Koozakar Festschrift
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Editorial

Technology Management and the Challenges of Sustainable Development: A Festschrift for Matthew Ilori

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https://doi.org/10.69798/k0066500

Background

One of the most sought-after and critical capabilities in the world today is the ability of nations to use technological options to solve ongoing and potential challenges posed by food security; health outcomes; the provision of essential infrastructure such as energy, water supply, housing, security and education; and the production and distribution of goods and services among others. Technology management defined by Ilori (2006), is the body of knowledge linking science, engineering, technology, social sciences and management for the purpose of building technological capabilities required for running a public or private organisation or a nation in order to achieve strategic goals and objectives. The capability of nations to identify, select, acquire and exploit technologies at firm, industrial and national levels thus become an essential determinant of favourable and sustainable socio-economic and developmental outcomes. The entire teaching and research career of Matthew Olugbemiga Ilori was dedicated to developing this capability in Nigeria.

Professor Ilori's academic journey began with a National Certificate in Education (NCE) in Mathematics/Chemistry obtained from Adeyemi College of Education (now Adeyemi University of Education) in 1975. Four years later, he obtained a Bachelor's degree in Chemistry from the University of Ife (now Obafemi Awolowo University - OAU) in 1979. His shift towards engineering and technology came in 1983 when he obtained a Master's degree in Food Science and Technology also from OAU. One year before completing the Master's degree, he secured an appointment as a Research Assistant in the Technology Planning and Development Unit (TPDU) of the University. Thus began an academic career that eventually produced Nigeria's first full professor of Technology Management in 1999 and OAU's 191st Inaugural Lecture in 2006, after no less than 80 research publications in

diverse areas of Science, Technology and Innovation (STI) management. Today, Ilori's profile holds over 150 research publications, more than a third of which are listed in Scopus.

At the time of his first appointment there, TPDU was a nascent centre of teaching and research in the emerging field of Technology Management. Thus, while he still went ahead to obtain his doctorate in Food Technology from the University of Ibadan, a clear teaching and research trajectory pathway had appeared before Ilori. Indeed, at that time, TPDU was the only academic centre in Nigeria and one of the very few in Africa that awarded postgraduate degrees in Technology Policy and Planning. In the early eighties, Nigeria and several other African countries had already begun to face a severe reversal of economic fortunes and industrial growth was already beginning to dwindle. These led to the realisation of the role that technology policy and planning has to play in national, technological and economic development. The TPDU was therefore created as an instrument of capacity building and intellectual support for STI policy in Nigeria. Future-oriented people like Matthew Olugbemiga Ilori found an intellectual home in this unit quite naturally, despite an eclectic academic background. No doubt, such a background is well suited to the multidisciplinary nature of STI teaching and research.

In Ilori's career lifetime, the TPDU would later grow to become a full-fledged institute, now named the African Institute for Science Policy and Innovation (AISPI). From this institute, and after 40 years of a formidable scholastic narrative, Ilori has helped to build a strong discipline of STI management in Nigeria. In addition to his work in AISPI, the Department of Public Administration and the Department of Management and Accounting in OAU, Ilori helped build course modules and degree programmes in the Ladoke Akintola University of Technology (LAUTECH), Ogbomso, Yaba College of Technology, Yaba, Lagos and the Federal University of Technology, Akure among others. Between 1992 and 2022, he supervised and graduated over 100 postgraduate students. In the next section we provide an overview of Ilori's research.

Forty Years of Impact: An Overview of Ilori's Research in Science, Technology and Innovation Management

This section attempts to examine Matthew Ilori's publications and contributions to the field of Technology Management. Professor Ilori has over 150 publications made up of book chapters, monographs, journal publications and proceedings of learned conferences. This assessment however focuses on his entries in the Scopus data base which indexes content highly recognised by the global academic community. His metrics show 53 entries, 548 citations and an h-index of 12. In light of his educational background and research focus, his works can be considered under three headings; R&D and Innovation, Innovation Management and Policy, and Industrial Technology Management. For lack of space to analyse all his works, we select three of his most cited works from each of these headings for analysis. Table 1 shows the central works by Ilori under these three headings in the Scopus data base.

Under the R&D and Innovation focus shows some of Matthew Ilori's earliest research output. At that time, the Nigerian Government was concerned with reducing the Country's import bill which consisted mostly of raw material items used by the manufacturing industry. Notable among these import items was Barley consumed majorly by the Brewing Industry. As a response to this challenge, and as a Food Scientist, Ilori and colleagues attempted to find local substitutes for the industry. This resulted in the extensive research on Sorghum, a widely available grain in Nigeria as a substitute for Barley.

In Ilori and Adewusi (1991), the effect of ammonia treatment as a steep liquor on the malting losses of 2 Nigerian Sorghum varieties was examined. In the study, the authors concluded that malting with ammonia solution may be useful for minimising malting losses provided the malt produced will only provide malty flavor in beer and external enzymes will be added during processing. In Ogundiwin *et al*. (1991), Ilori and colleagues attempted to solve the problem of bacteria and mould growth associated with Sorghum grain and malts during malting using five chemical preservatives.

Table 1: Matthew Olugbemiga Ilori's Selected Scopus-based Research in Science, Technology and Innovation Management

Research Focus	Authors	Title	Scopus Citations
R&D and Innovation	**Ilori, M.O**., Adewusi, S.R.A.	Effect of Ammonia on the Malting Losses of Some Improved Nigerian Sorghum Varieties, *Journal of the Institute of Brewing*, 1991, 97(2); 111-113	14
	Adewusi, S.R.A., **Ilori, M.O**.	Nutritional Evaluation of spent grains from Sorghum Malts and Maize Grit, *Plant Foods for Human Nutrition*, 1994, 46(1), 41-51	14
	Ogundiwin, J.O., **Ilori, M.O**., Fessehatzion, B., Babalola, G.O., Olajuyigbe, A.O.	Effect of chemical treatments on the microorganisms associated with malting of sorghum grains and sorghum malt, *Journal of Applied Bacteriology*, 1991, 71(2), 139-143	8
R&D Innovation Management and Policy	**Ilori, M.O**., Oke, J.S., Sanni, S.A.	Management of new product development in selected food companies in Nigeria, *Technovation*, 2000, 20(6), 333 - 342	37
	Sobanke, V., Adegbite, S., **Ilori, M**.O., Egbetokun, A.	Determinants of technological capability of firms in a developing Country, *Procedia Engineering*, 2014, 69, 991-1000	25
	Abereijo, I.O., Adegbite, S.A., **Ilori, M.O.**, Adeniyi, A.A., Aderemi, H.A.	Technological innovation sources and institutional supports for manufacturing small and medium enterprises in Nigeria, *Journal of Technology Management and Innovation*, 2009, 4(2); 82-89	22
Industrial Technology Management	Akinbami, J.-F.K., **Ilori, M.O**., Oyebisi, T.O., Akinwumi, I.O., Adeoti, O.	Biogas energy use in Nigeria: current status, future prospects and policy implications. *Renewable & sustainable energy reviews*, 2001, 5(1): 97-112	129
	Adeoti, O., **Ilori, M.O**., Oyebisi, T.O., Adekoya, L.O.	Engineering design and economic evaluation of a family-sized biogas project in Nigeria, *Technovation*, 2000, 20(2), 103-108	53
	Jesuleye, O.A., Siyanbola, W.O., Sanni, S.A., **Ilori, M.O.**	Energy demand analysis of Port-Harcourt refinery, Nigeria and its policy implications. *Energy Policy*, 2007; 32(2); 1338-1345	14

Source: Scopus Author Profile of Ilori, Matthew Olugbenga, sc 55804808800 (accessed July 18, 2022)

In Adewusi and Ilori (1994), the potential use of the high protein by-product of beer production using 77% Sorghum malt and 23% Maize grit as animal feed was investigated. These research works and others in this period encapsulated Matthew Ilori's technological entrepreneurship capabilities in his attempts to employ technological solutions in Food Science and Technology to create ventures associated with Sorghum production and brewing to solve the Nation's challenge of foreign exchange deficits caused by massive importation of Barley. These laboratory processes and product development efforts on Sorghum malting and brewing were scaled up to industrial levels twice at the International Breweries Plc, Ilesha, Nigeria in 1989 and 1990.

With respect to R&D and Innovation management and policy, notable works were concerned with mechanisms for building technological and innovation capabilities in the manufacturing industry in Nigeria. These studies came later after his involvement with Industry at his initial stage of his research work. Ilori *et al.* (2000) was focused on evaluating the planning and management of new product development in the Nigerian food industry. The scholar and his colleagues reported that food

companies need to adequately fund R&D and be more active in all phases of the product development process. The study concluded that adequate technical and production capability support should also be provided for Nigerian firms in the sector to remain productive.
In Sobanke *et al*. (2014), actors associated with the accumulation of technological capability among metalworking firms in Nigeria was examined. This industry poses an important factor in the industrialisation of Nigeria for the production of capital goods. The study concluded that firm-specific assets such as entrepreneurial training and experience as well as in-house training are highly important for building technological capability in firms in developing countries.

In Abereijo *et al.* (2009), in view of the relevance of small and medium scale manufacturing enterprises (SMEs) to the development of any country, the importance of technological innovation sources, institutional support as well as their significance to the firm's innovativeness was studied. Ilori and colleagues recommended that SMEs be provided opportunities to continuously learn about new technological developments and opportunities to enhance the competitiveness of enterprises in the sector.

Research efforts under the Industrial Management focus mostly include studies that emphasise the role of technology in venture creation, engineering economy analysis of engineering and science projects, maximising firm returns and gaining competitive advantage. These studies emphasized the research focus of the Unit (TPDU). This role was maintained with the establishment of the Institute in 2011. Ilori and colleagues in Akinbami *et al.* (2001) examined biogas (renewable) energy use in Nigeria, in a fossil fuel rich country and an oil exporting nation. The authors reported in the study that envisaged benefits of biogas use to the national economy includes reductions in CO_2 emissions. They conclude that if biogas displaces kerosene, at least between 357-60,952 tons of CO_2 per annum would be avoided. They also suggested ways potential entrepreneurs could overcome economic, technical and socio-cultural constraints associated with the development of a biogas industry.

One of Matthew Ilori's main areas of research was to examine the economic viability of inventions. In fact, engineering economy was a major course taught by Ilori at the Institute. This was aptly demonstrated in Adeoti *et al.* (2000) where the discounted cash flow micro-economic assessment was used to evaluate a 6.0 m^3 family-sized biogas project in Nigeria. The authors reported the biogas project had a good economic potential. Jesuleye *et al*. (2007) epitomises Ilori's penchant to engage the Country's challenges and research favouring industrial calculations and analyses. This chapter analyses the energy demand of the Port-Harcourt refinery, Nigeria using the calculation of energy intensities to determine the Refinery's annual energy demand for various energy types considered from 1989 to 2004. Ilori and colleagues conclude that lack of optimal fuel utilization-mix and non-compliance with the Turn-Around-Maintenance schedules were attributed to the refinery's inefficient energy demand pattern.

The contributions in this festschrift speak to the three broad areas of Ilori's research and beyond. We find several contributions on R&D and Innovation, Innovation Management and Policy as well as Industrial Technology Management. Beyond these, there are at least two chapters that study the rapidly developing fields of digital technologies and artificial intelligence. Considering the relevance of these fields to national technological capabilities, it is not strange to imagine that Ilori would have made important contributions. However, these fields are relatively new for a man whose career began in the days of computer punch-cards, a truly long and fruitful academic career that is now transiting into retirement.

Overview of the Festschrift

This section summarises the contributions that make up this festschrift. The first chapter is written by Felicia Adeyemo and Grace Okoronkwo and examines the effect of Artificial Intelligence (AI) on the operational efficiency of deposit money banks in Lagos State with a view to informing management practice and public policy strategies in the sector. AI is making the world smarter and more innovative

in terms of providing solutions to various challenges in many industrial and service sectors. The chapter contributes to the scarce literature on the effects of AI on business processes in developing countries. The authors select the Nigerian banking sector as their focus of study because the sector is one of the largest service sectors in the country and probably the most influential in terms of potential to contribute to economic development. The authors reported that types of AI such as deep learning, automation, fraud prevention had significant and positive effects on operational functions such as service innovation, cost reduction, service quality and customer satisfaction and recommend that deposit money banks should effectively make use of artificial intelligence.

Chapter 2 is written by Oluseye Adesokun, Matthew Ilori, Margaret Afolabi, Maduabuchi Ihekoronye and Kanayo Osemene and examines the impact of the application of mobile telephone-based intervention on adherence to medication by Type 2 Diabetic (T2D) patients. Evidence shows that adherence to antidiabetic medication is associated with reduced mortality, overall cost of healthcare and odds of hospitalization, and better control of risk factors. This chapter contributes to the literature by providing information on the capabilities of mobile telephony in shaping health interventions in Nigeria; a country with a fast-developing rural telecommunications network. The authors reported that intervention which majorly consisted of a twice-weekly Short Message Service (SMS) text messages significantly improved glycemic control, knowledge of T2D and adherence to medications. Policy reforms in healthcare financing were recommended for sustainable provision of mHealth follow-up in diabetes care.

Omoniyi Ola-Olorun, Timothy Oyebisi and Margaret Afolabi examine the factors influencing the adoption of Information Technology (IT) among pharmacists in Nigerian hospitals in the third chaper of this festschrift. Recognising the problem of inefficiency and compromise of effectiveness in pharmaceutical service delivery in hospitals in Nigeria and the potential of IT adoption in overcoming these challenges, the authors provide information on the adoption influencing factors in the sector in order to inform IT deployment initiatives. The authors report that end-user knowledge and skills in the application of the technology, quality of output of technology and the relative advantage of the technology over current practices where factors that could aid the prompt uptake of technology among pharmacists in Nigerian hospitals.

In chapter 4, Victor Sobanke, Matthew Ilori, Helen Aderemi and Billy Oluwale examine whether the man-power in Food and Beverage processing firms in Nigeria is capable of absorbing existing technologies and knowledge from industrialised countries with a view to generating new technologies for the sector. The chapter reveals that extent of employees' career and skills utilisation, level of job satisfaction and willingness to adopt new technologies and responsibilities contribute significantly to innovativeness. The authors further suggest that flexible management practices encourage teamwork to innovate among employees.

Olawale Adejuwon, Waheed Olatunji and Tomilola Oguntunde examine the potential of a traditional social innovation, the *Eku* in enhancing small-scale palm oil production in Nigeria in chapter 5. The authors argue that just like technological innovations, social innovations can be improved upon to be made to work more efficiently. Towards this end, a framework which emphasises removing constraints to the practicality and efficiency of social innovations with institutional and funding interventions was developed. This was applied to create a prototype *Eku* that can be up-scaled and diffused. The authors recommend equipping *Ekus* with innovations for all the non-mechanised stages of palm oil production and suggest up-scaling and diffusion of the model in the sector through small-scale entrepreneurs.

In chapter 6, Babatunde Salu, Ibikunle Ogundari, John-Felix Akinbami and Joshua Akarakiri examined the solar irradiance benchmarks for off-grid photovoltaic power systems development in Ikeja, Lagos State, Nigeria as a power supply alleviation strategy in the State and strategic model for other service providers at large. Solar irradiance was determined using the NiMet pyranometer, the NASA satellite, and the Mechlouch and Brahim model. The study established solar irradiance benchmarks of 15

MJ/m2/day (upper (maximin) value) and 20 MJ/m2/day (lower (minimax) value) for photovoltaic power systems development in Ikeja, Lagos State, Nigeria.

Abiodun Momodu and Tofunmi Adepoju review the technological options available to manage effluents and emissions in the Nigerian oil and gas industry in chapter 7 for lack of literature for options on the Nigerian situation. The authors scoured Microsoft Academic and Google Scholar databases for studies on the subject and identified three major technological options namely; biological, chemical and physical and 18 other sub-options. They reported that biological options seem the most suitable for effluent treatment in the Nigerian Oil and Gas industry. The authors further stated that chemical and physical options are also both used for the treatment of effluents and emissions in the oil and gas industry, but do not remove aromatic compounds and hydrocarbons as do biological agents.

Chapter 8 shows an assessment of the Engineering Economic Viability of Conversion of Open Cycle to Combined Cycle Gas Power Plant by Oluwaseun Fadare, Olutosin Ilori, John-Felix Akinbami and Matthew Ilori. This work is motivated by the continuing challenge of the dearth of power supply in Nigeria. The authors propose the conversion of existing open cycle to combined cycle gas power plants in order to maximize electricity generation output in existing thermal plants in the country. The authors report that by converting existing power plants in Nigeria, an additional 1142.1 MW could be obtained without an increase in gas consumption and cost. In addition, Net Present Value (NPV) and benefit-cost ratio of the proposed project were greater than zero and one respectively, indicating that the project is economically viable.

Munakur Megudu, Gbonjubola Binuyo, Sanjo Efunwole and Timothy Oyebisi examine the deployment of Security Management Technologies in the Hospitality industry in the Lagos Metropolis in chapter 9. Due to the rising challenges of insecurity in Nigeria, the authors investigated the factors influencing the deployment of the security technologies in hotels and also assessed their effectiveness with a view to informing security management practices in the sector. The results showed that Close Circuit Television (CCTV), access pass for cars, badges and lightings were the most used security technologies in the hotels. The study also showed that level of training of security personnel, level of knowledge and expertise of security management, user acceptance of technologies and location of the hotel were factors that influenced the deployment of the security technologies. The authors also reported that the deployment of security technology had significant effects on increasing efficiency and reliability of security initiatives.

In chapter 10, Safiriyu Eludiora and Benjamin Ayoade design and implement an English to *Yorùbá* Verb Phrase Machine Translation System. The authors argue that there have been significant works on English to *Yorùbá* (E-Y) phrase translation systems such as noun phrase translation. They however focus their research on the E-Y verb phrase translation. Lexical translation was done by assigning values of the matching word in the dictionary. The syntax of the two languages was realized using Context Free Grammar and rewrite rules were validated with finite state automata. Human evaluation method was used and expert opinion scored. An evaluation of their system showed that it performed better than sampled Google translations results with over 70% of the responses matching that of the system's output.

In chapter 11, Adeyemi Binuyo, Gbonjubola Binuyo and Bose Ayeni examine the relationship between time spent on social media to study and the time spent to study outside the classroom on the academic performance of students in selected tertiary institutions in Nigeria. In view of the wide spread engagement of students with social media platforms, the authors attempted in this study to determine if there are any detrimental effects of this on academic performance. The authors reported a positive relationship between time spent on social media and performance of students of selected tertiary institutions and recommended that programmes should be put in place to sensitize students of the advantages that could be derived from the use of the social media to study effectively.

Chapter 12 contributed by Ibikunle Ogundari, assesses the potential of an off-grid 100 million litres a day water desalination plant to solve water supply challenges in metropolitan Lagos. Using the Technology Foresight Analysis (TFA) methodology, the author estimates a plant design requiring an initial investment of ₦ 70.82 billion. The author reports levelized costs of ₦ 0.89 per Litre of water and annual revenue and profits estimated at ₦ 24.13 and 3.638 billion respectively at a retail price of 1.00 per Litre of water. Profitability indices of the project showed Net Present Values of ₦ 16.15 billion, break-even time of 1 year, payback period of 13 to 20 years, and Return on Investment over a 25-year life span of the project of 122.8%. Daily cost savings of ₦ 100.56 – 201.12 million (₦ 36.72 – 73.42 billion annually) were projected. The author recommended the project as a strategic municipal water supply alternative for the Metropolis.

Olatunji Ilori and Charles Akanbi assessed the factors influencing Engineering Assets Management (EAM) decisions in small- and medium-scale food processing companies in Southwestern Nigeria in chapter 13. In view of the high cost of imported food processing machines and inefficiencies of locally fabricated ones, the authors examine the factors influencing EAM decisions in the food and beverage industry in Nigeria with a view to informing management practice and recommending policy measures for improving asset management in the industry. The authors reported that most firms only considered the intensity of maintenance needed to keep production going. They further recommended that firms develop more proprietary EAM guidelines and policy statements rather than generalised instructions on how EAM decisions and actions are to be taken.

In the light of policy initiatives to encourage public-private partnerships as a solution to the deficiency in student housing in Nigerian universities, Hakeem Bakare and Phillip Ayoola examined the techno-economic viability of a 50-room students' hostel in Nigerian Universities in chapter 14. An engineering economic project analysis framework was used as a template for the study. The authors estimated an initial investment of ₦151,120,155, an annual expenditure of ₦3,610,000 and an annual revenue of ₦15,240,000 based on a survey of what students were willing to pay for rent. Payback period of 12 – 13 years was estimated. The study concluded that the 50-room students hostel infrastructure was technically and economically viable, and a suitable public-private partnership template for Nigeria Universities.

Tolutope Fakokunde is the sole contributor to chapter 15 where the author assesses the entrepreneurial characteristics influencing the sustenance of printing firms faced with the challenges of changes caused by the rapid uptake of digital technologies in Nigeria. Using the popular printing hub in Shomolu, Lagos State, Nigeria as a case study, the author reported that commitment, determination and ability to adapt where key personal entrepreneurial characteristics (PEC) that support the growth and survival of the printing business. The author further recommended policy mechanisms which can harness the PEC of entrepreneurs for public interventions in economic transformational efforts.

Chapter 16 is another study that employs engineering economy as an analytical template. Written by Ayodeji Ilori, Bolanle Oyedoyin, Oluyemisi Asagbra, Adekunle Lawal, Joy Oyinbe and Moji Dehinsilu, it examines the economic viability of the production of yoghurt using indigenous starter culture. Based on an output of 180 x 10^3 litre/year, all profitability indices were positive. The authors concluded that the project is technologically and economically viable.

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