DISRUPTIVE FRUGAL DIGITAL INNOVATION IN AFRICA

Edited by Brighton Nyagadza and Abu Bashar

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To all digital technology enthusiasts in Africa and dotted around the globe.

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Preface

For the purpose of achieving the 2030 SDG Agenda, this volume discusses potential disruptive frugal digital technological innovation that could support Africa's sustainable human development. It explores the potential barriers and opportunities of disruptive frugal digital technological innovation in promoting sustainable development of African people's standard of living in Africa. In order to support the 2030 Sustainable Human Development Agenda, the volume's goal is to identify potential frugal disruptive technology for sustainability.

Furthermore, it makes future projections for some specific indicators based on current information and forecast future digital transformations that will need to occur as a result of frugal disruptive technology implementation. This edited volume will provide disruptive frugal digital technological innovation policy-makers, academics, doctoral and graduate students in business with comprehensive knowledge on the nature, dynamism and complexity of technology adoption in Africa. While Ratten's (2019) *Frugal Innovation* book addresses innovating in a cost-efficient manner by considering and exploiting available resources and distinguishing frugal innovation from other innovation types in the context of developing creative solutions to sustainability challenges and the circular economy, our currently proposed book distinguishes itself from her book. The current edited volume targets the scientific contributions of disruptive frugal digital technological innovation, specifically their implications for advancing sustainable human development in Africa.

While McMurray and de Waal's (2019) book titled *Frugal Innovation* explores principles and theories of frugal innovations across the globe, our proposed edited volume develops and extends literature by fusing it with disruptive frugal digital technological innovation terrains that are often under-explored among resource-poor economies of Africa. Our intended book exhibits some notable associations with the seminal works of Mahajan et al.'s (2020) Technologies for Sustainable Development, which dealt with veritable discussions on technologies and green environment, sustainable manufacturing processes, machine intelligence/computational intelligence, design and analysis of machine and mechanism. The edited volume, however, extends the strong technological focus of their scholarly contribution by applying different disruptive frugal digital technological innovation to development in emerging contexts of Africa. *Frugal Innovation and the New Product Development Process*, by Cadeddu et al. (2019), is a complementary intellectual piece that explores the new product development process of firms, while

developing disruptive frugal digital technological innovation for the base-of-the-pyramid (BOP) markets in developing countries.

The current edited volume extends the concepts of disruptive frugal digital technological innovation by interlacing it with technology entrepreneurship, a less charted emergent path with reference to emerging markets on the African continent. By taking a multifaceted approach, the readers of this edited volume will get insights into the role of disruptive frugal digital technological innovation in Africa. An iterative review of these conversations suggests in a rationalist fashion that some commentators perceive this enormous potency in the acceleration of the adoption of disruptive frugal digital technological innovation by these techno-enterprises, which is systematically reflected in their increased internet business in Africa. The adoption and development of disruptive frugal digital technological innovation are some of the strategies, which can be used to ameliorate the situation, especially in developing countries where it is dire. Unfortunately, the concept is still less common, while the adoption of this type of technology is also low, in many developing countries.

Despite all these challenges, Africa has been able to provide for its people and the world at large through all its concerted efforts, and if it can adopt the recent methods such as the use of frugal disruptive technology and modernized digital tools such social media, cloud computing, virtual reality (VR), augmented reality (AR), and robotics which are less laborious and produce more output, Africa could become a self-sustaining continent. The volume maintains analysis levels consistence within the proposed chapters, through the use of empirical data and real-world case studies, by considering incorporation of insights from various fields such as economics, sociology and environmental science to enrich the depth of the analysis and multi-pronged interdisciplinary approach. Of great interest, it would be for the wider audience to appreciate, compare and contrast these practices and their applications in Africa drawing on different methodologies, analytical frames, contexts and settings.

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Chapter 1

Nexus Between Disruptive Digital Frugal Innovation and Sustainable Development in Africa

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Abstract

While digital technologies have striven to contribute to Africa's development, there is much disparity in the attainment of economic, social and ecological sustainability in emerging African economies. The strategic adoption of disruptive digital frugal innovations contributes to sustainable development (SD) in Africa while mitigating challenges associated with digital technologies. This chapter gives a deeper understanding of the opportunities and challenges of adopting digital frugal innovations (FIs) in the African context from an interdisciplinary perspective, thereby advancing ongoing discourse on SD and digital tech-driven progress and guiding policymakers, entrepreneurs and researchers in these fields. Through a comprehensive synthesis of the literature, practical insights and case studies of firms that have utilised digital FIs for disruption while offering sustainable solutions, the chapter concludes that, by leveraging opportunities for collaboration and having a mindset that promotes SD, disruptive FI can be achieved with digital technologies.

Keywords: Frugal innovation; Africa; digital technology; disruptive innovation; sustainable development

Introduction

Sustainable development (SD) ensures the needs of the current generation are met, without compromising the ability of future generations to meet their own

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needs (World Commission on Environment and Development, 1987). SD, which comprises economic, social and environmental dimensions, is an advantageous driver in this era when human activities have contributed the most to environmental changes.

While the United Nations Sustainable Development Goals (SDGs) are global, most African nations are lagging in achieving them in terms of public life, education and welfare compared to other climes (Li et al., 2021). Over the years, different factors have facilitated SD in Africa. One is digitalisation (Balogun et al., 2022), which involves adopting digital tools and technologies that increase efficiency and productivity, consequently contributing to economic growth and social development. It is also believed that digital technologies promote environmental sustainability, through innovations that address environmental challenges (Zakhozhyi & Jinxin Ma, 2023), by reducing carbon emissions and promoting a circular economy (Rosário & Dias, 2023) amongst other benefits. While digital technologies can address sustainability issues (George et al., 2021), some challenges must be tackled, including e-waste, pollution, high energy consumption and data protection (Rosário & Dias, 2023).

Considering this, imbibing innovation in digital transformation is necessary for dealing with unexpected threats and challenges and exploring new business opportunities while simultaneously carrying out business operations, collaborating, coordinating and generating new knowledge (Al Omoush et al., 2023). The UNDP (2023a) acknowledges that through digital technological innovation, African digital entrepreneurs are facilitating the progress towards achieving the SDGs and 2063 Agenda of the African Union by leveraging EdTech, FinTech, AgriTech and HealthTech.

Furthermore, adopting a frugal and disruptive approach enables digital technologies to be holistically sustainable in transforming Africa's economy and promoting the social and environmental landscapes. This ensures that no dimension is neglected. Digital frugal innovations (FI) enables emerging economies in Africa to enjoy tailored products, services and resources; it is cost-effective and resource efficient. They disrupt by creating new digital products for the new and underserved bottom-of-the-pyramid (BOP) markets and, consequently, significantly transform the industry operations. Frugal digital innovations promote SD through natural resource minimisation, resource recovery and the use of eco-friendly materials, economic growth, inclusivity and more. By employing efficient sustainability principles, FI in digital technology can advance SD in Africa.

Theoretical Development

Disruptive Innovation Theory

Companies disrupt by satisfying un(der)served consumers with their cost-effective, good-enough offerings. Christensen's Disruptive Innovation Theory, drawn around 1995, defines disruptive innovation as a process whereby a smaller company with fewer resources can successfully challenge established

incumbent businesses Christensen et al. (2015). The authors assert that disruptive innovations stem from low-end or new-market footholds which top players overlook by focusing on incremental product offerings which the lower end cannot afford. Disruptive innovations are made possible in these markets which established players overlook thereby creating a loophole for the disrupter to gain entrance by offering low-cost but 'good enough' products and competing favourably over them. In this case, Christensen et al. (2015) pointed out that disruptive innovation has frequently been misconstrued for other forms of innovation which merely entail an entity shaking up the industry, which disruptive innovation is not, at least not according to his theory. Therefore, disruption occurs from the bottom un(der)served and upward, causing a significant change in that industrial landscape.

Frugal Innovation: Doing More With Less

A similar concept which offers disruption is the FI. Like disruptive innovation, it involves offering low-cost and good enough products. The early definitions and understanding of the concept of FI arise mostly from conceptual papers from which we can deduce that FI involves managing costs and resources in developing solutions that meet the needs of consumers. FI can create value with fewer resources and at low costs (Sharmelly & Ray, 2018). As defined by Radjou and Prabhu (2015), 'Frugal Innovation is the ability to "do more with less" – which implies creating significantly more business and social value while minimising the use of depleting resources such as energy, capital and time'. Yet, there are several other synonymous and related terms such as jugaad innovation, reverse innovation, frugal engineering, bricolage, etc. These ideas also aim at 'doing more with less.'

Bhatti proposes a definition of FI which goes beyond costs and offers a more holistic way of creating value for underserved markets. 'Frugal innovation may redefine business models, reconfigure value chains and redesign products to use resources in different ways and create more inclusive markets by serving users with affordability constraints, often in a scalable and sustainable manner' (Bhatti, 2012). In his studies, he asserts that FI distinguishes itself from the other related concepts by being more encompassing and involving both the process and outcomes (Bhatti, 2012; Soni & Krishnan, 2014). Additionally, he insists that the solution should solve needs at the intersection of technological, institutional and social innovation. In a nutshell, FI emerges as a multifaceted approach, uniquely positioned to bring about positive change through a thoughtful integration of technological advancements, institutional adaptations and social considerations.

Zeschky et al. (2011) connect a link between disruptive and FI in that the latter is prevalent in resource-constrained emerging economies. Other authors have also pointed out a relationship between the twain. Some (Soni & Krishnan, 2014; Tedards & Hill, 2020) inferred that not all disruptive innovations are frugal but disruption is often a product of FI. However, Agnihotri (2016) proposed that, unlike disruptive innovation, frugal goods are not readily accepted by an upper

middle-income segment of society. This may be a consequence of Zeschky's stand that FI is often driven in resource-constrained emerging economies and often leads to inferior-looking products (Zeschky et al., 2011). In FI, minimal resource use results in satisfying products that achieve more with less, meeting consumer needs.

Frugal Innovation in Emerging Economies

The emergence of FI in developing economies has challenged the conventional belief that innovation is the exclusive domain of developed countries. Winkler et al. (2019) and Zeschky et al. (2011) underscore that emerging economies provide fertile ground for the thriving of FI. However, a cautious approach is crucial as multinational corporations seize opportunities in these economies. Lessons from the environmental mistakes of developed countries should guide strategies. Prahalad and Hart (2002) caution against repeating resource-intensive and polluting product offerings. FI, which minimises the usage of financial and natural resources, emerges as a compelling strategy for inclusive development in these economies (Nari Kahle et al., 2013; Rosca et al., 2017) and contributes to the resilience of SMEs in these climes (Al Omoush et al., 2023).

FI is not an afterthought but is often intentionally designed and developed for emerging economies, addressing their unique market needs (Sharmelly & Ray, 2018). This notion aligns with the idea that FI may originate in these markets and eventually make inroads into developed economies – a phenomenon coined 'reverse innovation.'

Indigenous expertise and participation are indispensable for an understanding of prevailing local needs. Their competence is pivotal in the successful execution of FI. For instance, the collaboration behind Renault's 'Logan', involving high-end French designers and cost-sensitive Romanian manufacturing engineers, exemplifies a successful cross-cultural approach to implementing FI. The Logan's significant success in both emerging economies in Eastern Europe and the Middle East, as well as in affluent Western Europe, highlights the transformative potential of such collaborative FI initiatives (Radjou & Prabhu, 2015). Additionally, in the case of Mettler Toledo, a Swiss company, local R&D subsidiaries in China were instrumental in implementing FI (Zeschky et al., 2011). Thus, the input of locals in the disruptive innovation process is vital.

The success potential of FI in emerging economies is notably higher. The untapped ground for sustainable resource utilisation and a vast customer base at the BOP markets in developing countries amplify the transformative impact of FI.

Digital Transformation for Sustainable Development

Digital transformation has the potential for the attainment of SD. This type of development prioritises three dimensions: economic prosperity, social inclusion and environmental sustainability. Digital transformation has been recognised as one of the six major transformations required to attain SDGs (Sachs et al., 2019)

because appropriate technology when combined with entrepreneurial ideas is a powerful combination to create value and bring solutions to social and environmental issues (Khadria & Mishra, 2023). Consequently, several studies have shown the contribution of digital transformation to the three key dimensions of SD. A study by Leal Filho et al. (2024) showed the contribution of digital tools to boosting SD and innovation in higher education institutions. Lugonja et al. (2022) report on the application of the Internet of Things (IoT) (Bashar & Rabbani, 2022) and Unmanned Aerial Vehicles (UAVs) in sustainable food systems. The UNDP blog reported how digital transformation is driving more sustainable and inclusive development by enabling economic development, resilience building and climate adaptation (Zakhozhyi & Jinxin Ma, 2023). In the blog, such cases were reported from several countries; in Afghanistan, the United Nations Development Programme (UNDP) implemented a digital cash transfer system as part of the ABADEI programme, resulting in increased financial inclusion and resilience for communities recovering from crises. In Nigeria, the adoption of open-source mobile e-health platform SORMAS nearly tripled the coverage of healthcare services between 2019 and 2020, particularly crucial during the pandemic. The case in Ukraine leveraged existing digital platforms and inclusive design efforts, including support from the UNDP, to facilitate the provision of digital public services, which addressed the financial needs of internally displaced persons, affected by war and crisis. Additionally, greener solutions to environmental challenges have been implemented through digital technologies in Malawi, Turkey and Kenya, still according to the report.

These cases and many more underscore the pivotal role of digital transformation in promoting SD across diverse sectors and geographies.

Methodology

This chapter employs a comprehensive literature review methodology to explore the nexus between disruptive digital FI and SD in Africa. The review encompasses a range sources, academic and non-academic, including peer-reviewed journal articles, books, conference papers, blogs and reports from the World Economic Forum and the UNDP.

The literature search used various databases, including Scopus, Google Scholar, Emerald Insight and EBSCOhost. Keywords used for the search were ‘disruptive’, ‘frugal innovation’, ‘disruptive innovation’, ‘digital transformation’, ‘sustainable developmentSD’ and ‘Africa’. These were used to identify studies relevant to the chapter. The search was refined to include publications from the last two decades to be encompassing, not overlook the most important discourse, and include recent developments in the field. The selected literature were analysed and synthesised to identify key themes, trends and gaps in the existing research. The emphasis of the analysis was on the theoretical underpinnings of disruptive and FI, the mediating role of digital technologies in enabling these innovations and their impact on SD outcomes in Africa.

Case studies of successful disruptive digital FIs in Africa, such as M-Pesa and Flutterwave, were also presented to provide practical insights and real-world examples of how these concepts are being applied to address socioeconomic challenges and drive SD on the continent.

By combining theoretical frameworks, evidence from literature and case studies, this chapter seeks to provide an understanding of the complex interaction between disruptive digital FI and SD in Africa. The insights gathered herein can inform policymakers, businesses, entrepreneurs and researchers in their efforts to leverage frugal digital innovation for inclusive and sustainable growth in Africa.

Related Literature

The State of Sustainable Development in Africa

African nations have long been ranked amongst the least developed in different respects including the SDGs. The UNDP (2023b) reports the current state of SD in Africa to be uneven amongst different geographies with a much smaller number of countries on the track of the 2030 agenda with reasonable improvements while others are slow. The report showed that financial and gender inequalities are the major issues. However, they stated that there is a significant improvement in 4G mobile network coverage, potable water and electrification rates. These have been facilitated by technological development, research and innovation. This corroborated the United Nations Economic Commission for Africa (2022) report which argues that the current pace is insufficient to attain the SDGs in Africa by 2030.

More specifically, in the areas of health and well-being, poverty and inequality pervade amongst the population (Cerf, 2018). In public life, education and welfare, significant regional disparity exists, with North and South Africa performing better than the sub-Saharan region (Li et al., 2021) where there is poor economic sustainability (Bekele et al., 2024).

Achieving SD Through Disruptive Digital Frugal Innovation

Frugal Innovations

FI can be vital in contributing to SD. Sustainable improvements in both economic and non-economic aspects (De Marchi et al., 2022) have been recorded due to the adoption of FI (Rabbani et al., 2022). Some of these are labour market inclusion, local entrepreneurship, capacity building, decreased inequality and promotion of environmental protection, which are components of the UN SDGs (Rosca et al., 2017). Thus, the authors recognise that FI can be a tool for SD. However, this depends on the right combination of efforts, skills, resources and stakeholders' motivation (Pansera, 2013 as cited in Rosca et al., 2017). In line with this, De Marchi et al. (2022) acknowledge that several factors are important in understanding the relationship between FI and SD: the actors who play in the development of FI, their form, motivations and collaboration sustainability outcomes.

the authors assert SD outcomes are more likely to emanate from non-firm actors and local developers than from firm actors and foreign developers, who are for the most part, profit-motivated. The literature also suggested that collaboration is essential for FI to achieve SD outcomes; however, the topic should be explored further to see where and when sustainability-enhancing outcomes of FI are more likely to occur.

Previous research by Molina-Maturano et al. (2020) evaluated the sustainability of two latent FIs in México and the motivation of their innovators. The findings revealed that in both cases, the innovations did not violate any of the 17 SDG goals. Furthermore, they had a neutral impact on the SDGs and had a positive effect on all three dimensions of sustainability, with a slight emphasis on social sustainability. Another study showed how frugal systems contributed to the combined preservation of jobs and pastoral landscapes (Garambois et al., 2020), thereby promoting sustainable agriculture. Similarly, Stöber et al. (2022) acknowledge that FI is a promising approach to promoting SD from an economic and social perspective but point out that positive and negative effects could exist in all three dimensions of sustainability; hence, a positive relationship must be proactively formed since several external factors can influence the impact of FI on sustainability. Albert (2019) found that FI often contributes to ecological and social sustainability; however, he recommends that such innovations be considered 'ecologically sustainable frugal innovation.' Additionally, Agnihotri (2015) asserts that it is generally more environmentally friendly and resource-conservative as it is simpler by nature.

Consequently, FI can promote SD with the right goals, motivation, cross-sectional collaboration and technologies. Also, in agreement with Rao (2013), FIs present significant potential for advancing SDGs by optimising resource utilisation and prioritising simplicity in products and services and incorporating cutting-edge technology. By combining these tools and ideas. FIs can contribute geometrically to SD.

The Role of Digital Technologies in Frugal Innovation and SD

A proper business model innovation requires a design based on digital transformation, social and environmental sustainability in addition to sustainable engagement (Hajiheydari et al., 2023).

Digital technologies are catalysts for FI and SD. On the one hand, digital transformation, that is 'Digitalization', helps firms' sustainable performance and boost their innovative capabilities in emerging markets (Lee & Roh, 2023). It significantly promotes disruptive innovation (Wu & Li, 2024; Zhang et al., 2022) and fosters frugal tendencies (Bashar, 2020). Findings from previous studies show how *digital technologies* facilitate frugality in innovations. They improve the performance of firms through minimal cost and resource usage accompanied by more efficiency (Al Omoush et al., 2023; Vey et al., 2017). An example of this is the mediating role of information technology in advancing frugal functionality, frugal cost and the frugal ecosystem (Shehzad et al., 2023).

On the other hand, digitalisation is recognised as one of the key transformations required for achieving SD. Frugal and sustainable digital innovation, using IoT devices, has the potential for addressing ecological issues by reducing waste and churning out high-quality products which meet the needs of low-end consumers in emerging markets providing a sustainable solution (Yousaf et al., 2021). IoT-enabled frugal devices have also been used to facilitate the SD of healthcare services in BoP markets (Singh & Bashar, 2021), by creating social impact, economic growth and resilience for the communities concerned (Park et al., 2022). Incorporating digital tools can improve SMEs' Corporate Social Responsibility performance, thereby benefiting the business (Bashar, 2021), society and the environment (Ahmad et al., 2024). Chatbots as a digital transformation tool are now used to foster financial inclusivity in Nigeria by engaging more customer segments (Abdulquadri et al., 2021).

Barriers and Enablers to Frugal Innovation

Research and Development

In many African countries, much attention is not given to R&D. Only about 0.45% of their GDP is spent on R&D, far below the global average of 1.7% (World Economic Forum, 2023). This greatly hinders innovation from within. It is worth noting that even though FI is affordable and cost-effective, it requires adequate funding for research, innovation and development. Adequate training must be provided for the workforce population.

Technical Know-How

The FI process may not have the required knowledge. This occurs in areas where there is not enough skilled manpower. Education, training and collaboration prove vital to empower locals to work with innovative multinational companies.

The Lack of Infrastructure

Inadequate infrastructure greatly hampers development in emerging countries. Deplorable road networks hinder the flow of goods and resources necessary for production and supply. In logistics, a long lead time results in delays and higher costs (Ramdorai & Herstatt, 2015), negating the very tenets of FI. Similarly, poor electricity supply affects production. On the other hand, good infrastructural development facilitates the production and transport of goods and raw materials thereby saving time and cost.

The Reluctance of Senior Management

Internal stakeholders are most likely to resist FI because it will be an unusual way of doing things around the organisation. They fear that a lot may be invested or