



# The Enabling Role of IT Solutions in SMEs Frugal Innovation: Post Coronavirus Crisis in Bahrain-Case Study

Maryam Zainal\*

Department of Social Science, Arabian Gulf University, Manama, Bahrain

## ABSTRACT

SMEs were pushed to implement innovative procedures and transform from traditional operations into a digital transformation process of converting into more technologized and enhance the market needs to obtain new employment opportunities post to the COVID-19 crisis, the expectations of development put the stockholders and investments under stress to adopt the new techniques of innovation to fill the market gaps and needs, keeping the low cost as the first target with quality of values in products and services at the same or better level, taking into consideration the customers' satisfaction as the main factor that affects the technology adoption, policies changing and the low-cost innovation due to the economic crisis. To take into consideration this issue, we built a conceptual framework model based on multi-model founds in different studies concerning different factors that affected the adoption, focusing on the digital transformation and had an impact on the Frugal innovation in 50 of new established SMEs undergoing the new program adopted by SME's society in Bahrain. The hypothesis of the adopted model will provide the relationship of some of the most founded factors affecting the Frugal innovation Implementation, which had a link with digital transformation and a positive impact on Customer satisfaction, keeping in mind that the COVID-19 anxiety is considered a moderator that affected the adoption of digital transformation directly. To test the hypothesis, data would be collected with both quantitative and qualitative methods in a longitudinal study before applying the digital transformation and after the technology adoption and expected that the data analysis will support the testing of the hypothesis.

**Keywords:** Frugal innovation; IT solutions; Coronavirus; IoT; SMEs; Digital transformation; Digital platforms; Economic countries

## INTRODUCTION

Though the innovation concept had been associated with the availability of resources and financial funds in the firms in developed countries, the researchers approach the practitioners in developing a concept that can be used to explain the low cost, resources and financial source of Innovation, later the studies and models have concluded the concept of "Frugal innovation". The description of the practice allocated and linked to Frugal innovation is rooted in low-cost processes, constrained resources approaches and flexible improvisation in the country. Some studies addressed by talked about the difference between Frugal

innovation and a normal one that is linked with the resources richness and abundance which is not available in the countries that are implementing the Frugal innovation.

It can also be defined as the design and development of products with low-cost prices rather than features, as a starting point to introduce the product in the market, besides focusing on the end users' advantages and value of the products to the customers rather than the high precaution. The development of Frugal innovation products and services is a critical way for global organizations in operating emerging economies due to the consumers' attitude toward price and value. Although this type

**Correspondence to:** Maryam Zainal, Department of Social Science, Arabian Gulf University, Manama, Bahrain; E-mail: maryamzainal9@gmail.com

**Received:** 12-Feb-2024, Manuscript No. JSC-24-24891; **Editor assigned:** 15-Feb-2024, PreQC No. JSC-24-24891 (PQ); **Reviewed:** 29-Feb-2024, QC No. JSC-24-24891; **Revised:** 19-Feb-2025, Manuscript No. JSC-24-24891 (R); **Published:** 26-Feb-2025, DOI: 10.35248/2167-0358.25.14.258

**Citation:** Zainal M (2025) The Enabling Role of IT Solutions in SMEs Frugal Innovation: Post Coronavirus Crisis in Bahrain-Case Study. J Socialomics. 14:258.

**Copyright:** © 2025 Zainal M. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

of innovation is usually empowering the market share in the third world and poor countries that cannot afford the same products and services prices the developed countries are paying for, the developed economies and countries are looking for the value of such products with the lowest prices due to the recent economic crisis post to coronavirus. Furthermore, governments and markets in developed countries are urging global firms to boost innovation without spending more on new programs and primarily to meet social and customer demands.

As global organizations and factories notice the opportunities of producing low-cost products and services that are designed for third-world countries and promoting them in developed countries, they started marketing emerging and developing their strategic plans. Yet the origin and the stated ideas behind Frugal innovation are not clear, however, the first mention of the concept was by the economics which introduce it during the last decays economic crisis. Some examples of Frugal products and services that are available in Bahrain include the affordable and widely popular mobile application “Benefit” designed to support money transfer that is used by almost 70% of the population; Bahraini hand sanitizers factories that produce medical consumables of sanitizers cheaper comparing to the exported brands; some brands tablets and laptops that are costing less than \$300; the low-cost ultrasound scan service available in 4 hospitals and medical centers around the kingdom that cost less than \$15 that is marketed as a high-quality service (actually the concept of this type of services is to gain a high number of patients with low cost and fast service rather than a small number of patients with high quality and slow service, and newly the Bahraini brand of solar panels installations that provide a continues energy/Electricity with a one-time payment [1].

Thus, to remain inside the competition of the dynamic changes in the economy and the business environment, the firms might take a back step and start thinking about developing and investing more in Frugal innovation based on the learning experience gained from the emerging markets and countries. Recently, the emergence of digitalization and innovation processes have been the first target for firms and business models. Innovation refers to the procedures of firms and people to produce new products, ideas and services in a conceptualized and modern way and some cases as a solution for faced problems or a market need. It's usually a planned process to achieve the advantages of growth and development that is leading to maximising the firm performance and satisfaction besides facing the challenges of business organizations and environments and recently the economic crisis posts COVID-19 era, in compensation with paying attention to the Frugal innovation and IoT concept (Internet of Things).

Considering the research talked about the areas and different aspects of Frugal innovation in developed countries, motivated by the resources availability of population, knowledge and local innovation during the economic crisis, this research is investigating the use of resources available in the Kingdom of Bahrain, the success factors of the digital transformation in the government and private sectors and the outcome of the Frugal innovation Implementation between local brands. A systematic

literature review with a comprehensive review of the Frugal innovation from different countries is provided. However, the research will be conducted among the private sector and the local brands innovated during the crisis by investigating the outcomes of 50 Bahraini brands adopted by SMEs society to support their business digital transformation. Despite the pressure from the governments to implement and face the offer of producing more value and lower price products and services through the traditional digital channels available globally and the digital transformation process, the research and studies are not concerned about the public sector.

## MATERIALS AND METHODS

### Data and methods

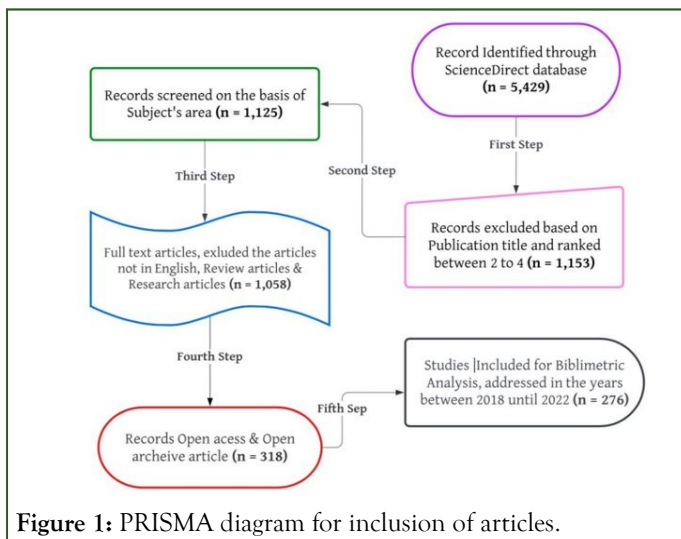
The coronavirus crisis has caused a wide change in the disruption of human lives across countries, but humanity started new implementations and investigations to take Frugal innovation as a tool to take over the crisis and gaps introduced in the market. In this research, we conducted this review of a bulk of studies to embrace Frugal innovation and its role in the creation and augmentation of the infrastructure of countries in the most important areas of health, education, trade and industry. The research articles in the past twenty years have been less recognized and less focused on addressing the Frugal innovation use and implementation during the global pandemics.

Governments worldwide have been adopting and utilizing different types of Frugal innovation to combat pandemics through the introduction of relevant technology and IT solutions, enhancement of medical infrastructure by focusing on frugal health innovation for medicines and vaccination introduction and a large number of additional types of policy interventions in different aspects. In this research, we used bibliometric analysis to analyze the current state of the subject matter of digital transformation and Frugal innovation to build a research-driven policy agenda for IT solutions adoption, followed by a manual review of each sample article. In the research methods, we have used an advanced search in Science Direct by using keywords related to IT solutions, digital transformation and Frugal innovation.

The chosen database is widely acknowledged as it provides the most extensive overview of the world's research output in the field of Frugal innovation and the streams of digital transformation, technology, social science and innovation. The database is equipped with numerous functions that facilitate bibliometric analysis, which include the journal title, number of citations, type of document, authors, as well as authors' affiliations, year of publication, and h-index metrics. In sum, the databases contain hundreds of thousands of journal titles and the wide features are covering the facilitates faster by viewing orphaned and errant records in different aspects.

We filter the papers to retain only the journal articles in English related to the fields of “Frugal innovation” AND “IT Solutions OR Digital Transformation” AND “SMEs” which leaves us with 5,429 papers (Figure 1). These 318 papers are categorized on

account of the ABS list and we review the papers published in ABS 2 and above-ranked journals, bringing the number of finally selected papers to 276. During the literature review building, we use the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines for conducting and reporting research articles as shown in Figure 1. While performing an integrative review, the PRISMA flow diagram helps in demonstrating the various search efforts that are carried out throughout the review's lifetime and the choices made during the inclusion and exclusion of the articles to be selected for the review.



As suggested in some articles, the use of quantitative approaches (such as bibliometric analysis and citation analysis) to bibliometric data (units of publications and citations) is referred to as bibliometrics. Bibliometric analysis as per recognized is a rigorous and thorough method for discovering and analyzing large volumes of scientific data. The analysis allowed for unpacking the evolutionary subtleties of a particular discipline while also offering more professional insights into the budding field of the research area. However, it is used usually in business research and is still very young in many cases to under develop the analysis. Our bibliometric analysis helps uncover the trends of research papers oriented toward digital transformation and frugal innovation through the use of the Bibliometrix R-tool [2].

### Frugal innovation and technology innovation

According to a study addressed by Mundim et al. talking about the IT industry that with the digital transformation and development in the last twenty years, they are relatively keeping always a new, renewable solutions to face rapid lifestyle changes, therefore the IT industry tends to have fewer problems in related to the legacy of the innovation process and developed systems and keep the sector as number one in innovation from different perspectives. As a result of continuous innovation in IT solutions, they can supply customers with updated solutions promptly at reasonable prices. According to a report issued by the Center of Information Systems Research in Cambridge, companies in third-world countries are currently spending a large percentage of their input to catch the digitalization and development in the developed countries, although they are faster to penetrate the market with the new offers and perform

better outcomes, but still the effort of the expense that the customer must take into consideration is high for most of the population in these countries.

Moreover, the report approved that the firms developed in a mixed economies approach (Innovation and Frugal innovation) are faster in adopting the latest and newest technologies, besides having the skills of better performance and an advantage in financial reports and terms of IT adoption solutions. For these reasons the studies focused on the IT solutions enabling factors on Frugal innovation, resulting in a better understanding of the IT solutions developed in the economic countries. Firstly, we should distinguish the IT sector by looking into Frugal innovation, they defined it as a reverse Innovation of existing solutions, which is adapted to be used in emerging or third world countries before taking it recently into the rich countries during the economic crisis. Another study describes it as the inclusive innovation that uses the process of knowledge creation to absorb and give the effort to support emerging economic countries in digitalization.

For the seek of investigating the role of IT in enabling Frugal innovation, previous studies spoke about IT capabilities in terms of supporting the Frugal innovation process, unfortunately, the lack of literature reviews that are talking about the supporting systems for the innovation and the availability of tending to focus on policies, governmental support and other activities that are fostering the innovation only cause a gap in studying the IT inability and effect on the Frugal innovation. Furthermore, there is evidence that firms in emerging countries are exceeding the long-term development of IT solutions and investment costs, by adopting short-term Frugal IT development to accelerate their innovation capabilities.

More studies suggested that the flexibility of adapting IT systems and solutions, enhances the light assets of IT and in relation increase Frugal innovation and firm performance productivity. Taking into consideration the development of IT solutions, we should be able to keep the Frugal innovation companies in the competitive wave, by ensuring that the investment of the solution will not affect the cost efficiency, the output and the capability of the firm in innovation. A study addressed the relationship between IT and the role in enabling Frugal innovation by using absorptive capacity (ACAP) theory, they argue that Frugal innovation in firms must require a knowledge base to learn the basic concepts of innovation by using the internal and external dynamics and resources to fit the theory of having this type of innovation. Moreover, by measuring the capability of IT solutions they concluded that IT development in economic countries can support the innovation process, besides the frugality of it, since the limitation of sources and unavailability of the basic concepts and efforts of the knowledge base for the population, led the firms globally to compete for each other in providing the cheapest valuable IT solutions for the third world countries and be part of the Innovation system [3].

### Frugal innovation and Internet of Things (IoT)

Frugal innovation is explained as a systematic mechanism that enables the firm, organization or country to serve the customers

who are not able to afford the high cost of innovative solutions and products, in a way of providing a low-cost product with similar values. Recent studies addressed that the IoT is described as a roadmap to improve the process and implementation of Innovation. The IoT is defined as an internally reconnected device by using a network of software or the Internet inside a specific region, the process of knowledge exchange is providing communications and ideas loops about the different types of advanced knowledge and business models that involve the Frugal innovation. Particularly, in the area of digital transformation, the firm capability and availability to receive the information data is playing an important role in developing services and innovative ways with the best values and lower costs.

The concept of Frugal innovation brought ways of changing business operations, by moving small and medium firms from traditional ways into more digitalized innovations with affordable prices, especially for the firms the operational services in it are affected directly by digital technology and transformation including the IoT in the loop of the mechanism. The transformation means complete changes in the strategy, which is resulting from a large decision to convert and remove the traditional way of operation, keeping the firm as part of the market. An example of IoT adoption and one of the Frugal innovation implementations in developing countries is the industry 4.0 revolution, where the researchers focused on innovating the business by using the IoT and technology solutions from the existing available assets rather than completely exchanging and costing the firms' operation's system.

The IoT technique is a way of enabling organizations to communicate through different channels and local networks around the world, benefiting from the technology advancement and exchanging innovational knowledge at the cheapest prices. In slow-growing firms and small assets capitalizations, the business environments usually refer to the use of Frugal innovation to survive and keep the sustainability inside the firm. Based on research that studies different aspects of digitalization and its effect on the Frugal innovation development in the firms, they found from results that the relationship between the IoT and Frugal innovation is positively affected from both sides, which causes an increase in the innovation with more development and high investments of the IoT. Due to the advancement of Frugal technology, a large number of firms reported changes in the traditional ways of operations and shifted to digital transformation processes with lower costs.

### Frugal innovation and digital platforms

Digital platforms are introduced as companies are usually adapting in the process of growing the business and changing the model, by activating digital services in a wider area, clear examples have been noticed during the coronavirus pandemic, where most of the companies and business converted into the digital platform to communicate with the customers during the peak of the social distance and yet the organizations and governments are developing the technology for the post-COVID era. The use of IoT has been related to the digital platforms' implementations such as live meetings and social networks'

different services for sharing information and questioning the customer's feedback and related inquiries.

Offering new opportunities, communicating the devices and globally sharing information and knowledge are all linked with the use of IoT through the digital platforms adoption as part of the low-cost innovation for developing small and medium firms by linking all these data in a simple link, allowing the exchange, knowledge and innovation sharing. The growth of IoT applications extended to include small smart devices that can share information by sending out data through the internet. The most used application in the IoT inside the firms was the exchange of data and information knowledge and the innovation with other firms, this practice supported the open innovation that lead to the Frugal innovation for the small companies that are not able to afford the research and laboratory income.

Moreover, in applications used in the IoT, customers are welcome to leave their comments and feedback through digital platforms, where the employees can analyse the data and share the comments internally. Therefore the systematic literature review is trying to link the positive relationship between Frugal innovation and the use of digital platforms that are required for global connections and online identifications between populations. The platforms are usually consisting of users, data of things and customers who are adding and creating content as part of electronic business transactions and development. In a study conducted to measure the relationship between digital platforms, the internet of things and Frugal innovation, they concluded that the internet of things is directly affecting Frugal innovation in a positive relationship, on the other hand, the relationship between digital platforms and Frugal innovation was not approved and needed further investigations in this field, although the positive relationship between IoT and two other variables can be taken into consideration as a mediator for the relationship between Frugal innovation and digital platforms.

Another study, addressed the relationship between Frugal innovation and digital platforms as the capability to achieve the firms' objectives and targets by using innovation, so the digital platform in this relationship was described as a moderator that fastens the process of developing the organizations by using the Frugal innovation and with the appearance and availability of the digital platforms. Digital platforms are supporting Frugal innovation inside and outside the organization with different types of services, product processing and data exchange. Digital platforms offer a multi of communications and sharing information with other firms locally and globally that maybe will include competitors, consumers, suppliers, investors and business partners. The applications of digital platforms allowed the firms to increase and enhance their performance of the firms concerning Frugal innovation collaboration.

In dynamic business environments, digital platforms are playing a significant role in business performance and success, by building a relationship between the supplier and consumer on an online platform. By gathering the involved parties in the relationship altogether in an online platform they are creating a huge effort and changes in the market in combination with and adoption of the Frugal innovation technology. Through



collaborations in the domains, the firms can bring new services and products by adopting the ideas and exchanging with other organizations, clear implementation of the Frugal innovation technology was seen during the coronavirus pandemic, when the countries and organizations inside started the information and data exchange to support a different field of the community, including the learning distance platforms, the e-shops, working from home techniques and online meeting and conferences.

### Frugal innovation and digital transformation/digital technologies

By initially associating the resources in private sectors globally in the process of developing the countries, the firms started looking after the researchers and practitioners that are involved in the development and innovation with low cost in the developed countries where they gave the rise to introduce the Frugal innovation in the developed countries. The digital transformation appearance is related to Frugal innovation started to be part of the innovation process around the world, especially during the economic crisis.

It is explained as a resource solution from different types of services, products, business models and innovation process that is created to achieve specific goals that suit the market needs, despite the technology they are using during the creation process, the technology, the digital transformation steps other materials used the outcome measure significantly is cheaper than the other available resources at the same time keeping the value and quality in an acceptable range to meet the consumers' expectations. Digital transformation is related to Frugal innovation in the public and private sectors have become one of the main targets of governments digitalization research and goals, especially in the Kingdom of Bahrain 2030 vision have been describing the digitalization of different aspects as the main goal of the upcoming years, to catch up the digital innovation around the world. Despite that most of the focus was on governmental services such as taxation and social and medical insurance. Based on European Commission, the consideration of public values can be implemented and developed by using the digital transformation for simply provided services by using the Frugal innovation digital transformation ways before proceeding into more complex and lengthy procedures that are usually taking time and costly, which significantly can result in an improvement and eliminating the routine tasks, by reducing the errors of applying the complete system in one. Furthermore, as mentioned previously, in most countries and due to the economical and Coronavirus pandemic the governments are not affording the cost of high implementations of digital transformation, rather than they prefer to go into the procedures of low-cost implementation and adoption of Frugal innovation.

A study was conducted to measure the relationship between digital transformation with the Frugal innovation efficiency, by measuring the consumers that used public sector services satisfaction, during the study they used both quantitative and qualitative methods to measure the aspects, the qualitative part was conducted 22 interviews with citizens that prefer to use the traditional physical services rather than the digitalized to

understand the barriers that prevent this group of citizens of using the new digitalized services. The second part of the data collection consisted of questionnaires, based on the diffusion of innovation theory dimension concerning the participant's experience in using the digital service and the frequency of using these services range before and after the implementation of digital transformation changes. Moreover, questions were focusing on different aspects of general consumer satisfaction, intention to use the services again in the future, complexity and compatibility and level of trust that is associated with data privacy and information security when using these services.

The results of the study showed some interesting barriers to be discussed, as the interviews show disappointed agreed opinions concerning the digital transformation poor awareness and how to use the services themselves not the matter of accepting the services, moreover for the qualitative data gathered by the distribution of the questionnaires, the results showed that users tend to have some concerns regarding the digital services newly introduced in the banking sector, and the level of security and risks might be taken when converting from the traditional methods of banking. Moreover, they agreed on the benefice of using technology and digitalization in the country's development although they prefer to use conventional services rather than, easy use and physical interaction. All over, the study could link the significance of using the digital transformation innovated by Frugal innovation on the overall performance of the government-proposed services, although a group of people tend not to use it, the majority approved the changes and positive effect [4].

### Frugal innovation and ICT

Recently, small and medium businesses have increasingly taken a place in demanding information and technology innovation to operate daily procedures. Concerning the use of low-cost available technologies, the researchers linked the value of Frugal innovation to the implementation procedures of the market needs and customizing the information and data in a way that will save the data knowledge management and will be less costly to the startup and small business. In Latin America, they reported the lack of technology and development in the companies, however, in the last 10 days, the governments and private sectors started the adoption of Frugal innovation technologies with lower baggage and affected information communications and technologies, the activity of adopting such an implementation and concept in the market, cause an increase in the overall countries economics and social welfare among the population.

Recent research approved the demand for ICT in the evaluation and developing of Frugal innovation in different aspects and causing customer satisfaction. The ICT concept refers to the information and communication technologies used as a key strategy in the implementation of Frugal innovations in the firms, affecting the overall companies' performance and consumers' satisfaction rates. Today, the Frugal innovation concept is taking a greater opportunity in the investigations sector, researchers and interest by the business models, focusing on explaining the problems that the firms are facing with the

economic crisis and lack of resources for the opportunities of development and innovation.

The Frugal innovation of ICT has been offering valuable services to firms and governments the reeducation of waste and costs will produce the generating of new ideas and fill the gaps in the market need. Since the literature reviews were studying the effective approaches and themes to be considered when reviewing and creating the products and services under the effect of Frugal innovation, the capacity of using a better practice for this type of innovation is still unclear. A study conducted to fill the gap in the relationship between ICT and Frugal innovation found a positive and significant way of approach to both variables.

First, they studied the relationship between ICT and small and medium business performance and development. Secondly, they shortlisted the companies with good performance and re-studied the effect of Frugal innovation on the development inside the organizations besides the customer's satisfaction with the mediating effect of small and medium business opportunities in the market. The results agreed on the positive relationship established between ICT and Frugal innovation in small-size firms and suggested further investigations and studies in the same field on other aspects of the firms with different sizes. The ICT is beneficiary to the industry in increasing and the adaptation of facilities management of information toward the ICT systems is specifically needed in the organizations. Digital transformation and innovation in the global markets require the firms to be updated and communicated to keep the productivity level at the same target as the other countries and for a more strategic level of decisions making.

### Frugal innovation and other factors

**Social innovation (Sustainability and development):** Global phenomena that we are facing every several years, such as climate change, the health crisis of Coronavirus and the economical crisis, have been pushing the policymaker, decision makers, governments, societies and the United Nations to take a step in developing the agenda and implementation of changes in the sustainable development, keeping in mind the growing number of population and their needs. The overcome of the crisis and changeable global issues, have made the companies in a position to keep their strategies advanced and developed to achieve the sustainability and development required to support the governments that could not be standing alone. For the economic, social and environmental recent issues, the governments found themselves standing in a competition to save the consumers, customers, regulators and society itself and keep them in the innovation competition.

Representing more challenges to the supported firms, the SMEs were focusing on the concept of sustainability and concerned about Frugal innovation use which is giving them a more significant position facing the challenges with their limited resources and capabilities. Therefore, the Frugal innovation relationship with the firms and societies' sustainability have been playing an essential role in developing them and supporting the low-cost, easy to use and available limited resources to be converted into a new innovative mode of

products and services. Furthermore, in recent studies, they suggested that companies that are looking for sustainability and development should use the path of Frugal innovation in their innovation and fill the market's gaps. More studies concluded that Frugal innovation can be a tool in companies' generation of sustainability performance and positive impact, and to develop and implement new models of business that will lead to a positive impact on society, the environment and the country.

**Diagnostic capabilities and dynamic capabilities:** The strategic planning and controlling the financial input inside the firm is known as cost management in the operating business and since the Frugal innovation approach is the concept of reducing the cost and resources used to approach new products, services and operation ways in a lower cost that can be affordable by everybody, especially for the economic countries that required a higher level of development in capitals used and technologies to catch up the technology revolution of the twenty-one century. The COVID-19 crisis, has been classified as one of the worst pandemics in global occur for humanity in the century. It affected directly the high rates numbers of morbidity and mortality among the population of the world and the countries and governments were underestimating the financial cost and resources needed to face this crisis, which cost economic sequences and increased the unemployment rates and hunger in the third world countries.

Besides the previously mentioned causes, the governments were trying to survive by reducing the cost of resources and capital they are using to keep the welfare lives of their populations besides saving the resources for the recovery plans. As a result, global firms and organizations started the introduction and implementation of Frugal innovation procedures and started to increase the acceleration rate in support of the diagnostic and dynamic capabilities. Considering the important parts of economic support and sources of increasing the rates of employment, the governments started the concertation toward the small and medium-sized enterprises development as part of the country's source of income and economic growth. Consequently, during the pandemic and due to the lockdowns, the SMEs faced issues in exchanging the sources and raw materials to continue the production of products and the communication and consultation channels for the development of the service and started the point of converting and introducing the Frugal innovation and supporting the local production, to improve the development and reducing the costs.

Dynamic capabilities are one of the government resources that are used as strategical during the crisis to achieve sustainable performance. During the limitation of purchasing powers, lack of services support and high competitiveness, the dynamic and diagnostic capabilities set were the focus for the organizations targeting the available opportunities and detecting the market changes and competitors' development. A study conducted by (Jiraphanumes, Aujirapongpan and Songkajorn) studies the relationship between the diagnostic capabilities and dynamic capabilities affects both Frugal innovation usage and implementation in organizations and found that both variables are positively effecting Frugal innovation and can be considered

part of the factors that accelerate and enhance the practice of Frugal innovation [5].

**Entrepreneurial orientation:** In combination with the basic resources and attention toward innovation development, proactivity and risk-taking, the studies showed a positive impact on the availability of it in the entrepreneurial capacity and ability for more business opportunities. Moreover, from an entrepreneurial perspective and side of view usually, organizations and governments or in some cases individuals are supporting the elements that can show predict the future and act on it. Acting to achieve the highest levels of future development by creating routines or new ways to adapt to the environment is the most affected business development step in different types of firms.

Hossain mentions in one of his studies related to Frugal innovation that when there is greater difficulty in achieving objectives, the entrepreneurial vision uses its resources by developing Frugal solutions of innovation to face risk despite adversity based on intuition and tenacity for being present in limited conditions. On the other hand, another study talked about the same matter inside the organizations and points out that the willingness to create efficient and accessible products is related to an innovation that is driven by opportunity gaps found in the market or due to crisis as shown in the last 3 years and not a necessity or a need of fancy products, leading entrepreneurial actions through an outside the box position and due to the study conceptual model, the results showed that the entrepreneurial orientation is effecting the Frugal innovation on a positive significant effect and supporting the positive changes inside the organization.

More studies talked about the mediation role of entrepreneurial orientation on the relationship between IT solutions adoption and Frugal innovation implementation, several studies have identified entrepreneurial orientation as a key element to take advantage of business opportunities. In these related studies, entrepreneurial orientation has been studied as a mediating variable in previous literature to encourage orienting the efforts and effectiveness of using it inside an organization toward an innovative, proactive and risky stance to face new challenges, the crisis and identify and fill the market's gaps. In conclusion, the study found that entrepreneurial orientation positively and effectively affecting the relationship built between the use of technology and IT solutions concerning Frugal innovation implementation and development [6].

### Innovation during crisis

The pandemic coronavirus in the last three years, the crisis causes a significant impact on global health and economic development, besides organizations and firms' innovation. As part of the direct influence on health innovation and the individual and social welfare health, the studies linked the relationship with a direct impact also on the economic and political institutions. The governments classified the last coronavirus pandemic as the worst global economy since the great depression and measure the loss in humans and assets with unbelievable numbers and rates. At the time of restrictions, social distancing regulations and resources availabilities

limitations, the firms required redoubling efforts to conceptualize, create and implement new ideas inside the organizations to develop the goods and services with an innovative mindset that supports the gaps filled in the market.

On the other hand, the pandemic also provided more opportunities and development goals for future growth and firms' innovation and took the opportunity to develop new plans and strategies to face similar crises in the future. The innovation fields of health, pharmaceutical, energy, artificial intelligence and technology were mostly focused on during the planning and development and considered critical to overcoming such roadblocks of market needs. Technical advancement and digital innovations are growing with traction as a global phenomenon, in different fields of work, social life, living, education and recreation of solutions. A study found that due to the use of technology during the crisis, digital innovation plays a significant role in developing the global economy and supporting the firm's development and recovery, whereas the other study agreed that the technology acceleration is supporting the innovation of ideas and data and enabling the economic progress [7].

Moreover, Governments are more looking toward investment boosting in innovation in response to the COVID-19 pandemic, to assist and support the humankind health, social life and other life aspects in navigating the crisis by raising scientific output reports with live evidence and experimentations, extending research and development centres to support the firms and governments and filling patents in a step of encouraging the innovation. Wang, Zhang and Verousis examine the effect of the duration of the pandemic on Frugal innovation output and suggested that policies directing the innovative process and procedures firms are on the right path and their recovery time is reduced, besides the cost-effective reduction. A study addressed the Business Model Innovation (BMI) can assist SMEs in remaining competitive the firms during crises while focusing on revenue creation and value addition concerning the recovery process [8].

The use of open innovation activities by opening the channels for interaction with consumers and open for more exchange of knowledge with other firms and consumers about market demands and technological possibilities can play an advantageous role in minimizing the impact of COVID-19 on different aspects and sectors including the education and health. Moreover, several organizations have restructured their innovation team and allowed more development and involvement in manufacturing services to assist the health and associated services to meet the products and services supply shortages during emergencies such as COVID-19. The implementation of Frugal innovation plans is recorded as accomplished the most effectively through the use of a dynamic capabilities viewpoint and centring the innovation on meeting the consumers' and decision makers' expectations rather than chasing for random profit and competitive advantage in a crisis scenario. In the future, it's expected that the Frugal innovation gaps will be obvious and noticeable across diverse firms that could not be implemented during the crisis. Thus, the innovation ecosystems need to be more focused and improved

to build a healthier relationship across the sectors in association with the help of investments in new technology innovation and business strategy building [9].

### Local implementation for Frugal innovation and digital transformation-Hrain's case study

The coronavirus crisis seems to take into consideration as part of the digital transformation expansion system, although the studies talked about the advantages of using digital transformation in SMEs during and after the pandemic, other scenarios were taking customer satisfaction after implementing and the economic crisis with the need of low-cost innovation as this type of transformation to expand in exploring and implementing or to stop and re-think of new solutions using the Frugal innovation concept. The variables gaps shown in the framework are part of other modules adopted in the research and talked adopt the effect of firm's development, digital transformation and enabling the role of IT in supporting Frugal innovation in the economic countries and to be considered for adoption in the developing countries after and during the crisis.

In more detail, few studies address the relationship between digital transformation and the adoption of Frugal innovation in SMEs and did not find any research related to the Kingdom of Bahrain. The gap was to monitor SMEs' development and use of digital transformation for more Frugal innovation taking into consideration the coronavirus pandemic and justify the relationship in the 50 SMEs that are starting the digital transformation within the next two months. Transformation of the technologies by using the concept of Frugal innovation digital transformation in SMEs has been taking place the recent 3 years after the first registered case of coronavirus in China. Indeed, taking into consideration the advantages of low costs and time-saving for this kind of Frugal innovation we have to do more researches to consider it as part of the policies and procedures being implemented in different sectors during and after the crisis [10].

A recent study indicated that digital transformation can be used in certain firms by Frugal innovation that will reduce the invested money, time-consuming and releases stress for business developer, by communicating with further expertise around the world and supporting more innovation techniques. In general, the most recent studies focused on consumers satisfaction as the most important factor to be taken into consideration before deciding the proceeding with the Frugal innovation implementation and the key indicator is the quality of products and services provided by measuring the cost effect and the repetition with other competitors, countries or organizations [11].

This indicates that the lower cost effect, more consumers to serve and better service quality using advanced technologies and innovated solutions, the higher will dependent on digital transformation and Frugal innovation in SMEs and more research to be conducted. Moreover, consumer satisfaction as a result of the digital transformation and Frugal innovation, besides the attitude of modern firms that are innovating the operations concepts and being more technologized can

influence consumer satisfaction positively. In conclusion, the purpose of this study is to test the hypothesis as per the build framework model and justify the relationship between the variables and its effect on the use of Frugal innovation, especially during the pandemic situation where firms, organizations and governments were forced to convert to more technologized solutions and reduce the operation costs.

### Hypotheses development

The studies related to business sustainability relation to innovation in SMEs is one of the most trendy topics recently, the researchers showed a related performance. Some studies showed that sustainability performance is related to a better economic and financial situation. As an enabler for more development in the firms, Frugal innovation, which is focusing on more development with lower costs and acceptable quality and value of products and services as part of the innovation process in SMEs, is in a positive relationship with sustainability. By developing Frugal innovation, they are considering the scarcity of resources that seeks to reduce the environmental impact by using low-cost friendly technologies. Empirical studies found evidence of a positive relationship between the sustainability effect using Frugal innovation. Considering the previous discussion of related studies, we developed the following hypothesis to confirm the relationship in Bahrain's market [12].

**H1: Sustainability and development has a positive effect on Frugal innovation:** To enhance the understanding of the Frugal innovation concept and its use concerning technology innovation, a study talked about the learning enables of producing new products using Frugal innovation and the relationship of having a new technology on increasing the rates of innovation inside the firms, concluding that the firms that are having advance technology solutions tend to have more innovative products and services, besides operation the innovation in different aspects of the operation mechanism. Technology innovation tends to be more widely disturbed recently with the advance of the economic and coronavirus crisis that pushed organizations, firms and governments to use technology and IT solutions to find more productive Frugal innovations. The above arguments lead to the following propositions.

**H2: Technology innovation has a positive effect on Frugal innovation:** The internet of things system is consist of the collection of data being received and transferred through a wireless internet connection without human interference, this will lead to more knowledge management and Innovation opportunities. On other hand, the transformation of data between firms and governments are supporting Frugal innovation by saving the cost of searching, testing and building a new concept by taking the product or service in a ready approach and starting implementing it with low cost. Another study approved that the IoT allows for more Frugal innovation development and allows companies for more development and applications from other companies experiences to solve their issues and face challenges. Based on the above discussion, we



developed a hypothesis that is testing the relationship as follows [13].

**H3a: IoT has a positive effect on Frugal innovation:** Digital platforms are referred to as a set of commercial networks recently established and adopted by most firms and organizations to activate digital services. The IoT implementation and use have increased the productivity and connectivity of different knowledge management for more information sharing to a great extent and innovation process. The development and adoption of technology increase information sharing and enhance the number of machines and tools the firms are using for Frugal innovation. The IoT's broad use and dimensions impact the social sustainability of growth and digital use economy and adoption. Digital platforms recently are considered the most used application of IoT solutions that help firms in developing Frugal innovation. Customers have been capturing the value of using digital platforms as per agreed in a study, that addressed the positive relationship between IoT use and the application of the digital platform in SMEs [14].

**H3b: IoT has a positive effect on digital platforms:** These days, after the global crisis of coronavirus, governments around the world start the calls to convert their countries to digital technologies by using Frugal innovation. The digital platforms affected a positive relationship in supporting Frugal innovation with data allocation and transformation with different parties of competitors, consumers and business partners. The firms started to link the communication channels between the business and consumers through digital platforms for increasing and enhancing the Frugal innovation implementations that play an important and significant role in the success of businesses and organizations in any dynamic environment. A study talked about the efficiency of improving the markets and increasing the economy by using digital platforms that are built by using Frugal innovation in the economic countries. Based on the negotiation of the relationship between digital platforms and Frugal innovation, we built the following hypothesis [15].

**H4: Digital platforms has a positive effect on Frugal innovation:** An organization with strong capability is efficient in creating and developing an innovative solution. Dynamic capabilities are the concept of transforming knowledge and information into a production process by using innovation. Usually, the organizations' sustainability development is built based on the integration of resources and the combination of data and information. The use of capability is allowing the firms to scan the most recent technologies in the market and convert them into a business opportunities, it is working as part of the organization innovation rotor that accelerates the procedures of Frugal innovation. As approved in a recent study, the dynamic capability is positively effecting Frugal innovation and supports the firms' development. By combining existing the previous studies, we proposed the following hypothesis.

**H5: Dynamic capabilities has a positive effect on Frugal innovation:** Usually, the development of Frugal innovation is starting with the implementation of customer information and feedback collection, the necessary products features are later to others and producing new solutions and products by using

Frugal innovation, therefore the good relationship with the consumers and knowledge management is a key factor in producing and innovating the trust and new production's lines, that is affecting the environment by improving a more economical and flexible direction of innovation. The diagnostic capabilities are enhancing productivity and the use of Frugal innovation as per a study that found a positive relationship between the two variables and as described above, this research proposes the following hypothesis [16].

**H6a: Diagnostic capabilities has positive effect on Frugal innovation:** Since business analytics involves the development and use of data and information from different business processes and steps that are accumulated in different stages, by integrating the capabilities of consumers and firms and using the technologies to make decisions about new solutions, products or opportunities by using the Frugal innovation. As a result of organizational diagnostic capabilities transforming the data and information into knowledge and insights or dynamic capabilities is a way of the development process that is used in firms these days; concerning the approaches of capabilities, firms can better use and implement the business opportunities into productivity. Also facilitates understanding of the solutions and decision-making about any expectation of Frugal innovation investments and future projects, diagnostic capabilities enhance the use of dynamic capabilities by activating the positive relationship between the two variables. A study attempts to explain the importance of using and adopting diagnostic capabilities to support organizational development and dynamic capabilities has approved the positive impact and relationship between both. Based on the previously mentioned discussion and adopted research, this research is proposing the following hypothesis [17].

**H6b: Diagnostic capabilities has positive effect on dynamic capabilities** (Figure 2).

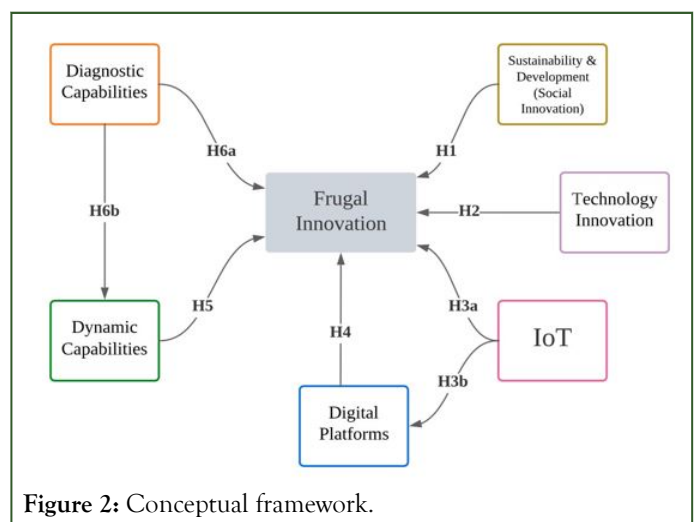


Figure 2: Conceptual framework.

## RESULTS AND DISCUSSION

### Study search and selection

After defining the research gaps and hypothesis, we initiated a citation index of the web of Science Direct database with the

keywords “Frugal innovation” AND “IT solutions OR digital transformation” AND “SMEs” in different fields of studies, restricting the language to English and the document to articles where we generated 276 results. To ensure that our review did not exclude relevant articles, the research was further complemented and cross-checked in google scholar searches. Since we are using a meta-synthesis method to conduct the research and it needs to incorporate a broader range of research, yet a still manageable set of studies, the initial sample found in the research engine was then screened according to inclusion and exclusion criteria of specific data needed to be available and the open access. The first criterion regards a quality appraisal-articles were included if published in journals ranked between 2 as a minimum standard and 4 or indexed in the journals that are cited and reported in known journals. Secondly, we excluded

the non-interested areas of research that are more toward economics and finance and also the case studies with experimental analysis. The remaining articles were then categorized as quantitative, qualitative or mixed methods studies (systematic literature review). Finally, articles were excluded according to the publication year, since we are talking about the innovation field and looking for the latest technology and development. The data selection process is summarized in Figure 2. After applying these criteria, we ended up with 276 studies talking about different factors related to Frugal innovation and a total of 15 studies were analyzed in more detail (Table 1) [18].

**Table 1:** Journals analysis talking about Frugal innovation over 2020-2022.

S. no	Author(s)	Year	Journal	Country	Research methodology	Independent variable	Dependent variable	Mediator/moderator
1	A. Nassani, et al.	2022	MDPI	Saudi Arabia	Quantitative-questionnaires	Internet of Things (IoT), digital platforms	Frugal innovation	Digital platforms, organizational readiness
2	Loukadounou, Koutsona and Loukis	2020	Springer Link	Greece	Qualitative-22 interviews	Customer's satisfaction, intention in future use, complexity, compatibility	Frugal innovation	
3	Hossain	2021	Elsevier Ltd	India	Mixed methods-observations and 8 interviews	Frugal innovation	Value proposition, value creation, value capture	
4	Vargasa, Camarenab and Espinoza	2022	Elsevier B.V.	Mexican	Mixed methods-predictive type, non-experimental, cross-sectional design and questionnaires	Frugal innovation	Sustainability performance	
5	Jiraphanumes, Aujirapongpan and Songkajorn	2022	Asia Pacific Management, Elsevier B.V	Thailand	Quantitative-questionnaires	Diagnostic capabilities, dynamic capabilities	Dynamic capabilities, Frugal innovation	
6	Vargasa and Montoya	2022	The 8 <sup>th</sup> International Conference on Information Technology and Conference on Information	Mexican	Quantitative-200 questionnaires	Information Communication Technologies (ICT), Entrepreneurial orientation	Entrepreneurial Frugal innovation	

			Technology and Quantitative Management, Elsevier B.V					
7	Clarysse, Fang and Tucci	2022	Elsevier Ltd		Systematic literature review	Internet of Things (IoT)		
8	Hossain	2021	Elsevier Ltd		Systematic literature review			
9	Vargasa, Camarenab and Escobedo	2022	The 8 <sup>th</sup> International Conference on Information Technology and Quantitative Management, Elsevier B.V	Mexican	Quantitative-cross-sectional design	Information Communication Technologies (ICT), Frugal innovation	Frugal innovation, customer satisfaction	Frugal innovation
10	Sarkar and Mateus	2022	Elsevier Ltd		Systematic Literature Review			
11	Winkler, Ulz, Knöbl and Lercher	2020	Elsevier Ltd		Systematic literature review-3 case study analyzing			
12	Sarkar and Mateus	2022	Elsevier Ltd		Systematic literature review-3 case study analyzing comprising 95 F1 cases			
13	Kaur, et al.	2020	Elsevier Ltd	United Statues	Mixed methods- observation and database analysis			
14	Sharma, Kraus, Srivastava, Chopra and Kallmuenzer	2022	Elsevier España, S.L.U. on behalf of Journal of Innovation and Knowledge		Systematic literature review evaluation of 218 studies			
15	Ploeg, Knoben and Vermeulen	2022	Elsevier B.V	Countries	Systematic literature review analysis of a firm-level dataset	Conformism, cushion effect, pay it forward and embeddedness	Frugal innovation activity	

---

 covering  
31,860 firms
 

---

## Data analysis

The study started by reading the full-text articles and highlighting the general details such as the method typically used in the study, research questions and/or objectives, hypothesis and conceptual model used, methodology of the sample, the country, key results and findings, limitations and lastly, the future contributions. All details have been added to the build excel sheet and numbered the articles by serial numbers for easier search in the information. An inductive coding strategy was used to mark the most important breaking details and categorise the results and data. The analysis was specifically focusing on the variables and factors studied by the researchers and found a positive impact on it Frugal innovation and more deeply toward the Frugal innovation used in SMEs. Moreover, in the next step, we focused on the articles talking about technology adoption and IT solutions and the impact on Frugal innovation in the firms. This strategy allowed us to extract and remove the uncertain or unwanted relevant data and aim to answer our research question directly and contribute to defining Frugal innovation affected dimensions. After the analysis of each study, the process of crossing the cases analyzed data and comparing the analysis was performed. The comparison process of each study paper allows for more identification of common themes and studied factors.

In the previous sections of this study, we have been describing and evaluating the factors that are affecting Frugal innovation and IT solutions in general or more specifically digital transformation. The study has been based on multi of previous published papers and case studies conducted in different countries that are showing clearly the implementation of Frugal innovation in their SMEs. Furthermore, these firms are using different types of IT solutions and technology adoption that are hosted inside their organizations and firms with the use of digital transformation process during and after the coronavirus pandemic, the use of Frugal innovation resulted in a high quality of services and products that are manufactured and produced from local supplements and with the association of low-cost operations and maintenance. The first evaluation of these services found that they introduced a good solution and a necessary characteristic to survive during the crisis. The concept of wide diffusion that is used during the implementation of Frugal innovation according to the DOI consists of shown advantages, low complexity of production and compatibility, besides the use of available products. The use of digital transformation as an accelerator for Frugal innovation also has revealed the high level of technology innovation procedures trust among the firms and consumers toward these new services.

Our study has significant implications for research and practice in the different aspects and areas of Frugal digital innovation in SMEs, especially the Frugal digital transformation newly implemented program in the Kingdom of Bahrain by government services and agencies. The overall studies agreed on

that reveals that the importance of trust should be taken into consideration when studying to implement the new Frugal digital innovation and for the adoption of such innovations, indicating that adopting this type of innovation sometimes has to be extended with trust-related dimensions from all aspects of consumers, governments and the firm's internal people and this is quite useful for future relevant research. Furthermore, our study creates some new practically useful knowledge in the above areas and factors related to the Frugal innovation affected factors, filling existing gaps and revealing a generally applicable model by studying the low cost of Frugal innovation associated with the digital transformations in the SMEs in Bahrain.

## CONCLUSION

By investigating the relationship between IT solutions and Frugal innovation. In particular, we looked at the role of IT systems and digital transformation in enabling Frugal innovation. As there is a lack of well and-tested Frugal innovation theories to guide our work, we utilized other theories related to Frugal innovation affected factors. Using the theoretical foundation of absorptive capacity theory and the extant literature on IT solutions and firms' Frugal innovation, we built a research model for Frugal innovation, measuring the relationship of different variables that are affecting the enabling process of it. To achieve this, we tested the model theoretically and found that all factors were approved to affect the enabling role positively. Finally, the research model provided empirically testable propositions and helpful guidance for further future research.

## LIMITATIONS AND CONTRIBUTIONS

As with any study, the paper has several limitations. First, this paper has been built upon the nature and the propositions and has not been tested empirically. Second, although the concept of Frugal innovation is becoming a trend and many models have been built in association with studying the factors affecting it, but yet the model we build in the study is not created to be specific to any particular setting and not limited to specific sector or type of country (economic/development). This paper contributes to the Frugal innovation implementation in the SME sector and the supported works of literature extended it by highlighting the role of IT solutions and digital transformation in enabling and supporting Frugal innovation. Secondly, it provides a theoretical base for studying digital transformation and the association with supporting local products mainly and in general the Frugal innovation in products and services.

## Future work

As this paper is conceptual and based on previous literature reviews only, we suggest that conducting empirical studies form part of the future work to be completed. We recommend that



the entire research model be tested in the Bahrain market, by adopting the investigation of the government program of supporting 50 SMEs in digital transformation, the study can be longitudinal by measuring the Frugal innovation in the SMEs before and after implementing the IT solutions.

## REFERENCES

1. Agarwal A, Durairajanayagam D, Tatagari S, Esteves SC, Harlev A, Henkel R, et al. Bibliometrics: Tracking research impact by selecting the appropriate metrics. *Asian J Androl*. 2016;18:296-309.
2. Almeida F. Open data's role in social innovation initiatives to fight COVID-19. *Central Europ Manag J*. 2021;29:2-19.
3. Bessonova E, Battalov R. Digitalization as a tool for innovative economic development. *Economic Annals*. 2021;186:66-74.
4. Boeing P, Wang Y. Decoding China's COVID-19 'virus exceptionalism': Community-based digital contact tracing in Wuhan. *R and D Management*. 2021;51:339-351.
5. Borowski PF. Digitization, digital twins, blockchain, and industry 4.0 as elements of management process in enterprises in the energy sector. *Energies*. 2021;14:1885.
6. Broadus RN. Toward a definition of "bibliometrics. *Scientometrics*. 1987;12(5-6):373-379.
7. Le Bas. Frugal innovation as environmental innovation. *Int J Technol Manag*. 83:1-3.
8. Lim JH, Lee P. Frugal innovation and leapfrogging innovation approach to the industry 4.0 challenge for a developing country. *Asian J Technol Innov*. 2002;29:87-108.
9. Clauss T, Breier M, Kraus S, Durst S, Mahto RV. Temporary business model innovation-SMEs' innovation response to the COVID-19 crisis. *R and D Management*. 2022;52:294-312.
10. Cooke P. Regional innovation systems, clusters, and the knowledge economy. *Ind Corpo Change*. 2002;27:945-974.
11. de Reuver M, Sørensen C, Basole RC. The digital platform: A research agenda. *J Inf Technol*. 2018;33:124-135.
12. Govindarajan V, Ramamurti R. Reverse innovation, emerging markets and global strategy. *Global Strat J*. 2011;15:191-205.
13. Guderian CC, Bican PM, Riar FJ, Chattopadhyay S. Innovation management in crisis: Patent analytics as a response to the COVID-19 pandemic. *R and D Management*. 2021;51:223-239.
14. Gupta S, Leszkiewicz A, Kumar V, Bijmolt T, Potapov D. Digital analytics: Modeling for insights and new methods. *J Interact Mark*. 2020;51:26-43.
15. Hossain M, Levänen J, Wierenga M. Pursuing Frugal innovation for sustainability at the grassroots level. *Manag Organ Rev*. 2021;17:374-381.
16. Howell R, Van Beers C, Doorn N. Value capture and value creation: The role of information technology in business models for Frugal innovations in Africa. *Technol Forecast Soc Chang*. 2018;131:227-239.
17. Igwe PA, Odunukan K, Rahman M, Rugara DG, Ochinanwata C. How entrepreneurship ecosystem influences the development of Frugal innovation and informal entrepreneurship. *Thunderbird Int Bus Rev*. 2020;62:475-488.
18. Iorfino F, Cross SP, Davenport T, Carpenter JS, Scott E, Shiran S, et al. A digital platform designed for youth mental health services to deliver personalized and measurement-based care. *Front Psychiatry*. 2019;12:595.