, VAT and PAYE. Specifically, the study has found a positive and statistically significant causal effect between investment in modern technology, VAT, Corporate Tax and Employment Tax (PAYE), of the manufacturing firms in Tanzania for the period under review. The estimated correlation coefficient affirms that investment in modern technology and taxes collected from manufacturing firms in Tanzania have a strong positive relationship. Indeed, as investment in modern technology increases, it results in rising tax collection from manufacturing firms, as the upward and positive trend illustrates. The effects of 4IR technologies in Tanzania are, therefore, positive and statistically significant.

6.0 RECOMMENDATIONS

Based on the analysis and interpretations of results and considering that Tanzania is a developing country, much more needs to be done to address the technological impediments to the manufacturing sector in the country. As manufacturing is a crucial sector that contributes towards the country's revenue collections and economic growth, the Ministry of Industries and Trade should ensure the availability of supportive infrastructures (i.e., investment in technical education, innovations, research and development) to allow manufacturing industries to embrace 4IR.

The government should improve its integrated industrial development strategy as well as policy, so as to embrace and support the Fourth Industrial Revolution in a bid to expedite the growth of industries in the country and, ultimately, tax revenue collections.

The Tanzania Government should also improve its investment policies and align them with technological changes brought by 4IR, in order to attract more foreign direct investments and boost the importation of 4IR technologies from developed countries and, subsequently, improve tax revenue collections from manufacturing and related sectors.

6.1 Policy Recommendations

The positive effects of investment in modern technology by manufacturing firms in Tanzania signifies that, the Tanzanian manufacturing sector is an important sector that must be kept under close observation. Since its contribution to tax has revealed positive results over time, the complexity pertaining to the adoption of modern technology should be resolved. Moreover, the excessively numerous taxes imposed on this sector should be investigated and amended accordingly, to create a conducive environment for promoting the manufacturing sector in Tanzania. The Integrated Industrial Development Strategy 2025 should be reviewed to accommodate both resource-based and technology-based industries. Since the world has shifted to technology-based based industries, over-reliance on the bountiful natural resources the country is endowed with might not be enough. As such, a re-alignment of its development strategy could allow the country to optimise both technological advancement and cheap resource availability, for manufacturing purposes.

Also, the government should improve the country's education curricula by putting more emphasis on technical education, to produce enough experts that support technology-based industrialisation and innovation, by creating more technological incubation centres to avoid the problem of job dislocation and skills mismatch during the Fourth Industrial Revolution. Furthermore, emphasis should be provided on awareness programmes among existing and new investors in the manufacturing sector to accept and embrace investment in modern technology features, in a bid to harness the advantages associated with such investment. Doing so would not only be beneficial to the manufacturing industries, but also to the government, by increasing the amount of taxes collected due to a technology-driven, steady rise in productivity.

6.2 Recommendation for Further Research and Limitations

The study was limited by data availability. As a result, the study utilised annual data for the 2012 – 2021 period. More studies could be conducted in this area, especially on measuring the effects of investment in modern technology of manufacturing firms in Tanzania, by expanding the study to other performance variables besides tax revenue collection. Moreover, other studies could capture other methods, for example, the use of Vector Autoregressive Models, to test whether results would be the same. Some studies on the causal effects of investment in modern technology in Tanzania can still be conducted to determine the causal relationship between the investment level in modern technology and Tax to GDP ratio. As this study did not consider control variables such as governance, political situation, infrastructure and corruption, due to unavailability of data, another study can consider these variables to determine how they may affect the volumes of taxes paid by manufacturing firms in Tanzania.

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