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Foreword

Dear Readers of the Journal of Economics, Innovative Management, and Entrepreneurship,

It is with great pleasure that we introduce the latest issue of the Journal of Economics, Innovative Management, and Entrepreneurship. As we continue our journey of exploration at the intersection of economics, management, and entrepreneurship, we are delighted to present a diverse collection of articles that reflect the dynamism and ingenuity of these fields.

In an era defined by rapid globalization, technological advancement, and economic transformation, the role of economics, management, and entrepreneurship in shaping our societies and driving innovation has never been more significant. Our journal offers a platform for scholars, practitioners, and policymakers to engage with the latest research, theories, and best practices in these areas, fostering dialogue and collaboration across disciplines and sectors.

Within these pages, you will find a wealth of insights and analyses on topics ranging from macroeconomic trends and policy implications to organizational strategies and entrepreneurial ventures. Each article contributes to our understanding of the complex dynamics that shape economies, businesses, and markets, offering valuable perspectives and practical implications for decision-makers and stakeholders.

As editors, we extend our sincere appreciation to the authors for their scholarly contributions and to the reviewers for their rigorous evaluation, which have ensured the quality and relevance of the published work.

To our esteemed readers, we invite you to delve into the articles in this issue with curiosity and an open mind. May the ideas and innovations presented here inspire new thinking, spark productive discussions, and ultimately contribute to the advancement of economics, management, and entrepreneurship as forces for positive change in our world.

Prof. Nataliya Bhinder
Editor-in-Chief
Journal of Economics, Innovative Management, and Entrepreneurship

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Research Article

Digital Healthcare Innovations and Idea Management

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Abstract: The aim of the paper is to analyse the global demand development and funding of digital healthcare innovations and also characterise idea management trends in the digital healthcare context. Web-based idea management systems (IMS) fall in line with the growing importance of information communication technologies, the spread of open innovation and co-innovation, etc. Especially systems, which are based on the Internet during COVID-19 have become important tools in all sectors. Plus, over the last few years the changes related to digital healthcare have taken place and now in this context the questions have been raised. How could they be linked with a web-based IMS? What are digital healthcare innovation demands and funding trends? The changes in search habits for health information over the last three years have become statistically significant. The growth of funding volumes has followed these changes because both digital health care and digital therapeutics have increased much faster during pandemic times than before. The growth in 2020 compared to 2019 reached 53.9%, but in 2021 compared to 2020 it even accounted 74.7%. The Asian region and Europe have also seen a sharp increase in the leverage over the past two years, but pre-pandemic levels were significantly lower than in the United States. Average annual volumes of investments in digital health have increased by about 4.2 Bn$ per year in the USA, by about 1.2 Bn$ per year in Asia, by about 0.83 Bn$ per year in Europe and by about 0.15 Bn$ per year in other regions. Such demand and funding could boost new innovations in healthcare with web-based idea management systems by internal, external, and mixed approaches in organisations with active and passive IMS. Plus, IMS could become a tool to create innovations in product or organisational innovation.

Keywords: digital healthcare innovations; idea management; funding analysis; web-based idea management systems; digital medicine

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1. Introduction

The COVID-19 pandemic has triggered a paradigm shift – it is also referred to as the sense of urgency — for accelerating digital healthcare and well-being innovations, although not all new innovations are directly related to COVID-19. Many of the topical innovations have to do with new findings related to artificial intelligence (AI) solutions. For example, scanning healthcare images for the signs of additional conditions or AI-powered mental health apps, the innovation that combines health data with a personalized remote neurofeedback training to improve sleep or an app that enables at-home hormone monitoring in real-time (Springwise, 2022). These are just few digital healthcare innovations which have been launched recently. The AI business platform model is virtually in affluence with the cloud SaaS model – it concerns AI solutions that can work together on the top layer of other digital systems (Mishra & Tripathi, 2021). One of the key questions is whether the growth in public-private funding followed these changes, and how web-based idea management systems (IMS) may support the ongoing digital healthcare innovations.

A digital healthcare innovation ecosystem has been researched by many researchers and has been highlighted as a very important one. Several studies have underscored its significance (Asi & Williams, 2018; Benedict & Schlieter, 2015; Bhavnani et al., 2017). Research has also examined various aspects of its development and implementation (Chae, 2019; Cheng et al., 2021; Craig et al., 2020). The role of technology and innovation in enhancing healthcare

outcomes has been a focus of many investigations (Cripsi et al., 2019; Gjellebæk et al.,2020; Han et al.,2021). Furthermore, the integration of digital solutions in healthcare systems has been explored extensively (Iyawa et al., 2017; Javaid & Khan, 2021; Kraus et al., 2021). Scholars have also looked into the challenges and opportunities within this ecosystem (Petrakaki et al., 2021; Walsh & Rumsfeld, 2017; Abasi et al., 2021). The impact of digital health innovations on patient care and healthcare delivery has been well-documented (Bygstad & Øvrelid, 2020; Kuo, 2011; Laurenza et al., 2018). Additional research has provided insights into the strategic and operational aspects of digital healthcare ecosystems (Raghupathi & Kesh, 2009; Serbanati et al., 2011; Kouroubali et al., 2021). Studies have also addressed the economic and policy implications (Nimmagadda et al., 2019; Oderanti et al., 2021; Ramadi & Srinivasan, 2021). The evolution and future prospects of digital healthcare innovation continue to be a vital area of study (Regan et al., 2009; Segers & Gaile-Sarakne, 2021).

However, in this paper the authors will try to link it with a web-based idea management system potential. Web-based idea management systems (IMS) fall in line with the growing importance of information communication technologies, the spread of open innovation and co-innovation, etc. Especially systems based on the Internet during COVID-19 have become important tools in all sectors. Plus, over the last few years the changes related to digital healthcare have taken place and now in this context the questions have been raised. How could they be linked with a web-based IMS? What are digital healthcare innovation demands and funding trends?

Digital healthcare tendencies were researched in previous research (Bhavnani, 2017; Chae, 2019), but in this paper, the authors will concentrate on the COVID-19 period that was the time of changes in healthcare. Previous studies have laid a foundation by examining various digital healthcare trends and their impact on the industry. These earlier works provided valuable insights into the gradual integration of technology in healthcare systems. However, the unprecedented global pandemic brought about rapid and significant shifts in how healthcare services are delivered and accessed. This paper aims to explore these specific changes, highlighting the acceleration of digital healthcare adoption during the COVID-19 period and analyzing its implications for the future of healthcare delivery.

The application and demand of digital healthcare have been well researched (Andersen et al., 2019; Bennion et al., 2017; Ding et al., 2019; Safi et al., 2018). Previous studies have provided comprehensive insights into the growth and integration of digital healthcare solutions (Oborn & Pilosof, 2021; Chang et al., 2021; Safi et al., 2018). Additionally, these works have highlighted the increasing adoption and the benefits of digital healthcare technologies (Balcombe & De Leo. , 2021; Curfman et al., 2021; Hospodková et al., 2021). Several researchers have emphasized various aspects of digital healthcare demand and implementation (Cremers-Pijpers et al., 2021; Dykgraaf et al., 2021; Keasberry et al., 2017). Further studies have explored patient engagement and technology acceptance in digital health (Kursīte et al., 2022; Lai et al., 2021; Nikkou et al., 2020). However, in this case, the authors will focus on very specific aspects of digital healthcare to address current gaps in the literature.

To fill these gaps, the aim of the paper is to analyse the global demand development and funding for digital healthcare innovations and characterise idea management trends in digital healthcare context. In Figure 1 see the logical framework of the research

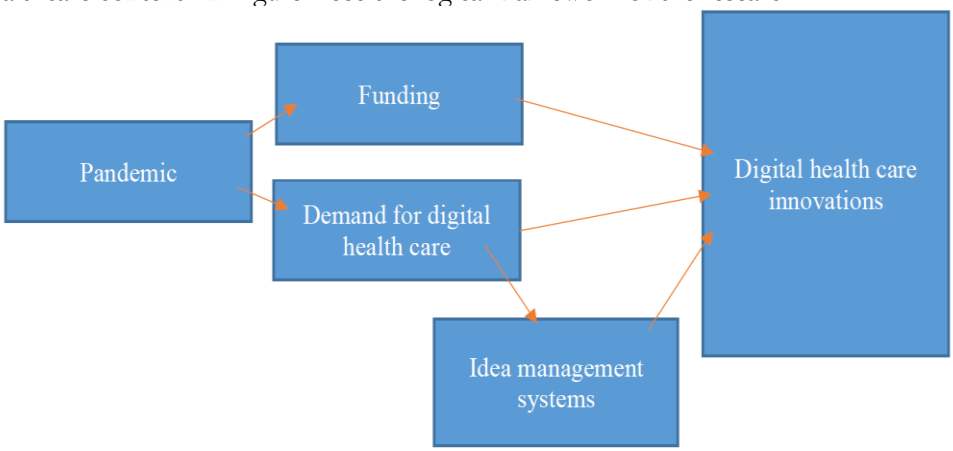

Figure 1. Logical framework.
Source: created by the authors.

By analysing statistical data and case studies to reveal answers to main questions identified in literature:

1. How has the collecting of health-related information changed over the last three years?
2. Has a pandemic boosted the demand for telemedicine?
3. Has an increased demand for digital medical services been supported by the growing funding in these areas?
4. Have some regions been supporting digital medical services by funding more than others? Is this approach data- driven?
5. How could the demand boost new innovations in healthcare by web-based idea management systems?

The paper provides theoretical and practical insights into digital healthcare information that could be relevant for the public and private sectors to follow the demand and funding based on data-driven conclusions.

The rest of the paper is structured as follows. The second section introduces the theoretical background. The third section continues by presenting the research methodology. The fourth section provides the main research findings. This structure can be seen in Figure 2.

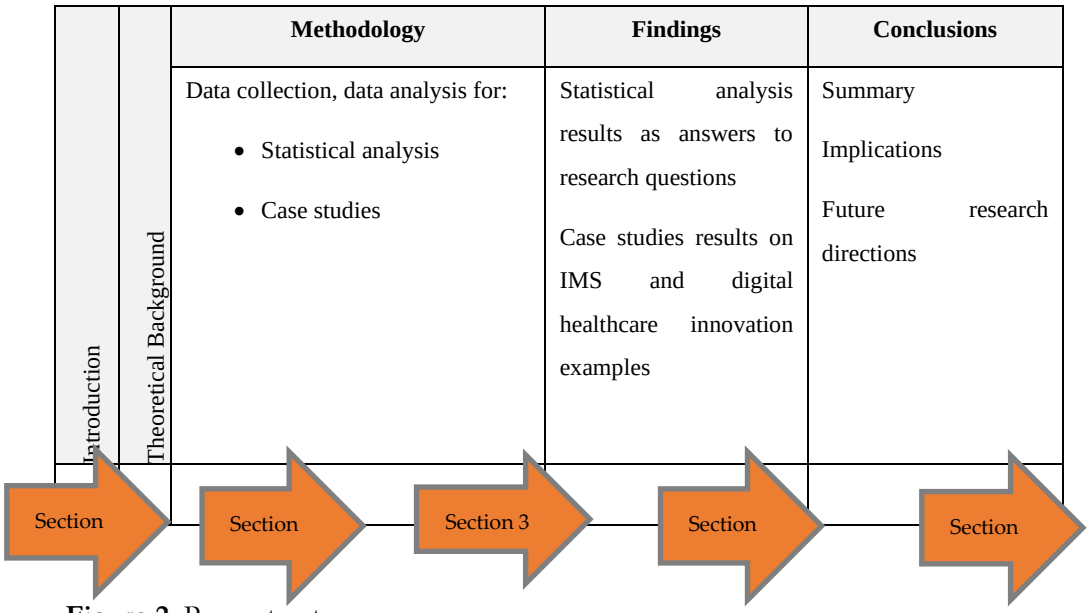

Figure 2. Paper structure.
Source: created by the authors

2. Theoretical Background

2.1. Digital Healthcare and Innovations

Ford et al. (2017) describe digital disruption as a 21st-century phenomenon that has transformed all levels of business and society (Schallmo & Williams, 2018). According to Porter and Kramer (2019), new digital business models will be more efficient and will address not only economic but also social needs with a shared value that will create a great impact on all stakeholders in the network. Reinventing the business models in order to remain competitive (Reis et al., 2018) is very important in this digitalisation era. Also, big data plays a vital role in this transformation by combining data from multiple sources, sharing it with diverse stakeholders, and analysing it in different ways enabling digital transformation (Pappas et al., 2018).

Digital health covers a range of digital solutions (S3 Connected Health, 2020), for example, digital medicine and digital services. They enable new product development and business models to improve the healthcare ecosystem (Segers et al., 2021). Cooperation in the digital health ecosystem is very important to create digital health solutions, connect with specialists at digital health companies, acquire or invest in star-tups, communicate with regulators and patients.

A digital healthcare innovation ecosystem has been researched by many researchers and has been highlighted as a very important one, but in this paper the authors will try to link it with a web-based idea management system potential. There are more and more digital

solutions in healthcare that even change stakeholder relationships, which are re-engineered around digital platforms that enhance patient-centred satisfaction and sustainability (Visconti & Morea, 2020). Previous research proves that there are many opportunities of digitalisations, for example, from AI and related technologies perspectives. They could help health and wellness providers to improve the efficiency and to create new value for their patients, but there are also requirements — effective planning and new strategies (Lee & Yoon, 2021).

Vanhaverbeke (2020) has highlighted that innovating through digitalization requires a different approach since digital technologies (AI, big data, etc.) are the base for new digital solutions that change entire business models. Digitalization has been transforming regulated industries including healthcare and this transformation has led to a growing need to establish, scale, and manage innovation ecosystems. Healthcare benefits from digitization by improving coordination between different stakeholders for example, patients and healthcare professionals and organisation, by putting the emphasis of healthcare on prevention more than on cure finding, by integrating data across the entire healthcare ecosystem, by making existing processes more effective and achieving personalized healthcare (Vanhaverbeke, 2020).

In this section digital healthcare innovation is defined as a new or significantly improved product, process, marketing, or an organisational activity in a healthcare industry in the digitalisation context.

2.2. Idea Management

Idea management (IM) can be used by organisations to manage their idea generation, evaluation, and continuation of IM to maximise the full potential of the ideas (Krejci & Missonier, 2021), but in the paper, IM is defined as a "tool, tool kit or a complex system which provides a systematic, manageable process in IM" (Mikelsone et al., 2022;), but web-based IMS are web-based tools that support IM.

There are 3 variants of IMS application types based on the involved sources:

•Internal – an organisation involves in IM only its employees;

•External – an organisation involves in IM external idea creators and/or evaluators (e.g., experts, clients etc.);

•Mixed – mixing internal and external IM approaches.

There are 2 variants of IMS application types based on task focus:

•Active – focused on IM tasks;

•Passive – unfocused on a task/ no tasks, submission of all ideas without any filters (Mikelsone et al., 2022). These types described in Figure 3.

Classifications

Classification criteria: Based on the application focus			
Passive IMS		**Active IMS**	
Functions	***Type of focus***	***Functions***	***Type of focus***
Focus on idea generation	Unfocused process	Focus on all IM dimensions	Focused process

Classification criteria: Based on the involved IM source					
Internal IMS		**External IMS**		**Mixed IMS**	
Description	***Main IM source***	***Description***	***Main IM source***	***Description***	***Main IM source***
IMS that allows to involve only internal IM sources	Employees	IMS that allows to involve only external IM sources	Crowds, experts, clients, etc.	IMS that allows to involve internal and external IM sources	Employees, clients, experts, crowds, etc.

Figure 3. IMS types.
Source: Mikelsone et al., 2021.

To summarize in this paper IM is defined as an idea generation, evaluation, and continuation of this process, but IMS in this paper will be a web-based tool that could provide an IM process.

3. Materials and Methods

3.1. Statistical Analysis

With the secondary data the authors will try to answer the first research questions. Data selection and analysis process are shown in Figure 4.

Figure 4. Statistical analysis data collection and analysis.
Source: created by the authors.

Eurostat data (Eurostat, 2022) on the search for health information online has been used to answer the second question of the study. As shown in Figure 5, the leading countries in this field, such as Finland (80%), the Netherlands (77%), Norway (77%), etc. have been considerably ahead of Bulgaria (36%) and Romania (40%). At the same time, there has been varying progress over the last three years. Has the progress been statistically significant during the last three years?

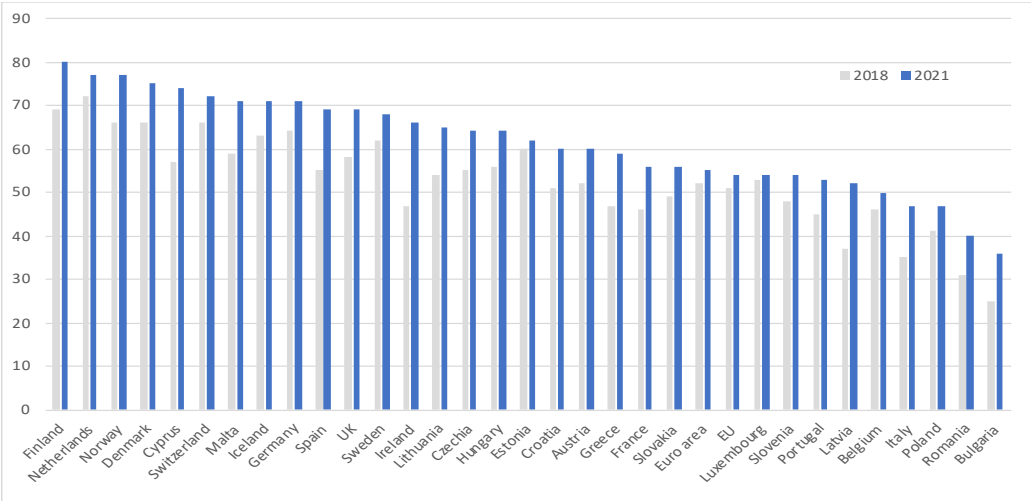

Figure 5. The share of households searching for health information online, 2021 vs 2018.
Source: Eurostat data.

In the European Union, telemedicine services have been also developing rapidly during a pandemic. Eurofound data shows the different level of development of this service, with the countries such as Finland, Slovenia, Poland, Ireland, and Lithuania accounting for more than 50%, while Malta, Germany, and France were significantly below 30% (Eurofound, 2021). See Figure 6.

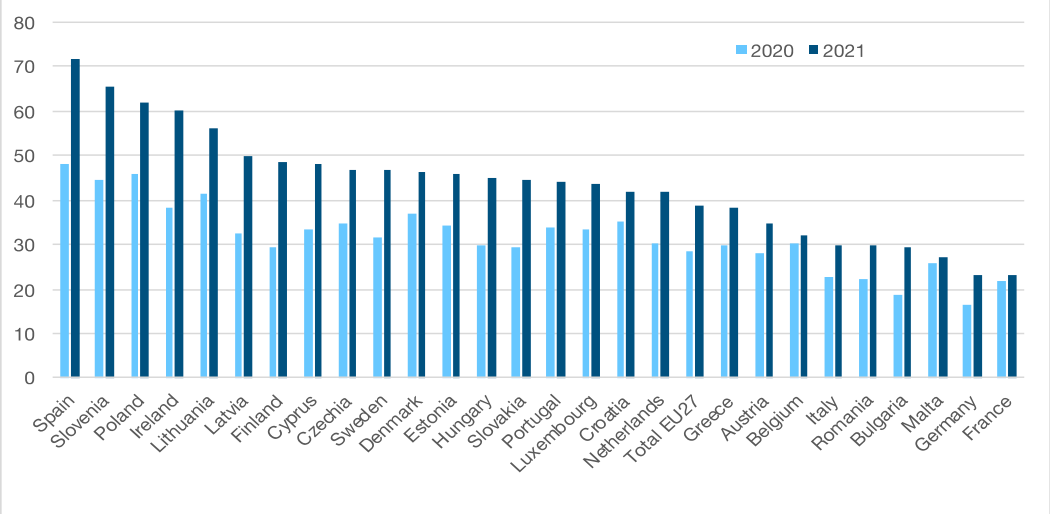

Figure 6. The share of households which received health care using telemedicine, 2021 vs 2020.
Source: Eurofound data.

The chi-squared test was used to assess the statistical significance of the differences in the demand for online health care. Chi-square statistic was calculated as follows:

$$\chi^2 = \sum \frac{(O_i - E_i)^2}{E_i} \quad (1)$$

where – O_i- observed year 2021 share of online health care;

E_i - observed share of online health care in a base year.

The decision rule applied: If >, differences in the demand for online health care services were statistically significant at the chosen confidence level (0.95), otherwise - statistically insignificant at the chosen confidence level (0.95).

Data from CB Insights were used in the study to explore the interconnections between the increase in demand for online health care services and investment in digital medicine. See Figure 7.

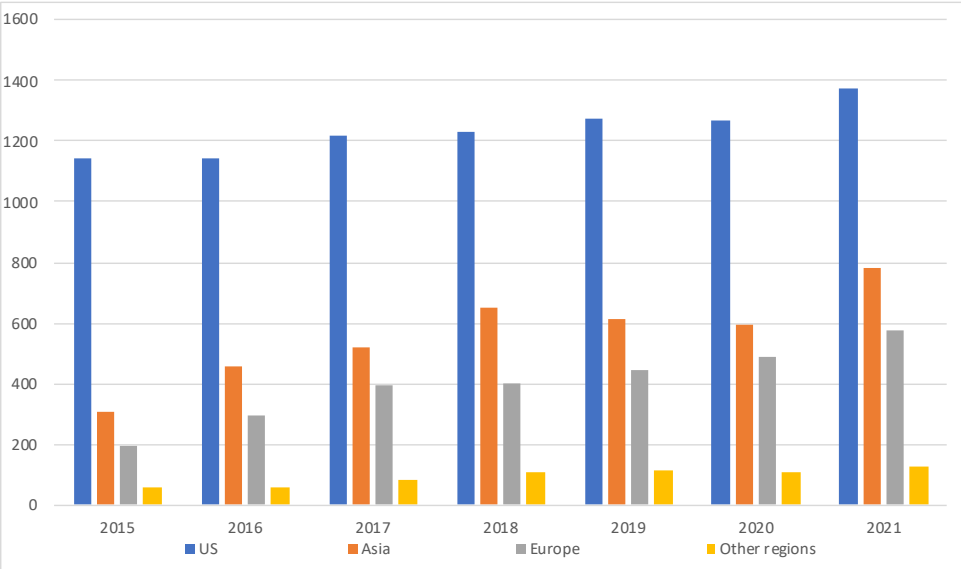

Figure 7. Digital health care funding deals by regions during 2015 – 2021.
Source: CB Insights.

As shown in Figure 7, the intensity of investments in the United States was significantly higher than in the rest of the world, but the development trend was markedly increasing both in the Asian region and in Europe.

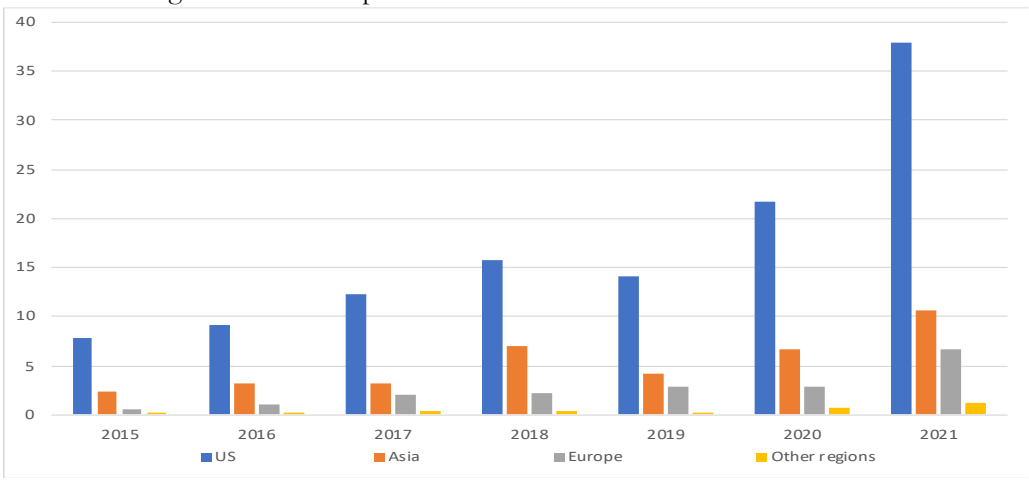

Figure 8. Digital health care funding volumes (Bn$) by regions during 2015 – 2021.
Source: CB Insights.

As one can see in Figure 8, the volumes of attracting digital medicine funding in the United States show a particularly rapid increase during a pandemic - the growth in 2020 compared to 2019 reached 53.9%, but in 2021 compared to 2020 was even 74.7%. The Asian region and Europe have also seen a sharp increase in leverage over the past two years, but pre-pandemic levels were significantly lower than in the United States.

Regression analysis methods were used to study development trends in digital health funding and differences by regions. See the results in Section 4.

3.2. Practical analysis

To overview the existing situation with innovations the authors have selected Springwise.com database. It helps not only to see the trends in innovations but also it provides innovation case documents. In Figure 9 see the data collection and data analysis methods.

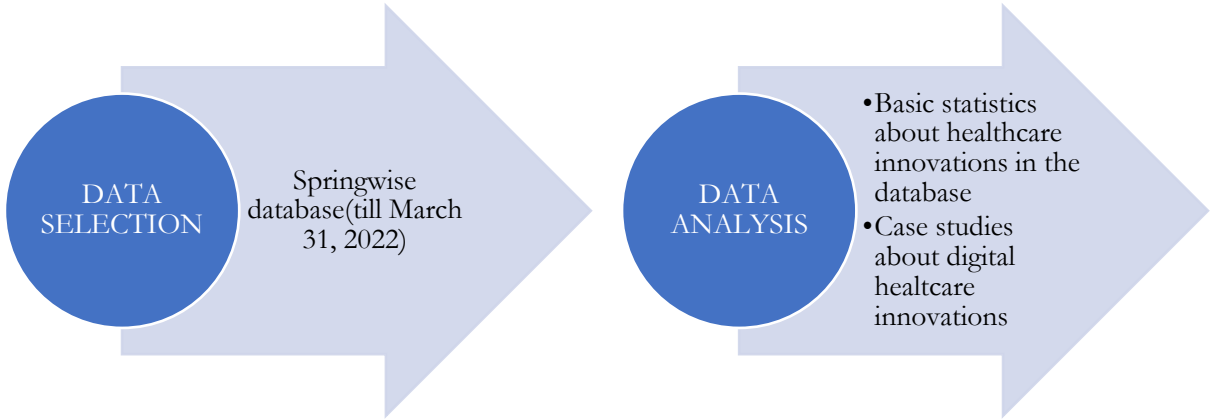

Figure 9. Innovation analysis data collection and analysis.
Source: created by the authors.

In order to analyze cases, the results of which have been processed through a content analysis (see Table 1).

Table 1. Case study steps

Data gathering method	Data analysis method	Time Period
Case studies	Content analysis	2010-2022

Source: developed by the author.

Case study analysis steps:

- Step 1 – The analysis of 5 out of 1007 (more recent, digital innovations, diverse ideas)

case analysis documents based on full and complementary information and individual communication available on IMS websites.

- Step 2 – The contented analysis of the materials obtained. This step fills in and analyzes information in case analysis protocols. A protocol is designed as a category map that makes it easy to analyze. The category map elements (see Table 2).

Table 2. Category map for case study

Basic	Name
	Country
	Year
	Creator (private sector, academic sector, public sector)
Innovation description	A problem that innovation has been solving.
	A product user (patients, society, hospitals, specific)
	The description of the innovation
	Innovation type based on results (product, process, marketing, organisational)
	Open/Closed innovation/no information

Source: developed by the author

Step 3: Creating and comparing case descriptions.

Springwise has the representative data from 1007 health and wellbeing innovations, there are 11 most popular sectors of innovations in this database. See Figure 10.

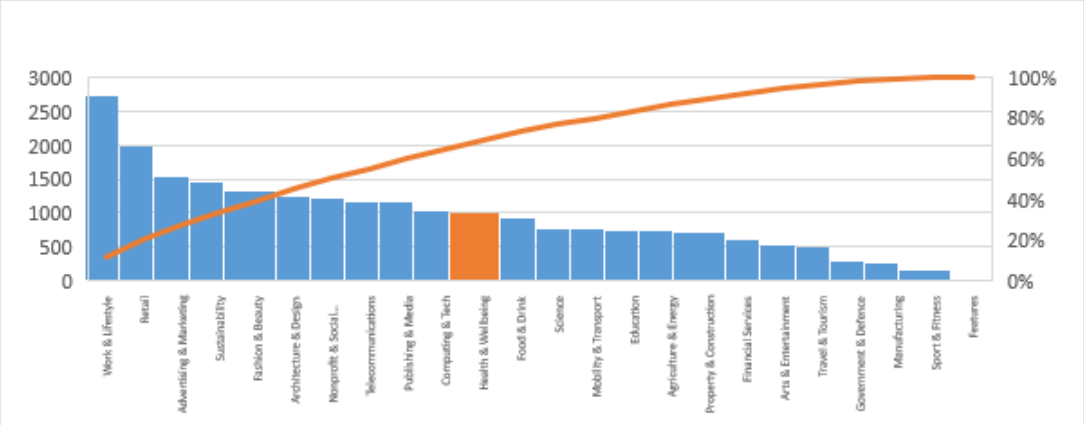

Figure 10. Database entries by sectors.
Source: created by the authors based on Springwise, 2022.

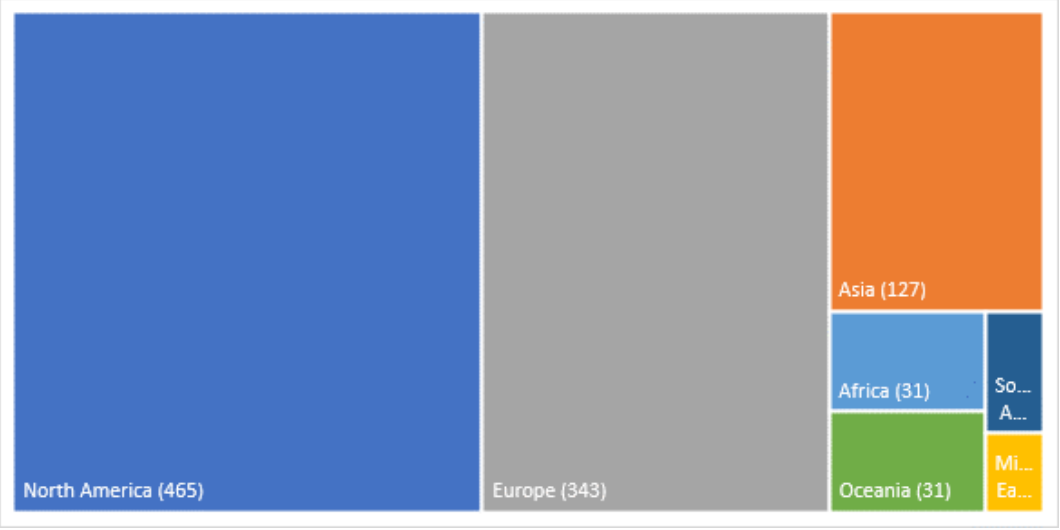

Figure 11. Database entries by countries for health and well-being innovations.
Source: created by the authors based on Springwise, 2022.

To find the cases for the web-based IMS approach another process was selected (see Figure 12), but case study steps are the same as in Table 1.

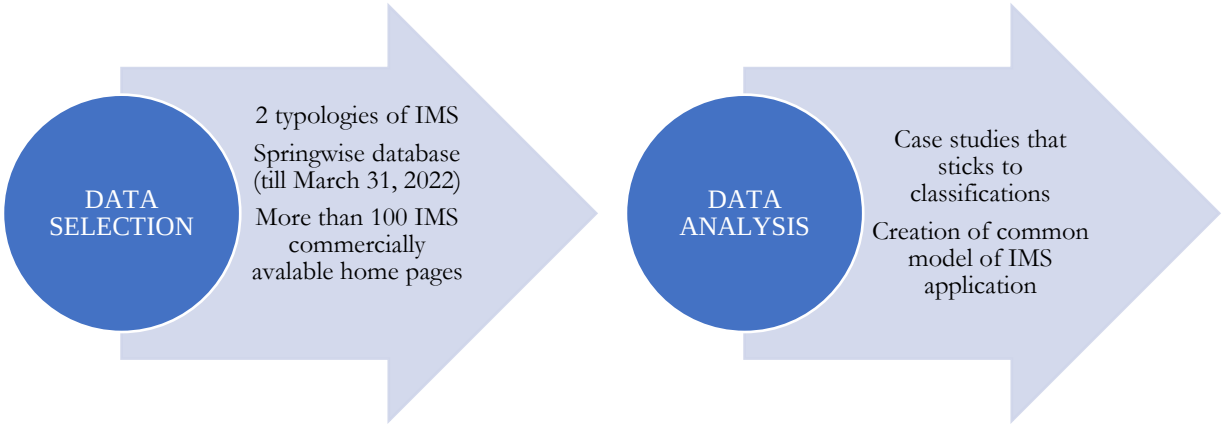

Figure 12. IMS analysis data collection and analysis.
Source: created by the authors.

See Table 3 category map for IMS cases.

Table 3. Category map for case study

	Web-based IMS
Idea management	The purpose of use
Organisation system	A product user
	The size of an organization (large/medium/small according to the EU principles)
	A country (a product user)
	Pre-use experience (yes/no, if so, how long)
	Idea management moderation (automatic, manual, both)
	The ownership of ideas (company, ideas, shared)
	Local or international use
	The number of people involved/the size of network
Other structural sources - task	A task
	Time period
	The method of using the idea management system (internal ideas management, external ideas management, mixed ideas management)
	Parties involved in idea management
	Active (focused)/Liability (unfocused)
	Product/process/organizational/marketing/all ideas created
	Adaptability (whether a task is tailored to different idea management members, one evaluates, while another group creates ideas)
	Award for the Best Ideas (yes/no)
Idea managementdirect results	The quantity of ideas
	The quality of ideas (how advanced solutions are)
	Engagement (how many people are involved)

Usage types – how the system has been accepted/used		Whether the mode of use is consistent with the type of idea management (consistent/inconsistent)
Final results		Achieving an eligible target (yes/no)
		In the case, those end-gains
Application based on the created classifications		Classifications based on the IM application (based on 9 elements of Business Model Canvas)

Source: Source: developed by the author

4. Results

4.1. Statistical Analysis Results

The following Table 4 summarizes the chi-squared test for changes in online health care demand over the recent years.

Table 4. χ^2- test statistics on online health care dynamic

Question	χ^2- statistic	χ^2- critical	p-value
Online health care information searching 2021 vs 2018	69.08	43.77	<0.001
Online health care services 2021 vs 2020	135.06	38.89	<0.001

Source: developed by the author

Since χ^2- statistic (69.08) is significantly greater than χ^2- critical (43.77) at a confidence level 0.95, we can conclude that changes in search habits for health information during the last three years have been statistically significant and, since χ^2- statistic (135.06) is significantly greater than χ^2- critical (38.89) at confidence level 0.95, we can conclude that changes in online health care services during 2021 were statistically significant. These conclusions are supported by a low p-value (<0.001).

Regression models were calibrated to determine trends in the intensity of digital health care funding and the parameters of which are summarized in Table 5.

Table 5. Digital health care and digital therapeutics funding volumes regression models statistics

Model	Type	R2	Fstat	Fcrit	p-value
Digital health care funding volumes	Polinom	0.8980	17.6090	6.9443	0.0104
Digital therapeutics funding volumes	Polinom	0.9237	24.2034	6.9443	0.0058

Source: developed by the author

Calibrated models are statistically stable because Fstat >> Fcrit and these conclusions are confirmed by low p-values (p <0.011). Thus, we can conclude that the growth of funding volumes in both digital health care and digital therapeutics elevated much faster during pandemic times than before.

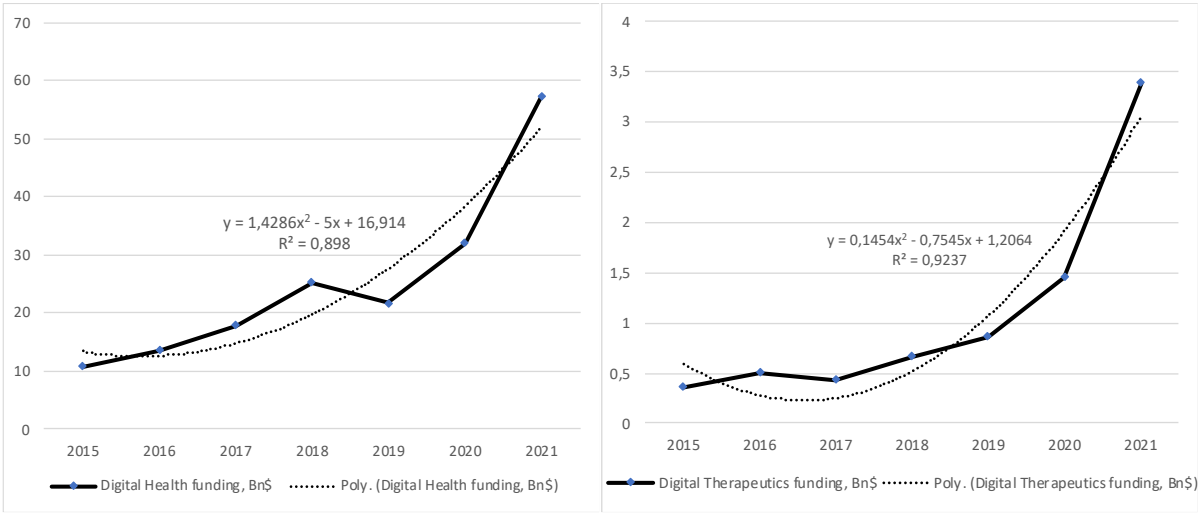

Figure 14. Digital health and digital therapeutics funding volumes trends.
Source: created by the authors based on CB Insights data.

The parameters of calibrated regression models to determine trends in the intensity of digital health care funding by regions are summarized in Table 6.

Table 6. Digital health care funding intensity regional regression models statistics

Model	Type	R2	Ffact	Fcrit	p-value
The US digital health funding deals	Linear	0.8973	43.6962	6.6079	0.0012
Asia digital health funding deals	Linear	0.8360	25.4919	6.6079	0.0039
Europe digital health funding deals	Linear	0.9466	88.5957	6.6079	0.0002
Other regions digital health funding deals	Linear	0.9091	49.9978	6.6079	0.0009

Source: developed by the author.

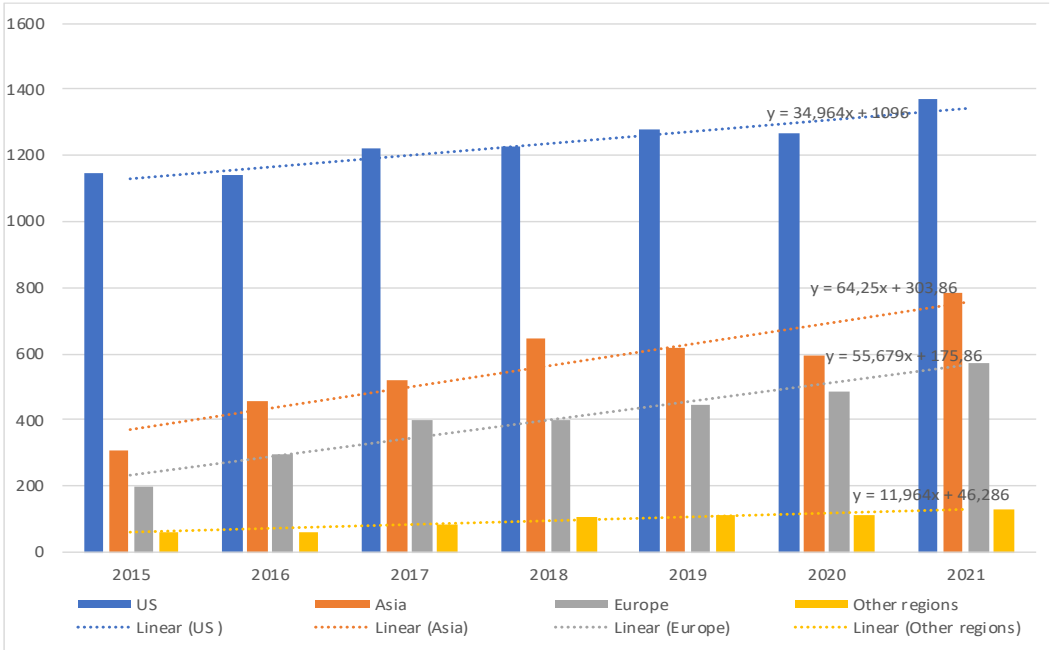

Figure 15. Digital health funding deals by regions trends.
Source: created by the authors based on CB Insights data.

Calibrated models are statistically stable because Fstat >> Fcrit and these conclusions are confirmed by low p-values ($p < 0.01$). Thus, we can conclude that the average annual number of investments in digital health grew by about 35 transactions per year in the USA, by about 64 transactions per year in Asia, by about 56 transactions per year in Europe, and by about 12 transactions per year in other regions.

The parameters of calibrated regression models to determine trends in the volumes of

digital health care funding by regions are summarized in the following Table 7.

Table 7. Digital health care funding volumes regional regression models statistics

Model	R2	Ffact	Fcrit	p-value
The US digital health funding volumes	0.7695	16.6937	6.6079	0.0095
Asia digital health funding volumes	0.7400	14.2276	6.6079	0.0130
Europe digital health funding volumes	0.7920	19.0421	6.6079	0.0073
Other regions digital health funding volumes	0.7592	15.7658	6.6079	0.0106

Source: developed by the author.

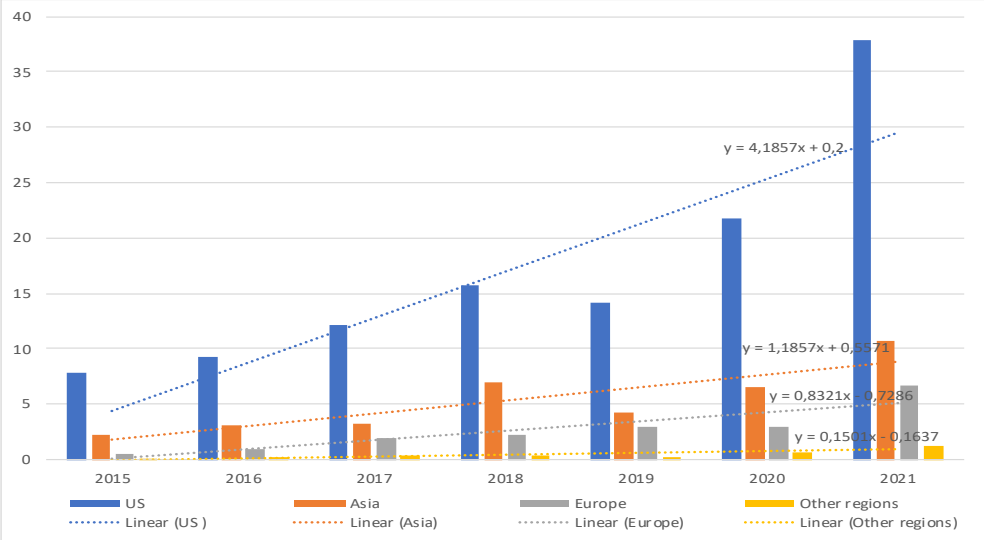

Figure 16. Digital health funding volumes by regions trends.
Source: created by the authors based on CB Insights data.

Calibrated models are statistically stable because Fstat >> Fcrit and these conclusions are confirmed by low p-values (p <0.013). Thus, we can conclude that the average annual volumes of investments in digital health increased by about 4.2 Bn$ per year in the USA, by about 1.2 Bn$ per year in Asia, by about 0.83 Bn$ per year in Europe, and by about 0.15 Bn$ per year in other regions.

4.2. Healthcare Innovations and Idea Management Systems

Springwise databases have summarized 1007 different health and well-being innovations. Based on these data the authors can conclude that the most frequent business models for health innovations are B2C and B2B. And some of them have been applied in the research (119) and 34 have created based on the crowdsourcing paradigm.

Research and crowdsourcing cases were later researched in detail from an IM application type perspective – because their research innovations will be mostly internal IM results, but crowdsourcing will be – external IM result and in some cases mixed IM. So, in these cases also such kind of web-based IMS could be used.

See Figure 17 Technologies that have been created by these health and well-being innovations.

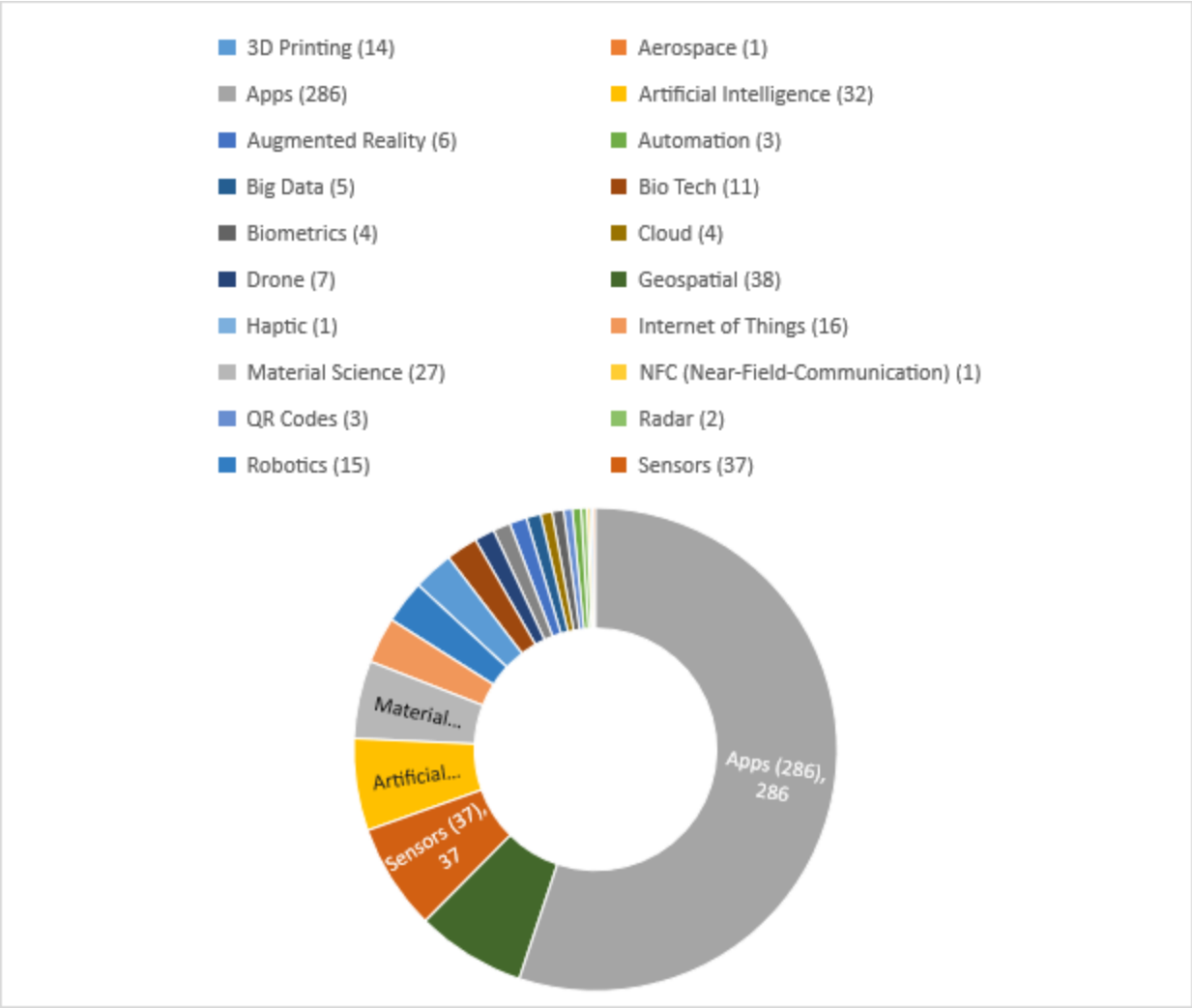

Figure 17. Database entries by technologies.
Source: created by the authors based on Springwise, 2022.

Apps are the most common digital innovation created in health and well-being. More specific technologies that are commonly used are artificial innovations, biotech, the Internet of things, sensors, 3D printing, and material science technologies.

In Figure 18 the authors have described the most common topics that these cases are related to. Coronavirus was one of the main topics for innovations – 191 innovations have been created in relation to this innovation.

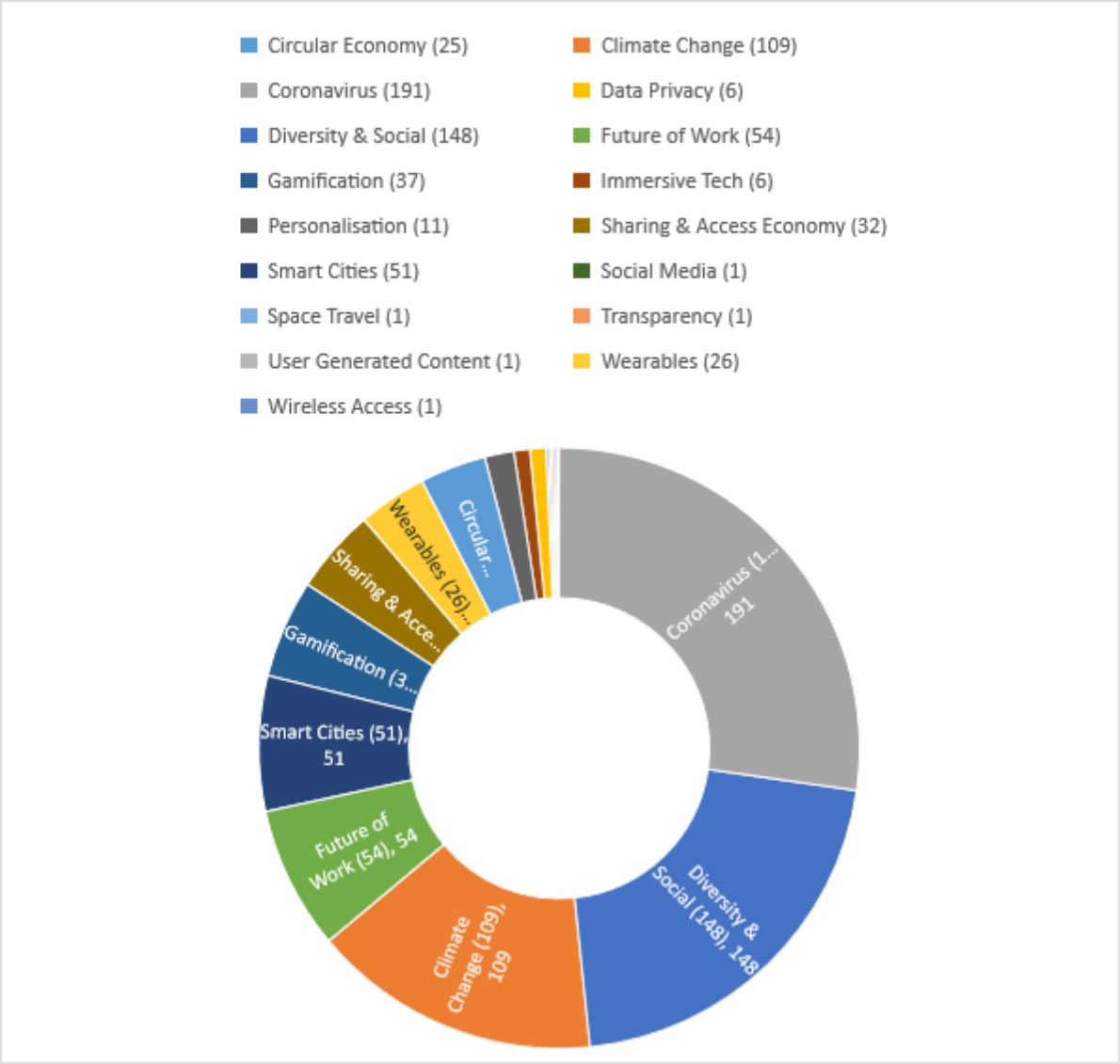

Figure 18. Database entries by topics.
Source: created by the authors based on Springwise, 2022.

It is not possible to characterise in this paper all 1007 healthcare innovations, and even not 191 innovations that took place during coronavirus time period and could be regarded as the main topic. So, the authors have decided to select and describe 5 diverse cases.

The first case is start-up Alike, which has understood that in medicine 'law of average' nowadays is not appropriate - so they have developed a solution – AI that creates matchmaking between patients, so they could share their experiences and provide personalised healthcare insights. See the case map in Table 8.

Table 8. Case study 1

Basic	Alike
	Israel
	2022
	A creator (a private sector)
Innovation description	The problem that the innovation solves: a traditional medicine is based on a 'law of averages' – it is a misleading approach!
	A product user (patients)
	The description of the innovation: 'A multidisciplinary solution to this problem – using health data and machine learning to match people who are alike on a holistic level. The AI's matchmaking takes into account

	considerations such as co-morbidities, lifestyle factors, age, and gender.' To communicate with persons that are in similar situation.
	Innovation type is based on results (a product)
	Closed
Source for citations	https://www.springwise.com/innovation/health-wellbeing/tapping-into-the-power-of-healthcare-records

Source: developed by the authors

Start-up Fornix has created a virtual reality technology that exposes patients to their object of fear in a controlled way and during the development process they have involved diverse crowd-clinical experts, researchers, and university representatives. See the case map in Table 9.

Table 9. Case study 2

Basic	Fornix
	Norway
	2022
	A creator (a private sector and an academic sector)
Innovation description	The problem that the innovation solves: 'one quarter of the global population will suffer from some form of anxiety during their lifetime'.
	A product user (hospitals and specific experts)
	The description of the innovation: 'Virtual Reality Exposure Therapy (VRET). This leverages a virtual reality (VR) technology to expose patients to the object of their fear in a controlled way in the safe space of a therapist's office. At present, Fornix offers programmes for acrophobia (the fear of heights), arachnophobia (the fear of spiders), astraphobia (the fear of thunder and lightning), odontophobia (the fear of dentistry), and trypanophobia (the fear of blood or needles).'
	Innovation type is based on results (a product)
	Open
Source for citations	https://www.springwise.com/innovation/health-tech/mental-heath-care-in-a-virtual-environment

Source: developed by the authors

Table 10 describes the case of BrainCapture at the Technological University of Denmark which has developed a cheap and mobile electroencephalogram equipment dealing with complexity and high prices for alternatives.

Table 10. Case study 3

Basic	BrainCapture
	Denmark
	2022
	A creator (a private sector and an academic sector)
Innovation description	The problem that the innovation solves: 'Although epilepsy can be treated with affordable drugs, diagnosing the disease has typically proven difficult in developing countries due to a lack of specialist equipment and neurologists with the required skills.'
	A product user (hospitals and specific experts)
	The description of the innovation: 'BrainCapture has developed a cheap and mobile electroencephalogram (EEG) equipment which is built using technology developed at the Technological University of Denmark (DTU Compute). The new device consists of a cap of electrodes which is placed on the patient's head.'

	Innovation type is based on results (a product)
	Open
Source for citations	https://www.springwise.com/innovation/health-wellbeing/low-cost-diagnosis-for-epilepsy

Source: developed by the authors

A new browser-based solution Anura provides more than 30 different health measurements by analysing video clips, more about this innovation in Table 11.

Table 11. Case study 4

Basic	Anura
	Canada
	2022
	A creator (a private sector)
Innovation description	The problem that the innovation solves: health and wellness measurement complexity and time consumption.
	A product user (patients)
	The description of the innovation: 'Anura offers over 30 health measurements including heart rate, breathing rate, blood pressure, stress levels, and metabolic risks. The new browser-based version provides the same level of measurement on any device with no download required.'
	Innovation type is based on results (a product)
	Closed
Source for citations	https://www.springwise.com/innovation/health-wellbeing/health-measurements-from-a-video-selfie

Source: developed by the authors

Pollie is the platform which provides people with hormonal imbalance with the support they need (See Table 12).

Table 12. Case study 5

Basic	Pollie
	The USA
	2021
	A creator (a private sector)
Innovation description	The problem that the innovation solves: 'polycystic ovarian syndrome (PCOS), a common painful and stressful condition that is often misdiagnosed and affects about 8 to 13 out of every 100 women. PCOS is also recognised as one of the greatest causes of infertility and increases the risk of developing other cardiovascular. '
	A product user (patients)
	The description of the innovation: 'The platform provides individuals with a personalised programme which includes a dedicated care team of doctors, life coaches and dietitians alongside a variety of lab options and educational content.'
	Innovation type is based on results (a product)
	Closed
Source for citations	https://www.springwise.com/innovation/health-wellbeing/femtech-startup-PCOS-hormone-imbalance-equality

Source: developed by the authors

Though, how to find and develop such kind of innovations in the times when everything is changing so rapidly? The landscape of the healthcare industry has changed drastically over the past few years due to changes in demand and digitalisation. Healthcare and pharmaceutical companies have uncovered the potential of web-based IMS to deal with this problem – externally by crowdsourcing and internally from employees. For example, a web-based IMS Spigit is applied by UnitedHealth Group, Adventis Health, Pfizer, and Cigna (Spigit, 2022). It is an excellent opportunity to involve patients directly in value creation, and also to make an employee involvement in these processes more effective, but it also suggests and gives opportunities to involve other stakeholders in IM to create innovations.

Employees have been engaged in the operating room sustainability and more than 90% of projects for implementation have been slated – these are just a few of the results that have been achieved by Vancouver Coastal Health, which provides healthcare services to 1.25 million people and has more than 18,000 employees. Internal IMS has helped them to use the power of employees in their specialisation areas – a primary care, mental health, public health, home health care, and community-based residential care (IdeaScale, 2022a).

BAYADA Home Health Care provides home health care by applying IdeaScale Bright Idea Forum in their 260 office places. They have gained 100% participation and by that have produced organization-wide changes in the processes and organisation – a crowdsourcing approach (IdeaScale, 2022b).

Also, public sector representatives in healthcare apply these systems, for example, the Food and Drug Administration (4,500 employees) within the Department of Health and Human Services (the USA) – achieved an 80% participation rate from their engaged employees and generated hundreds of ideas that improved internal Center for Drug Evaluation and Research functions (Idea Scale, 2022c).

To summarize the results on web-based IMS application for the creation of digital healthcare innovations. It was summarized that all types of web-based IMS could be used to create and improve these innovations. In Figure 19 is shown the process how different IMS organisations could conduct IM process through an innovation funnel. To collect more ideas, it is important to involve different idea sources, that is, internal, external, and also sometimes to use mixed approaches. After a source selection, organisations should select if they would like to define a specific task (active IMS) or just to collect all ideas (passive IMS).

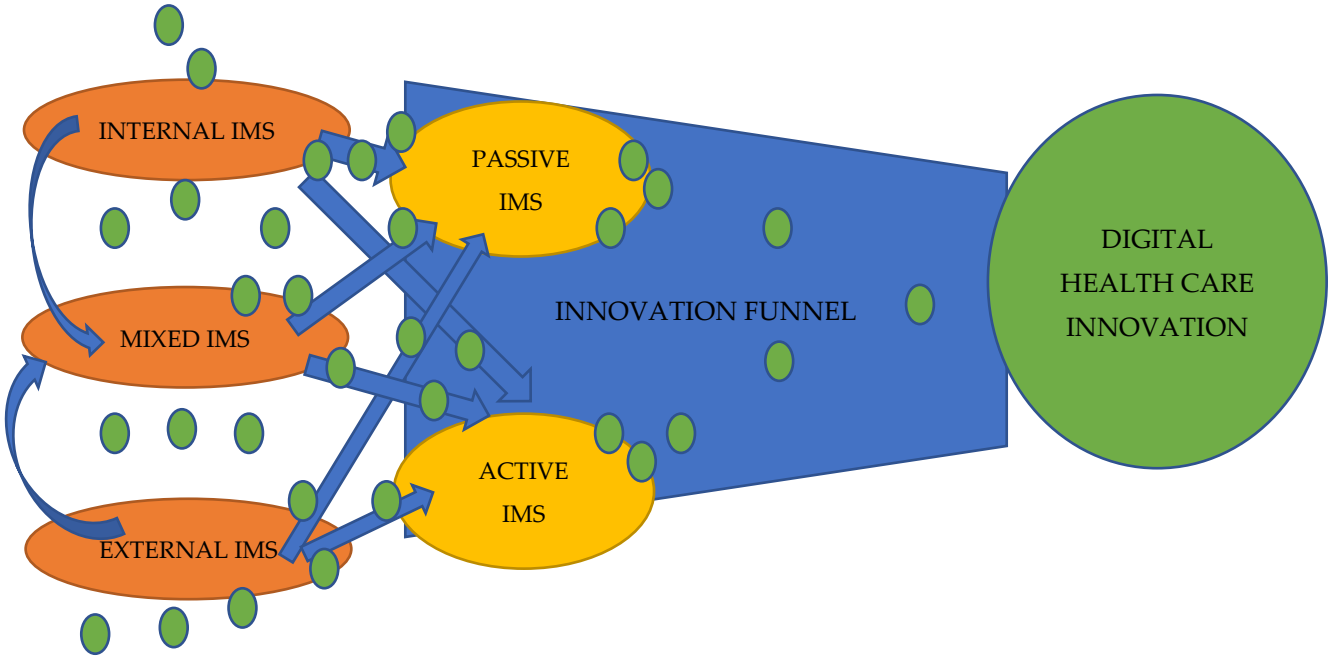

Figure 19. Idea Management System Application to Create Digital Healthcare Innovations.
Source: developed by the authors.

What kind of internal and external IM sources to involve? Based on the cases and innovation descriptions the authors have summarized the information about possible sources in Table 13.

Table 13. Internal, external, and mixed IM sources

INTERNAL IM SOURCE:	**EXTERNAL IM SOURCE:**	
Internal employees	University representatives	Other organisations/ enterprises
Specific departments	Researchers	Ministries
	NGO	Municipalities
	Society/ crowds	Hospitals
	Patients	Experts
	Patient Families	Technology enthusiasts
	Mentors	
MIXED IM SOURCES		

Source: developed by the authors

Web-based IMS IdeaScale (2022) helps a healthcare organisation to find new treatments and technologies and improve overall a patient care by providing an opportunity for collaboration of doctors, patients, researchers, and healthcare institution employees, thus building the future of healthcare. If all these sources are involved, it is an excellently mixed IMS.

The authors see the potential that the proposed web-based IMS application could help in implementation of mission innovations related to health and well-being, for example, in a mission definition web-based IMS could help gathering and evaluating ideas, after that for a selected mission to find possible projects (solutions) and at the end during an implementation support a process by idea management (See Figure 20).

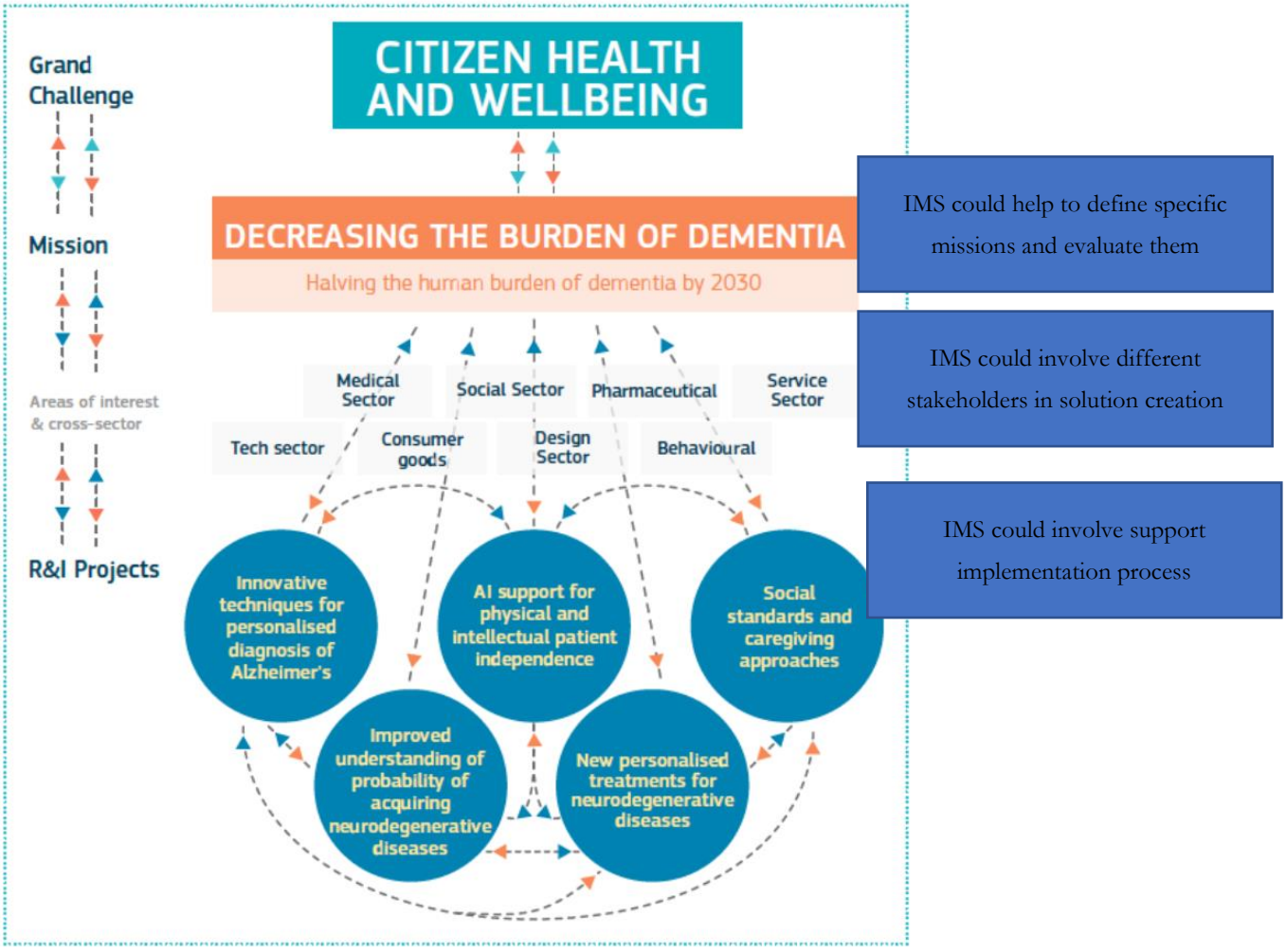

Figure 20. Mission innovations.
Source: Mazzucato, 2018.

5. Conclusions

5.1. Summary

Leading countries in the search for health information online in this field, such as Finland (80%), the Netherlands (77%), Norway (77%), etc. are considerably ahead of Bulgaria (36%) and Romania (40%). At the same time, there has been variant progress over the last three years

In the European Union, telemedicine services were also developing rapidly during a pandemic. Eurofound data shows a different level of development of this service, in countries such as Finland, Slovenia, Poland, Ireland, and Lithuania accounting for more than 50%, while Malta, Germany, and France significantly below 30% (Eurofound, 2021).

The intensity of investments in the United States is significantly higher than in the rest of the world, but the development trend is markedly increasing both in the Asian region and in Europe.

The volumes of attracting digital medicine funding in the United States show a particularly rapid increase during a pandemic - the growth in 2020 compared to 2019 reached 53.9%, but in 2021 compared to 2020 even grew to 74.7%. The Asian region and Europe have also seen a sharp increase in leverage over the past two years, but pre-pandemic levels were significantly lower than in the United States.

Since χ^2- statistic (69.08) is significantly greater than χ^2- critical (43.77) at confidence level 0.95, we can conclude that changes in search habits for health information during the last three years have been statistically significant and, since χ^2- statistic (135.06) is significantly greater than χ^2- critical (38.89) at confidence level 0.95, we can conclude that changes in online health care services during the 2021 were statistically significant. These conclusions are supported by a low p-value (<0.001).

We can conclude that the average annual number of investments in digital health increased by about 176 transactions per year, but the number of investments in digital therapeutics - by 10 transactions on average per year.

The growth of funding volumes in both digital health care and digital therapeutics was increasing much faster during pandemic times than before.

The average annual number of investments in digital health grew by about 35 transactions per year in the USA, by about 64 transactions per year in Asia, by about 56 transactions per year in Europe, and by about 12 transactions per year in other regions.

The average annual volumes of investments in digital health rose by about 4.2 Bn$ per year in the USA, by about 1.2 Bn$ per year in Asia, by about 0.83 Bn$ per year in Europe, and by about 0.15 Bn$ per year in other regions.

Apps are the most common digital innovation created in health and well-being. More specific technologies that are commonly used are artificial innovations, biotech, the Internet of things, sensors, 3D printing, material science technologies. The most common topics that these cases are related to Coronavirus was one of the main topics for innovations – 191 innovations have been created in relation to this innovation.

To collect more ideas, it is important to involve different idea sources, that are, internal, external, and, also sometimes to use mixed IMS approaches. After source selection organisations should be selected if they would like to define a specific task.

5.2. Implications

Academic contribution. The authors of the paper have concentrated their attention on the COVID-19 period that was the time of changes in healthcare and have described the demand changes during that period by answering to the research questions. In this paper, the authors have tried to link it with a web-based idea management system potential. Most common technologies and topics for healthcare innovations have been reviled.

Regression models were calibrated to determine trends in the intensity of digital health care funding and the parameters. The parameters of calibrated regression models to determine trends in the volumes of digital health care funding have been analysed. The parameters of calibrated regression models to determine trends in the intensity of digital health care funding by regions have been researched. The parameters of calibrated regression models to determine trends in the volumes of digital health care funding by regions have been summarized.

Practical contribution. The paper widens the understanding about funding and demand, which could practically help organisations to understand the existing demand and the supply of innovations to create new digital healthcare innovations.

5.3. Future Studies

Future research studies should deal with the limitations of innovation databases analysed - more databases should be included and compared.

At the moment, the research has highlighted overall technology and topic trends in healthcare innovations, but these elements should be researched in detail. Each part could be a separate research, for example, sensors, drones in healthcare or sustainability from a topic perspective.

In the paper, the authors have included only 5 cases but there are more cases, and they should be studied in detail because there is available information that could lead to the more detailed results about the supply of digital healthcare innovations.

There is limited information about web-based IMS applications in the healthcare industry publicly, so future research studies should use different methods to gain more in-depth information.

In the paper, the authors have not included detailed information about a web-based IMS as a potential process innovation in an organisation itself, but the future studies could focus on this aspect what organisational and process innovations these systems could provide.

There is so much happening so fast in this space embracing - Big Data, AI, Machine Learning, Genetics/Genomics and Multi-Omics – together with clinical science and technology and human expertise and motivation. It is rich indeed for exploration and research and especially in terms of choices which will need to be made about resource allocation for future focus and resource allocation.

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Research Article

Impact of Development Bank's Credit Financing on Small and Medium-Scale Enterprises Performance

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Abstract: This study examined the impact of Development Bank Credit Financing (DBCF) on the performance of small and medium enterprises, employment generation growth, financial asset growth and profit growth in Nigeria. A survey research design was employed; 398 SMEs were randomly selected from the beneficiaries of DBCF loans. Descriptive analysis was conducted, and binary logistic regression was employed to examine the impact of DBFC on SMEs. The result showed that the DBCF Amount of Credit Loan Received (ACLR) positively impacted the growth of SMEs, given their beta coefficients of 0.510 and 0.765, respectively. Their respective p-values and Wald statistics of 0.001, 0.001 and 14.050, 13.486 show their significance level. However, it was discovered that there is no significant impact of DBCF on the profit growth of SMEs in Nigeria. The average monthly tax payment (AVMTL) made by the micro, small and medium enterprises (MSMEs) was established to negatively impact on SMEs profit. The coefficient (β) = - 1.004 (100.4%) showed that a unit change in the AVMTL while holding other variables constant led to about 1.004 unit decline in the logit, SMEs profit. Specifically, it means MSMEs profit will decrease by the exact amount of what is paid as tax.

Keywords: development bank credit financing; small and medium enterprises (SMEs); binary logistic regression, SMEs

1. Introduction

Over the years, the life wire of many successful economies of the world has been traceable to the performance of their small businesses (Magaji, Muhammed, & Abubakar, 2015). Hence, all over the world, small and medium-scale enterprises (SMEs) have been recognised as an essential factor in modern economies because of their significant contributions to global economic growth and sustainable development through employment generation, poverty alleviation, wealth creation, and food security (Peter et al., 2018). The central role played by small and medium enterprises (SMEs) and their contribution to the socio-economic development of nations has been well documented in the literature.

SMEs account for 90% of all businesses globally. Likewise, SMEs were reported to generate 60% of employment worldwide and provide jobs to roughly 80% of the workforce in the developed world (Peterhoff, Romeo, & Calvey, 2014; Zidana, 2015; World Bank, 2021). Africa, too, is included, as small enterprises are the leading force in developing African economies and are essential for economic growth in many of her developing countries. According to the World Bank, small businesses account for 90% of all African businesses and represent 38% of the region's Gross Domestic Product (GDP). They also play essential roles in the process of industrialisation and economic growth. It is obvious today that a country can only achieve the goal of growth and development with the rapid development of its SMEs (Aluko, 2008; Magaji, 2004).

Furthermore, SMEs stimulate private ownership and entrepreneurial skills (Maggaji, Ibrahim & Abdullahi, 2024; Musa et al., 2022). The role of these businesses in an economy has been highlighted to include mobilization of domestic savings for investment, enhancement of real sector growth, creation of employment, poverty reduction, increase in income per capita, high living standard, economic diversification, promoting technological advancement and innovative industrial sector, curbing rural-urban migration and contribution to overall growth and development of the country to mention a few (Motilewa, Ogbari, &

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Aka, 2015). Hence, any effort geared towards advancing an economy without adequate support for developing SMEs will not likely produce favorable outcomes in the long run. (Bubou et al., 2014; Magaji & Saleh, 2010).

Also, in achieving Sustainable Development Goals (SDGs), most especially goals number one and eight, which are to end poverty in all its forms everywhere and promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all depends to a large extent on the performance of SMEs because of its role in generating employment both in developed and developing countries as documented in the literature. The SDG targets are ambitious and require transforming public and private activities. This transformation is associated with adopting new business models, bringing innovation, and doing business differently, more sustainably, and ethically (Magaji & Aliyu, 2007). This process opens up new business opportunities for the private sector, particularly for SMEs. These new opportunities can be fully utilized when adequate financing is made available to SMEs

Although there has been research work, such as (Musa, Magaji, & Salisu, 2023; Ayunkun & Eweke, 2020; Moussa, 2020), on the impact of credit financing on the performance of SMEs in Nigeria, their research focused on something other than Development Bank credit. However, the focus of this research work is exclusively on DBCF credit.

This study, therefore, sheds more light on this ongoing debate and contributes to the literature by examining the impact of credit financing from a public financial institution such as the Development Bank of Nigeria on the performance of SMEs in Nigeria. It is necessary to justify their presence and examine whether it is making a real economic impact. Therefore, this study aims to contribute to the literature by investigating how access to finance through DBCF impacts the performance of SMEs in Nigeria.

The aim and objective of this study therefore, is to examine the impact of credit financing from a public financial institution such as the Development Bank of Nigeria on the performance of SMEs in Nigeria. There is the need to justify their presence and also examine whether their presence is making real economic impact or not. It is therefore the goal of this study to contribute to the literature by investigating how access to finance through DBN impacts on the performance of SMEs in Nigeria.

2. Literature Review

2.1. Conceptual Framework

2.1.1. Development Bank and Credit Financing

To define DBCF, there is a need to understand what Development Bank and Credit financing are clearly. Development Banks are financial institutions typically offering subsidized, long-term financing for industrial development. The tools employed by each bank vary, but in general, include medium- to long-term credit, subsidized interest rates, credit guarantees, equity, and technical assistance while targeting industrial production and other businesses to foster their performance (Lazzarini et al., 2015). To understand the concept of the Development Bank, we need to understand what makes it different from other types of banks, and the difference makes it possible to understand it better. The standard type of bank is a commercial bank; this bank differs from Development Bank in that it is a privately owned commercial institution licensed by a government financial authority to engage in banking with the public (Bruck, 1998). The primary goal of commercial banks is profit maximization. In contrast, the goal of Development Banks is not profit maximization but rather to fill the financing gaps that other financial institutions cannot cover (Magaji, Musa, Ahmad & Eke, 2024). Therefore, a Development Bank is a government financial institution saddled with the responsibility of providing short to medium-term loans that will foster the productivity of enterprises in the country. They alleviate capital scarcity and promote entrepreneurial action to boost new or existing industries (Cameron, 1961).

2.1.2. SMEs Performance

A clear understanding of small and medium-scale enterprise performance can be obtained by clearly defining what small and medium enterprise is and what performance means. When attempting to clarify what SMEs are, there is no commonly accepted definition of small or medium businesses because classifying businesses into a large, medium or small-scale is a subjective and qualitative judgment (Ogboru, 2007). The definition ranges from the national perspective to the global perspective depending on factors such as business culture, the size of the country's population, industry, the amount of profit generated, the level of

economic development and the level of international economic integration.

Multilateral development institutions define small businesses commonly using quantitative measures. The World Bank Enterprise Survey (WBES) classifies enterprises according to their number of employees. They categorize enterprises with 5-19 employees as small enterprises and those with 20-99 as medium-scale enterprises. The World Bank Group gives a slightly different categorisation by giving three quantitative criteria for defining SMEs: the number of employees, total assets in U.S. dollars, and annual sales in U.S. dollars (Tebaldi & Elmslie, 2008). A business must meet the quantitative criteria of the number of employees and at least one financial criterion to be categorized as a micro, small or medium business. In using the number of employees, micro-enterprises are categorized as those firms with 0-10 employees, a total asset or total annual sales of 100,000 dollars or less. Small enterprises have 10-49 employees with a total asset or annual sales of 100,000 to 300,000,000 dollars.

Meanwhile, medium enterprises have 50-299 employees with total assets or annual sales of 3,000,000 to 15,000,000 dollars (World Bank, 2014). The Bank Group's research suggests in a review of 132 country standards of what constitutes an SME and concluded that 250 employees is the most common upper bound for defining SMEs. However, this definition is inappropriately high in many countries because it includes the entire, or almost the entire, formal private sector, including the largest firms in some economies. Therefore, it is not a meaningful distinction between SMEs and large enterprises (World Bank, 2014).

2.2. Theoretical Foundation

2.2.1. Classical Theory of Firm Growth

The classical theory of the firm as updated by Will Kenton (2023) is also known as the traditional theory of the firm. It is based on the work of early economists such as David Ricardo and Leon Walras. The theory is based on certain assumptions that firms seek to maximize their profit. There is no information asymmetry because owners and workers of the firm have good information, enabling them to maximize profit, and firms act as a homogeneous unit with owners wishing to maximize profit. Profit maximization occurs at an output where marginal revenue equals marginal cost; firms and managers are rational.

Scottish economist Adam Smith was the leading figure of the classical theory of growth. Smith wrote that the division of labor among workers into more specialized tasks was the driver of growth in the transition to an industrial, capitalist economy. As the Industrial Revolution matured, Smith argued that the availability of specialized tools and equipment would allow workers to further specialize and thereby increase their productivity. In order for this to happen, ongoing capital accumulation was necessary, which depended on the owners of capital being able to keep and reinvest profits from their investments. He explained this process with the metaphor of the "invisible hand" of profits, which would push capitalists to engage in this process of investment, productivity gains, and reinvestment by seeking their own personal gain, and indirectly the benefit of the entire nation.

David Ricardo extended Smith's theory to demonstrate how trade could lead to further economic prosperity on top of the gains from specialization and the division of labor. He developed the concept of comparative advantage as a basis for specialization and applied this not only to workers in a single economy but to separate nations that could trade with one another. Ricardo argued that by specializing in activities for which they each had the lowest opportunity cost and then trading their surplus product, nations (and by extension workers and firms within an economy) could all be made better off. Ricardo's theory of comparative advantage strengthened the foundation of Smith's theory of specialization and division of labor as a source of economic growth.

However, the classical theory of firm growth can be criticized based on the argument of modern economist theories. Some of the arguments put forward by modern economists include the following: firms are not a homogeneous unit. That is, owners may desire profit maximization while managers and workers may have a different objective from the owners; firms might have other objectives apart from profit maximization, sales maximization, market share maximization, and social responsibility. Also, the marginal approach to the firm is not practicable in the real world because people in business do not have the ability and time to work out the marginal cost and marginal revenue; information asymmetry is expected in the real world if business owners do not have perfect information that will help them maximize profit most of the time.

2.3. Review of the Empirical Literature

Adelekan, Eze and Majekodunmi (2019) examined the link between bank loans (measured by access to loan and debt financing) and SME performance (measured by business expansion and output) in Lagos, Nigeria. The study adopted the survey research design. The population for this study consists of 11,663 SMEs in Lagos State, Nigeria. The Yamane sample size determination formula was employed, which gave a sample size of 372. The survey research design was adopted in the study by administering structured questionnaires to selected chief executives of SMEs in Lagos. Two hypotheses were formulated, and Pearson correlation analysis was employed to ascertain the association between bank loans and SMEs performance. The findings revealed that access to loans is positively associated with the business expansion of SMEs in Nigeria ($r = 0.801$, p-value<0.05); also, debt financing is positively associated with outputs of SMEs in Nigeria ($r = 0.894$, p-value<0.05). Therefore, bank loans are strongly associated with SMEs' performance, particularly business expansion and output.

Khan (2020) studied microfinance banks' credit financing and its impacts on SMEs in Nigeria, explicitly referring to Damaturu in Yobe state. The study used representative random sampling and administered fifty (50) questionnaires, of which forty-one (41) were correctly filled and returned. For data analysis, the research used the Chi-square tool to test the formulated hypotheses. It was concluded that microfinancing does have a significant effect on the growth of small and medium-scale enterprises in Damaturu, and there is a significant relationship between the severity of borrowing conditions of Microfinance Banks and the development of small-scale enterprises in Damaturu.

Ayunku and Ewek (2020) examined the impact of banks' credit finance and macroeconomic dynamics on Small and Medium-Scale Enterprises in Nigeria using annual data from 1992–2016. The long-run and short-run relationships among the variables were examined via the non-linear ARDL model. The Augmented Dickey-Fuller (ADF) and Philip Perron's (P.P.) test revealed that none of the variables were I(2). The Bounds test to cointegration confirms the existence of a long-run relationship. The non-linear ARDL results suggested that in both long and short-run estimations, a rise in bank credit, government tax revenue and adverse shocks in interest rate, inflation rate and exchange rate will trigger a fall in SME performance in Nigeria.

In their study, Agyeman, Quarshie and Telari Bonn (2021) examined whether access to credit impacts the performance of SME in Ghana. Survey methodology was used to collect data for the study by administering questionnaires. Purposive sampling techniques were used to arrive at a sample of 65. Data was analyzed using the Predictive Analytics Software (PASW) version 20. Pearson's correlation coefficient was used to find the relationship between access and performance of SMEs, and the finding revealed a positive relationship of 0.368. This shows a strong relationship between access to finance and the performance of SMEs.

Babajide (2011) analyzed the effects of microfinance credit financing on Micro and Small Enterprises (MSEs) growth in Nigeria by employing panel data and multiple regression analysis to analyze a survey of 502 randomly selected enterprises financed by microfinance banks in Nigeria. The result showed that access to microfinance does not enhance the growth of micro and small enterprises in Nigeria. However, other firm-level characteristics, such as business size and location, positively affect enterprise growth in Nigeria.

Ezeaku, Anidiobu, and Okolie (2017) assessed the effect of SME financing on manufacturing sector growth in Nigeria using annualized data from 1981 to 2014. A cointegrating relationship was determined using the Engel and Granger residual-based approach, which showed evidence of a long-run relationship between SME credit and manufacturing output growth in Nigeria. The results of the error correction model showed that SME financing had exerted a positive influence on the manufacturing sector's growth. The finding indicated that when credits to the SMEs increased by 1%, manufacturing output rose by 14.5%. The results also revealed that interest and inflation rates adversely affected manufacturing sector growth. A unit change in interest rate led to a 15.7% fall in output growth of the manufacturing sector. They concluded that while SMEs are an important sector that can drive the Nigerian economy, rising interest rates stifle their growth and overall economic impact.

Oteniya and Lawal (2021) analyzed the impact of trade credit on SMEs in Nigeria; frequency analysis, logistic regression and correlation analysis were used as the estimation techniques. The study found that the cost of trade credit has a coefficient value of 0.036, a standard error of 0.093, and a significant value of 0.701, indicating that the cost of trade credit is positively essential. However, it is not significantly accessible to SMEs. More so, credit flexibility has a coefficient value of 0.018 and a standard error of 0.091 with a sig value of

0.846, indicating that credit flexibility has a positive impact but is not significant in influencing SMEs. The study concluded that the cost of trade credit affects SMEs, and credit granted positively affects SMEs' performance.

Imisi, Okunlola and Ayedun (2021) examined the effects of credit risk management on SME performance in Ondo State. A survey research design was employed; 261 SMEs were randomly selected from the Ondo State Microcredit Agency (OSMA) beneficiaries. Descriptive analysis was conducted, and Partial Least Square- Structural Equation Modeling (PLS-SEM) was used to test the stated hypothesis. The models specified by the study are statistically significant at 5% significance level. The study showed that the exogenous construct, CRM, positively and significantly affects SMEs' endogenous construct and performance (β= 0.522, R2 = 0.383, f2 = 0.407, T= 8.763 and P< 0.05). The result also showed that only four of the six sub-constructs were significant. The "credit terms", "loan appraisal", and "loan recovery" were significant at 95% (P< 0.05), including the control variable "loan applied for", while 'loan repayment" was significant at 90%. The study concludes that credit terms, loan appraisal, loan recovery and 'loan applied for' as indicators of CRM have both positive and significant effects on SMEs' performance during the period of this study.

2.4. Gap in Literature

The review of relevant empirical literature showed that most of the studies on the impact of credit financing on the performance of SMEs focused on commercial banks and microfinance banks' credit. However, this study examined Development bank (DBCF) credit on the performance of SMEs. DBCF is a specialized financial institution aimed at improving the credit financing of SMEs, thereby improving their performance. Therefore, it is imperative to analyze its impact on the performance of SMEs.

Likewise, it was discovered that liquidity and the amount of loan utilized or its proxies have yet to be used in literature as a measure of performance and credit, respectively, in Nigeria. Since liquidity has been identified in the literature as one of the essential measures of performance, based on the premise that large firms perform better than small firms because of their high liquidity level, this necessitated the inclusion of liquidity as a measure of performance in this research work. Likewise, the proportion of loans utilized is germane in measuring performance because some SMEs receive loans and divert them to ventures other than the purpose for which the loan was secured. That is why the proportion of loans utilized was considered an essential missing variable in other literature reviewed and, therefore, considered a gap that must be filled.

Also, most of the studies reviewed made use of linear regression analysis, mostly ordinary least squares (OLS) and descriptive statistics for analysis; these methods of analysis might not be scientific enough to arrive at a reliable conclusion, which might be the reason behind the mixed outcomes of the various past research work. This research work, however, made use of binary logistic regression analysis that facilitated a more informed decision to be taken.

These reasons, as mentioned earlier, are the gaps identified in the literature and, therefore, necessitate further research on this subject matter. Hence, there is a need to undertake this research to analyze the impact of another important source of SME financing. This will strengthen the literature depth on this matter and also influence economic decisions on this topic positively

3. Materials and Methods

3.1. Research design

This study used survey- based data; specifically, questionnaire was designed to elicit relevant information from the beneficiaries of Development Bank loans in Nigeria. In achieving the research objectives, specifically quantitative data on entrepreneur's characteristics; firm's characteristics and credit facility enjoyed were collected from the beneficiaries of Development Bank credit facilities through the monitoring and evaluation department of Development Bank of Nigeria.

The choice of quantitative data is as a result of the stated objectives of the research work which is majorly on measurement of impact, nature of our targeted population which are individuals and firms with peculiar characteristics, nature of information needed to achieve the stated objectives, past empirical work reviewed and the gap in literature that we want to fill. The stated objectives required information on the characteristics of the entrepreneurs, characteristics of the firms and information about the credit facilities from DBN to SMEs

which can be gotten through survey; this necessitated the use of survey through a well-structured questionnaire consisting of open and close ended questions to elicit information needed. Binary logistic method of analysis was employed due to the nature of our dependent variables which are dichotomous in nature while our independent variables were made up of nominal and categorical variables.

3.2 Population and Sample

The population of this study is 95,000 SMEs, which have benefited from Development Bank loans since they started operation in 2017. The population is limited to this because the Development Bank started its operation in 2017; therefore, this survey entailed the population of those who benefited from the Development Bank credit facility between 2017 and 2019. 398 beneficiaries were randomly selected through simple random sampling to elicit information needed to achieve our objectives. Our sample was hitherto determined using the Taro Yamani formula, which is stated thus. Therefore, this study covers the period between 2017 to 2019.

$$n = \frac{N}{1+N(e)^2} \ldots$$

$$where\ n = sample\ size$$

$$N = Population\ of\ the\ study$$

$$e = tolerable\ error\ which\ is\ 5\%$$

$$therefore, n = \frac{95{,}000}{1+95{,}000(0.05)^2}$$

$$n = 398$$

3.3. Survey Instrument and Data Collection

The instrument used for this survey is a questionnaire; the questionnaire was structured to elicit information on the impact of the Development Bank credit facility on the performance of SMEs in Nigeria. The questionnaire was divided into three sections containing both open and close-ended questions. Section one contained information on the entrepreneur's characteristics, such as age and gender. In contrast, section two contained information about the firm's characteristics, such as the age of the business, business sector, size of the business sector, and business location, and section three contained information about loans granted and the performance of SMEs. These included the number of loans granted, the proportion of loans utilized, interest rate on loans, easiness in loan collection, modalities of loan repayment, business growth, employment growth, profit growth and growth in financial capital.

The data set was sourced through the help of the monitoring and evaluation department of the Development Bank of Nigeria. The department requested the drafted questionnaire for the research work to ascertain if such information can be obtained from their customers. After proper joint evaluation of the items of the questionnaire by the researcher and some staff of the monitoring and evaluation department, it was discovered that significant questions contained in the questionnaire that will aid in the achievement of the research objectives comply with the survey questionnaire of the monitoring and evaluation department survey of 2020.

3.4. Data Aanalysis

For proper understanding and evaluation of the research questions raised and to ultimately achieve the research objectives, descriptive statistics such as frequency tables and percentages were used to summarize the entrepreneurs' demographic variables and describe the nature of our data. In contrast, inferential statistics, specifically binary logistic regression, was further used to examine the impact of finance on various aspects of the SMEs' performance.

3.5. Model Specification

To achieve the objective of this study, the models of Babajide (2011) and Magaji, Musa

and Dogo (2023) were adopted and specified as follows:

$$SBG = \alpha_o+\alpha_1 EAge_1+ \alpha_2 EE_2+ \alpha_3 MS_3+\alpha_4 EG_4+\alpha_5 Bizage_5+\alpha_6 Bizform_6+\alpha_7 Bizsize_7 +\alpha_8 Bizloc_8+ \alpha_9 Bizreg_9+\alpha_{10} ALS_{10}+\alpha_{11} ALD_{11}+\alpha_{12} ALR_{12} + \alpha_{13} LU_{13} + \alpha_{14} TT_{14} + \mu_1$$

The variables were defined as SBG = Sales growth, $EAge_1$ = Entrepreneur Age, EE_2 = Entrepreneur Education, MS_3 = Marital Status, EG_4= Entrepreneur Gender, $Bizage_5$ = Business Age, $Bizform_6$ = Business form, $Bizsize_7$= Business Size, $Bizloc_8$= Business location, Biz reg_9 = Business registration, ALS_{10} = Asset Loan Size received from Microfinance Bank, ALD_{11}, = Asset Loan Duration, ALR_{12} = Asset Loan Repayment, LU_{13} = Loan Utilization, TT_{14} = No. The entrepreneur or his staff received technology training in the last year, U_1 = Error term. Multiple regression analysis was used in analyzing the model. However, because of the nature of our dependent variables, binary logistic regression was used in our analysis. Therefore, our logit model for objective one is written as:

$$L_1 = ln\{\frac{p_1}{1\_p_1}\} = \beta_0 + \beta_1 AGE + \beta_2 GENDER + \beta_3 BIZSIZE + \beta_4 BIZAGE +$$

$$\beta_5 ACLR + \beta_6 AOLR + \beta_7 IROL + \beta_8 ISSTB + \beta_9 HODP + \beta_{10} HPIAL + \mu$$

Where,

$L_1 = logoistic\ model\ for\ objective\ 1$ Growth of the business

$AGE = Entrepreneur\ age,$

$GENDER = Entrepreneur's\ gender$

$BIZSIZE = Business\ size,$

$BIZAGE = Age\ of\ the\ business,$

$ACLR = Amount\ of\ credity\ loan\ requested,$

$AOLR = Amount\ of\ loan\ received,$

$IROL = Intereest\ rate\ on\ loan\ received,$

$ISSTB = Impact\ of\ surpport\ and\ service\ training\ before\ loan,$

$HODP = How\ often\ do\ you\ make\ payment,$

$HPIAL = Has\ profit\ increased\ after\ loan$

$\beta_1, \beta_2, \beta_2$..... β_{10} are regression coefficients which shows the impact of the independent variables on the dependent variable u = residual or stochastic term. A priori, $\beta_1 > 0$; $\beta_2 \gtrless 0$ *0;* $\beta_3 \gtrless 0$*;* $\beta_4 \gtrless 0$*;* $\beta_5 > 0$; $\beta_6 > 0$;$\beta_7 < 0$ $\beta_8 > 0$; $\beta_9 \gtrless 0$; $\beta_{10} > 0$.

4. Results and Discussion

This study investigated the impact of DBCF on SMEs in Nigeria. To actualize the study's objectives, primary data gathered through a survey undertaken by the monitoring and evaluation department of the Development Bank of Nigeria were employed. A representative sample of 398 was planned and obtained for this study. After subjecting the items of the questionnaires to a reliability test, Cronbach's Alpha of 0.678(67.8%) implied that the items were reliable since the computed Cronbach alpha is more significant than 60%. In the first instance, data were coded in Excel and exported to Statistical Package for Social Sciences (SPSS) version 22 to derive the estimates of descriptive and inferential statistics.

4.1. Descriptive Statistics of Data

The descriptive statistics of our data are presented below:

Table 1. Distribution of respondents on the ownership of business

Are you the owner of the business?		Frequency	%	Valid %	Cumulative %
Valid	No	2	0.5	0.5	0.5
	Yes	396	99.5	99.5	100.0
	Total	398	100.0	100.0	

Source: authors' computation, 2023.

Table 1 shows the distribution of respondents by ownership of business. It was revealed from the table that 396(99.5%) of the respondents are owners of their businesses, while 2(0.5%) of the respondents were not owners of their businesses. This implies that the majority of the small and medium-scale enterprise entrepreneurs who benefit from credit financing from the Development Bank are owners of their businesses.

Table 2 demonstrates the distribution of the respondents by gender and age. It was confirmed from the table that 213(53.5%) of the respondents were female, while 185(46.5%) were male. This signifies that females are more of the beneficiaries of the Development Bank's credit facility than their male counterparts. Since it was discovered in the literature that females are discriminated against when getting loans from banks. However, from the table above, females benefitted more, which means women have been empowered, and there is no gender discrimination against women when it comes to getting DBCF credit. This is one of the reasons why the Development Bank was established: to fill the credit gap created by other credit-giving agencies. It was also discovered that most small and medium-scale entrepreneurs fall within the age bracket of 31-40 years, constituting 42.7 per cent of the total respondents. Next is the age bracket of 41-50 years, constituting 138 (34.7%) of the respondents. 47 (11.8%) of the respondents fall within the age of 51-60 years, while 35 (8.8%) are in the lower age bracket of 21-30 years. At both extreme ends of the age, brackets are less than 20 years, which constitutes 1 (0.3%) and 60 years and above comprises 7 (1.8%) of the respondents, denoting a concentration of small and medium-scale entrepreneurs on the two middle age brackets of (31-40) and (41-50) years. This signals that the active population benefits more from the Development Bank credit facility. By implication, it means there will be a reduction in youth unemployment and an increase of the female gender in productive activity.

Table 2. Distribution of respondents by gender and age

		Frequency	%	Valid %	Cumulative %
Valid	Female	213	53.5	53.5	53.5
	Male	185	46.5	46.5	100.0
	Total	398	100.0	100.0	
Valid	60 years and above	7	1.8	1.8	1.8
	51-60 years	47	11.8	11.8	13.6
	41-50	138	34.7	34.7	48.2
	31-40	170	42.7	42.7	91.0
	21-30 years	35	8.8	8.8	99.7
	20 years and less	1	0.3	0.3	100.0
	Total	398	100.0	100.0	

Source: authors' computation, 2023.

To measure the enterprise size of the entrepreneurs in terms of employees' number, it was documented in table 3 that about 87.2% of constituting 347 correspondents had between 1 to 10 employees, classified as a micro-scale enterprise. 43 of the entrepreneurs had 40 – 49 employees, indicating it to be a small-scale enterprise, while 8 entrepreneurs, classified as medium-scale enterprises, have about 50-199 employees. This indicated that micro-scale enterprises dominated the SMEs scheme.

In terms of business assets, it was observed from the table that about 338(84.9%) of the enterprise assets were worth less than five (5) million naira, while 58(14.6%) of the enterprises owned assets worth between five (5) and fifty (50) million naira. 2(0.5%) of the enterprises possessed assets worth between fifty-one (51) and five hundred (500) million naira. This also corroborated that micro-scale enterprises dominated the categories of SME beneficiaries of the Development Bank credit facilities.

Table 3. Distribution of respondents by size of enterprise in terms of number of employees and business asset

Numbers of employees		Frequency	%	Valid %	Cumulative %
Valid	50-199 employees (medium-scale enterprise)	8	2.1	2.1	2.0
	40-49 employees (small-scale enterprise)	43	10.8	10.8	12.8
	1-10 employees (micro enterprise)	347	87.2	87.2	100.0
	Total	398	100.0	100.0	
Business asset		**Frequency**	**%**	**Valid %**	**Cumulative %**
Valid	N51m - N500m	2	0.5	0.5	0.5

	(medium-scale enterprise)				
	N5m - N50m (small-scale enterprise)	58	14.6	14.6	15.1
	less than N5m (micro enterprise)	338	84.9	84.9	100.0
	Total	398	100.0	100.0	

Source: authors' computation, 2023.

Table 4 illustrates the number of respondents (entrepreneurs) who received a loan. It was observed that only 4, representing 1.0% of the respondents, received between N51,000,000 and above, while 6, representing 1.5% of the respondents, received between N11,000,000 and N50,000,000. 55(13.8%) of the respondents received between N1, 100,000 and N10, 000,000 loan while 38(9.5%) of the respondents received between N501, 000 and N1, 000,000. The majority, 160(40.2%) of the respondents, were documented to have received N101,000 and N500,000 as a loan. Next to the group is the 135(33.9%) respondents who received the least amount of between N1,000 to N100,000. Given the above statistics, the volume of credit facilities received by business owners might not be sufficient to drive the desired growth for their businesses as the majority of the beneficiaries received not more than N 500,000.

Table 4. Distribution of respondents by the amount of loan received

		Frequency	%	Valid %	Cumulative %
Valid	N51,000,000 and above	4	1.0	1.0	1.0
	N11,000,000 - N50,000,000	6	1.5	1.5	2.5
	N1,100,000 - N10,000,000	55	13.8	13.8	16.3
	N501,000 - N1,000,000	38	9.5	9.5	25.9
	N101,000 - N500,000	160	40.2	40.2	66.1
	N1,000 - N100,000	135	33.9	33.9	100.0
	Total	398	100.0	100.0	

Source: authors' computation, 2023.

From Table 5, the majority of the respondents, about 149 (37.4%), paid between 1-5% on the loan amount received as interest. It was also observed that 131 (32.9%) respondents paid between 6-10% interest rate on the amount borrowed. It was seen from the table that 34 (8.5%) of the respondents paid between 11- 15% interest on loans given to them as interest rate while 36 (9.0%) of the respondents paid between 16 -20% interest on the amount borrowed. Only 15 (3.8%) of the respondents paid between 21-25% interest on the amount borrowed, while 33 (8.3%) paid 26% and above as interest rate on the amount borrowed. This shows that the interest rate paid by the beneficiaries of this loan is relatively low. By implication, the entrepreneur's profit will be less affected, given the relatively low-interest rate.

Table 5. Distribution of respondents by the interest rate at which the loan was given

		Frequency	%	Valid %	Cumulative %
Valid	26% and above	33	8.3	8.3	8.3
	21 – 25%	15	3.8	3.8	12.1
	16 – 20%	36	9.0	9.0	21.1
	11 – 15 %	34	8.5	8.5	29.6
	6 – 10 %	131	32.9	32.9	62.6
	1 – 5 %	149	37.4	37.4	100.0
	Total	398	100.0	100.0	

Source: authors' computation, 2023.

To determine the business sales changes since the respondents (entrepreneurs) collected loans, it was observed that about 331(83.2%) of the respondents agreed that there had been growth in sales since they collected loans. On the other hand, 67(16.8%) of the respondents maintained that there was no growth in sales since the collection of loans. This denotes that the credit facility they benefited from has contributed to the growth of sales of SMEs, as documented by 83.2% of the entire population.

The distribution of respondents in terms of increased profit after the collection of loans. It was recorded that about 267(67.1%) of the respondents upheld that the profit of their business witnessed increases after the collection of credit. In comparison, 131(32.9%) of the

respondents maintained that there was no increase in profit after the collection of loans. Table 6 shows the distribution of respondents in terms of increase in sales and profit of their business since collection of loans.

Table 6. Distribution of respondents in terms of increase in sales and profit of their business since collection of loans

Sales growth after loan		Frequency	%	Valid %	Cumulative %
Valid	No	67	16.8	16.8	16.8
	Yes	331	83.2	83.2	100.0
	Total	398	100.0	100.0	
Valid	No	131	32.9	32.9	32.9
	Yes	267	67.1	67.1	100.0
	Total	398	100.0	100.0	

Source: authors' computation, 2023.

4.2. Impact of DBCF on the Growth of SMEs

From the distribution of respondents with regards to ownership of business, gender and age, size of the enterprise in terms of numbers of employees and business asset, amount of loans received, interest rate at which the loan was received and sales and profit made, below is table 7 which shows Binary Logistic Regression Analysis indicating the impact of DBCF on the growth of SMEs.

Table 7. Binary logistic regression analysis of the impact of DBCF on the growth of SMEs*

	β	SE	Wald Stat.	Exp.(β) OR	Sig.(P-value)	
Constant	-6.637	2.007	10.938	0.001	0.001	
AGE	0.372	0.181	4.243	1.451	0.039	
GENDER	0.381	0.311	1.504	1.464	0.220	
BIZSIZE	0.527	0.298	3.128	1.694	0.077	
AOLR	-0.819	0.224	13.395	0.441	0.000	
IROL	0.199	0.098	4.100	1.221	0.043	
HPIAL	0.680	0.370	4.901	1.974	0.027	

Source: authors' computation, 2023.

*__Summary Stat.__-2Loglikelihood (-2LL) =295.83, X2=64.955, df=10, p<0.001, Nagelkerke R2=.253 (25.3%), Classification accuracy = 83.2%, Hosmer and Lemeshow Test (X2) =3.822, p-value =0.873

The estimated equation represents the sales growth model, which shows the relationship between small and medium enterprise growth measured by the sales growth and DBCF. It was observed from the model that there is a positive relationship between the amounts of credit requested (ACLR) with β = 0.765 and the sales growth of the SMEs. This denotes the probability of a unit change in the amount of loan requested by the entrepreneur to bring about a 0.765 change in the logit growth of sales of the entrepreneur while holding other variables constant. It is statistically significant at a 5% level given the computed Wald Stat. of 13.486 with p-value= 0.001, which is less than 0.05. The antilog of the parameter (β) of (ACLR) is computed as the Exp (β) = 2.148 or as the odds ratio (OR) (1.148) calculated as 1-Exp(β) = 1-2.148. The OR indicated that a unit change in β increased the logit of SME growth by the coefficient β.

The coefficient, β = -0.819 of the variable AOLR, which represented the actual amount of loan received, was found to hurt the SME's growth. It revealed that a unit change in the amount of loan received led to an about 0.819 unit decline in the growth of the SMEs at a 5% level of significance, given the Wald Stat.=13.395, p–value = 0.001. The Exp (β) = 0.441 with odds ratio (OR) = 0.551. This is contrary to the findings of Ezeaku, Anidiobu, and Okolie (2017) but in agreement with the studies of Babajide (2011). This inverse relationship between the loan received and growth in sales can be attributed to various factors ranging from individual prudential style of management of their businesses, prevailing business cycle, the general enabling business environment, monetary policy such as interest rate on lending and amount of taxes paid or that the size of the loan is too small to bring about positive change in growth of the business as mentioned by Babajide (2011). All the mentioned factors could affect the growth of a firm either positively or negatively.

The coefficient of the interest rate on lending (IROL) β = 0.199(19.9%) with Wald Stat. =4.100 and p-value =0.043 indicated a positive effect of interest rate on the growth of SMEs. This implied that a unit change in the interest rate level on borrowing brought about a 19.9%

variation in the logit growth of SMEs while holding constant other variables. It is statistically significant at a 5% level. The antilog of the parameter (β) calculated as the Exp (β) = 1.221 given the odds ratio (OR) =0.22(22.0%), denoting that a unit change in β increased the value of the logit (SMEs growth) by the value of the logit coefficient β. This implies that although the a priori interest rate is expected to hurt the growth of SMEs, the study findings showed otherwise, which is contrary to the findings of Ezeaku, Anidiobu, and Okolie (2017). By implication, this means that besides interest rate, there are other sales growth determinants such as support and service training the entrepreneur must have benefitted from before credit was given, which may have imbued in the entrepreneur the managerial skills and the ethic of managing businesses loans thereby neutralizing the negative effect of interest rate. The profit level made by a business may also mask the negative impact of interest rate, primarily if found in this model as the explanatory variable and exhibited a high positive impact on the SMEs' growth. Again, the frequency with which loans are paid will save the entrepreneur from experiencing the negative effect of the compounding interest payment.

To measure the impact of profit, the predictor variable (HPIAL) with its parameter estimates (β) = 0.680(68%) indicates a positive impact on the growth of the sales of SMEs. This means by magnitude that a unit change in the profit made by the SMEs while holding other variables in the model constant led to about 68% variation in the growth of sales of the SMEs. It is statistically found to be significant at a 5% level, as detected by the computed value of the Wald Stat. = 4.901 with p-value = 0.027, <0.05. The Exp (β) = 1.974 gave the odds ratio (OR) = 0.974, implying that SMEs making a profit are more likely to experience growth in sales than an entrepreneur with no profit; more specifically, it means that SMEs making a profit are 0.9 times more likely to experience sales growth than SMEs that are not making a profit. This denotes the significance of profit as a determinant of sales growth of small and medium-scale enterprises. The variables GENDER and BISSIZE (business size) positively impact the growth of SMEs, but they are not statistically significant. However, the variable AGE (age of the entrepreneur) exhibited a positive relationship with SME growth; this can result from experiences that might have been gathered over the years due to age.

The chi-square (X2) value of 64.955, df=10, P< 0.05 revealed that all the variables have a significant effect on the level of growth of the SMEs. The value of the -2loglikelihood=295.830 means that the model fits the data better. The Hosmer-Lemeshow test (X2) = 3,822, df=8, p-value =0.873, which is greater than 0.05, and the model's fit was also confirmed. The Pseudo R2 Nagelkarke = 0.253(25.3%). The Pseudo R2 in logistic regression is not highly emphasized because it usually comes out poor. Therefore, signs and significance of the coefficients are focused on (Gujarat, 2004:605-6).

Based on the discussion above, the study finds that the relationship between SMEs and DBCFs loans is positively related like the findings of Babajide (2011) that Microfinance Credit has positive impact on SMEs in Nigeria and the findings of Oteniya and Lawal (2021). It is also the finding of the study that there is a serious link between DBCFs loans and the growth of SMEs like the finding of Adeleke, Eze and Majekodunmi (2019) which found that SMEs are significantly impacted by loans from DBCFs.

5. Conclusions

Based on the summary of the significant findings, the study concludes that DBCF significantly and positively impacts the performances of small and medium-scale enterprises (SMEs) in Nigeria. Among the areas where DBCF has impacted the performance of SMEs is the growth of the SMEs, employment generation of MSMEs and financial liquidity of SMEs, which are vital to the overall performance of the economy. However, it was found that DBCF credit financing did not significantly impact the profitability of SMEs. The amount of loan invested, impact of support and training, and frequency of repayment of loan received were documented to be the main variables that impacted the growth of the SMEs. Regarding the SMEs' employment generation and financial assets, support and service training received before the loan and the proportion of loans utilized were the main variables that impacted them. Meanwhile, the average monthly tax paid after a loan was discovered to have a negative and significant impact on SMEs' profit.

It was established by the study that DBCF credit financing does have a significant impact on the growth of SMEs in Nigeria. Given this, the study recommends more credit availability by BDN and financing partners. The volume of money released as credit to MSMEs should be increased, and more SMEs should benefit from the credit scheme. Likewise, efforts should be geared towards ensuring that the amount of credit requested by SMEs is available to them

because of its significant impact on the growth of SMEs. Support and services training provided before a loan should be made mandatory by DBCF. It should be one of the criteria for accessing the credit facility because of its significant impact in explaining the growth of SMEs in terms of sales.

The study concluded that development credit financing does not significantly impact the level of profit of SMEs in Nigeria. This might result from the burden of loan repayment and tax payment. Based on this, the study recommends that tax reduction or tax holiday to the beneficiaries of this credit financing until the full repayment of their loan, as it was discovered that the average amount of tax paid by SMEs has a negative and significant impact on the profit of SMEs

Also, the study concluded that DBCF credit financing significantly impacts the financial performance (liquidity) of SMEs in Nigeria through the proportion of loans invested by the SME operators and support and service training received before the loan. This further corroborates the need to intensify training before loan disbursement and adequately monitor the credit to ensure it is well utilized.

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Literature Review

Innovation and Transformation: Keys to the Success of SMEs in the Digital Age

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Abstract: This article examines the strategic importance of Small and Medium Enterprises (SMEs) in the global economy, emphasizing their agility and innovation alongside the challenges they encounter in adopting new technologies. SMEs, constituting 90-95% of all global enterprises and responsible for 60% of employment, contribute to GDP, economic diversification, and community development. The study reviews a broad spectrum of literature to highlight the role of emerging technologies in enhancing operational efficiency and decision-making within SMEs while recognizing significant obstacles such as financial and human resource limitations and increased cybersecurity risks. Using a mixed-methods approach, this research assesses the impact of technological advancements on a diverse range of SMEs, ensuring generalizability and reinforcing the study's validity and reliability. It identifies a gap in empirical knowledge on technology integration and offers insights into the dual opportunities and challenges digital tools present. The findings suggest that while SMEs greatly benefit from technological progress, adequate policy support is crucial for overcoming implementation hurdles, guiding strategic technology investments, and fostering economic sustainability and competitiveness in the digital era.

Keywords: SMEs; technologies; technological innovation; technology adoption; business competitiveness; digital era

1. Introduction

Small and medium-sized enterprises (SMEs) are vital in the global economy, defined primarily by their limited number of employees and annual revenues. These entities, often run by their owners or a small group of individuals, are recognised for their agile decision-making and remarkable ability to adapt quickly to changing market dynamics (Alraja et al., 2021; Roffia et al., 2021). In the current economic context, SMEs contribute significantly to employment generation, accounting for approximately 60% of global employment, and are central to the Gross Domestic Product (GDP) and overall prosperity of nations (Costa Melo et al., 2023).

Moreover, SMEs foster robust competition in the marketplace, stimulating business efficiency and broadening the spectrum of products and services available to consumers (Romero Luna, 2006; Solís & Elgoibar, 2019). Remarkably, these firms account for 90-95% of all worldwide, underscoring their critical role in the international economic fabric (Salman & Oly Ndubisi, 2006; Annosi et al., 2023). Beyond their economic impact, SMEs are crucial in developing local communities and building robust and sustainable economies. This multifaceted role highlights the strategic importance of SMEs in the contemporary business environment (Solís & Elgoibar, 2019).

Cohen and Levinthal (1990) define innovation as a compendium of organisational processes and routines that enable a firm to seek, acquire, assimilate and apply resources effectively. This capability is crucial for firms seeking to remain competitive in a market characterised by constant rivalry and change (Ramírez et al., 2022). In the context of the digital age, technology plays a fundamental role in impacting various aspects of society. The globalisation of connectivity has eliminated geographical barriers, facilitating instant communication and international collaboration. In addition, continuous technological innovation drives significant improvements in various sectors, raising people's quality of life

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(Bijker, 2005).

From a business perspective, adopting new technologies increases operational efficiency. Tools such as automation, data analytics and artificial intelligence optimise processes, reduce costs, and improve decision-making (Quero, 2016; Ramdani et al., 2021). In addition, expanding technologies facilitates access to information, allowing individuals to acquire knowledge more quickly and efficiently (Caribe, 2021). Finally, new technologies have radically transformed how we live, work and interact, creating opportunities for constant innovation and personal and business development in an increasingly digitised world (Bijker, 2005; Caribe, 2021). This phenomenon underlines the importance of adapting and evolving in response to technological advances to ensure future success and sustainability.

The integration of new technologies into the business environment poses significant challenges for SMEs despite the clear benefits that their adoption can offer. A primary challenge is the limited financial capacity of many SMEs, which hinders the realisation of the necessary initial investments. This financial constraint is often compounded by a need for specialised staff, preventing SMEs from having the necessary internal resources to manage and maximise these advanced technologies. Furthermore, resistance to change and insufficient understanding of the long-term benefits are additional barriers. This is due to the need for clarity on how emerging technologies can improve operational efficiency and overall business performance.

The main objective of this research is to examine the adoption of new technologies by small and medium-sized enterprises (SMEs). This study focuses on identifying and analysing current trends in SMEs' use of new technologies, as well as assessing the benefits and challenges faced by these firms in the technology adoption process. The research seeks to comprehensively understand the contemporary dynamics shaping the business environment regarding technological innovation. By recognising these trends and analysing the experiences of SMEs, the study aims to sketch a picture of recent practices and lay the groundwork for anticipating future directions in this sector. This exploration is crucial to understanding how SMEs navigate the changing technological landscape and how these innovations impact their competitiveness and growth.

2. Materials and Methods

This study employed a literature review approach to examine the adoption of new technologies by SMEs. The research was conducted in three main stages: defining search and selection criteria, collecting relevant articles, and analysing and interpreting the results. The study sample consisted of scientific articles published between 2010 and 2023 in high-impact indexed journals, focusing on technological innovation and digitalisation in SMEs. Academic databases such as Web of Science, Scopus, and Google Scholar were used for article searches. The inclusion criteria encompassed empirical and theoretical studies that specifically addressed technological adoption in SMEs, the impact of new technologies on their operations, and the associated challenges and opportunities. Non-peer-reviewed articles and those not explicitly focused on SMEs were excluded. Data collection involved systematically extracting relevant information from the selected articles, including methodologies employed, primary findings, and conclusions. A narrative synthesis approach was used for data analysis, identifying recurring themes, trends, and gaps in the existing literature. This qualitative methodology was chosen for its ability to provide a deep understanding of emerging trends and current dynamics in technological innovation among SMEs. The detailed and critical analysis of rigorously selected academic sources allowed the identification of the most significant emerging technologies in the context of SMEs and elucidated underlying patterns and trends. Additionally, the study investigated the concrete benefits and potential barriers SMEs face in adopting new technologies, exploring how these technologies can be effectively applied and the limiting factors that may impede their successful integration. All data and protocols related to this review are available to readers, ensuring the study's transparency and reproducibility.

3. Results and Discussion

3.1. Types of new technology

The integration of new technologies is fundamental in the process of transformation and modernisation of SMEs. This phenomenon is reshaping the operations and management of these enterprises and expanding their opportunities to compete in an increasingly competitive

global marketplace (León-Gómez et al., 2022). Despite facing significant challenges such as limited resources and restricted access to capital compared to large corporations, adopting advanced technologies such as Artificial Intelligence, cloud computing and the Internet of Things (IoT) facilitates a more level playing field in the business environment (Palacios-Manzano et al., 2021).

This article examines in detail how SMEs are adopting these emerging technologies, identifies the obstacles they face during this process and assesses the positive impact this technology adoption can have on their operational performance, market positioning and contribution to economic development. Through the analysis of current trends, the study of representative case studies and the evaluation of relevant data, it aims to provide a comprehensive analysis of how technology adoption is becoming a key pillar for the sustainability and growth of SMEs in the contemporary economic landscape. This study seeks to deepen the understanding of technology's role in strengthening and transforming the SME sector, high-lighting the benefits and barriers to its effective implementation. This approach provides valuable insights for academics, business managers and policymakers seeking to support technology development in the SME segment.

3.1.1. Internet of Things (IoT)

In the last decade, the Internet of Things (IoT) has emerged as a critically crucial technological development, capturing the attention of organisations, industries and researchers worldwide. IoT plays a fundamental role in collecting and processing data from remote locations, significantly optimising the efficiency of distributed systems and improving people's daily lives (Sami et al., 2023). This advance represents a complex network that facilitates interaction and communication between smart devices, improving the location and management of re-sources. Through IoT, a wide variety of devices can be connected to the Internet, enabling the monitoring of multiple aspects of daily life, from home automation to environmental monitoring (Bi et al., 2023).

IoT is currently applied in many fields, such as residential automation, construction, healthcare, agriculture, traffic management, education, environmental protection, and radiation and pollution monitoring (Alvear-Puertas et al., 2017). Within this context, IoT stands out for its capacity for autonomous learning, rapid deployment, better understanding and analysis of data, and the ability to protect against fraudulent activities and cyber-attacks while maintaining users' privacy (Suciu et al., 2021).

IoT, far from being a revolution that displaces existing technologies, integrates and extends the capabilities of current technologies, creating new ways of communication and operation (Chen et al., 2014). With the advancement of IoT, new opportunities emerge to meet business demands and develop innovative services based on real-time data from the real world (Chen et al., 2014).

3.1.2. Artificial Intelligence and Machine learning

Artificial Intelligence (AI) is an advanced field of computer science dedicated to simulating human intelligence and cognitive capabilities through computer systems. This technology encompasses reasoning, learning, problem-solving, trend prediction and decision-making (de Tyler et al., 2023). The application of AI is wide and varied, from improving business productivity by optimising and automating processes and freeing employees from repetitive tasks to automating the analysis of customer behaviours, interests, and preferences to providing refined predictions about their needs and improving customer interactions. In addition, AI is employed in developing chatbots that facilitate more effective communication with consumers, thereby improving customer experience and operational efficiency (Soni et al., 2020). In data analytics, AI is crucial for identifying patterns, deviations and opportunities and anticipating future situations, significantly improving business decision-making.

Within artificial intelligence, Machine Learning (ML) is particularly relevant. This discipline focuses on developing algorithms that learn from data and improve performance through experience. ML algorithms are continuously refined with training data designed to address specific problems, enabling applications in diverse sectors such as credit evaluation, speech and image recognition, recommendation analysis, and natural language processing (Ramdani et al., 2021; Janiesch et al., 2021).

3.1.3. Cloud computing

Cloud computing is a technological paradigm that redefines how organisations access and manage computing resources. This model offers information technology services over the Internet, allowing users to store files, use software and process data remotely, anytime,

anywhere (Avram, 2014). According to Buyya et al. (2009), cloud computing is conceptualised as a distributed, parallel computing system composed of a network of interconnected, virtualised computers. These computers are dynamically provisioned to present themselves as one or more unified computing resources, operating under service level agreements (SLAs) negotiated between providers and consumers.

The implementation of cloud computing in the enterprise environment translates into multiple benefits. These include cloud data storage and remote access that provides significant operational flexibility. In addition, cloud computing offers considerable cost reductions by reducing the need to invest in physical infrastructure, which optimises the economy of space and resources (García Revilla, 2021). Another highlight is improved security and collaboration capabilities, allowing users to keep their data secure and facilitating access to third parties for viewing and editing information.

From a financial perspective, this technology eliminates the need for significant upfront capital investments, allowing companies almost instantaneous access to advanced hardware resources, which can significantly accelerate their business operations (Avram, 2014).

However, the use of cloud computing has its challenges, especially in terms of ethical and privacy issues. The management of information in the cloud must carefully consider privacy and confidentiality implications, as the centralisation of data may increase the risks of security breaches. In the current context, where privacy is becoming an increasingly pressing concern, it is crucial to address these ethical dilemmas proactively to protect data integrity and user privacy (Santi, 2016; González Arencibia & Martínez Cardero, 2020).

In summary, while cloud computing offers transformative business opportunities, it also requires meticulous consideration of ethical and security issues to maximise its benefits and minimise potential risks. This duality between capability and caution defines the context in which organisations must operate in the digital age.

3.1.4. Big Data & Analytics

Integrating Big Data and data analytics allows organisations to handle huge volumes of information and extract meaningful insights that inform strategic decision-making. According to Plugge et al. (2010), Big Data is a set of tools, technologies and procedures that enable organisations to generate, manipulate and manage large volumes of data and storage systems (Plugge et al., 2010). Big Data makes it easier for companies to manage data generation's variety, volume and velocity efficiently. This technology helps manage the overwhelming amount of information and transforms it into actionable knowledge, thus optimising business processes (Sagiroglu & Sinanc, 2013).

Data analytics focuses on exploring large sets of information across multiple categories, aiming to uncover patterns and trends that can bring tangible benefits to the organisation. This practice enables companies to gain competitive advantages over their rivals while maintaining a prominent position in the market. With the support of these technologies, companies can improve interaction with customers and deepen market analysis, offering products and services that better align with the specific needs of their consumers (Camargo-Vega et al., 2015).

3.1.5. Blockchain and Cryptocurrency

Blockchain technology, or blockchain, is a peer-to-peer network that maintains a shared, unalterable and decentralised accounting record, providing a highly reliable environment for transactions (Col, 2022; Lu et al., 2023). This technology is widely used for developing and hosting cryptocurrencies, an area that is rapidly expanding (Ahmed Alamer, 2023).

Despite its close relationship with Big Data, blockchain faces scalability challenges due to its limited storage capacity, which can complicate the management of large volumes of data. Nevertheless, its application in the business sector is increasingly valued, particularly for its security and confidentiality in handling customer information and the accurate and accessible documentation of business transactions (Elgamal et al., 2023).

Implementing blockchain technology can significantly improve the integrity, confidentiality, interchangeability, transparency and security of data in companies of any size, thereby optimising productivity and supply chain efficiency (Patil et al., 2023).

To understand how it works, it is essential to refer to Distributed Ledger Technology (DLT), which allows transactions to be recorded and managed in a decentralised manner through a network of interconnected nodes. This technological base facilitates the creation of tangible and financial assets, such as crypto assets, and allows the implementation of smart contracts to automate contractual processes (Zapata Sevilla, 2023).

Cryptocurrencies are decentralised digital assets that function like conventional currencies but operate on the Internet without intermediaries. Bitcoin, the most prominent example, uses an encrypted transaction validation system and a decentralised communication network, ensuring direct transactions between users (Díez, 2019).

While cryptocurrencies offer solutions to problems such as exchange rate dependency and centralisation, they also present significant challenges. According to some authors, the ad-vantages of anonymity and the absence of intermediaries can facilitate illicit activities, such as money laundering and trafficking in prohibited goods (Navarro Cardoso, 2019; Saldaña Taboada, 2017).

3.2. Implementation of New Technologies in SMEs

3.2.1. Trends in the current use of technologies

In today's dynamic environment, companies must adapt their organisational practices and structures to respond to continuous change and prepare for future challenges. Although technologies tend to be more prevalent in large companies due to their extensive scale, scope and capacity to invest and manage, this trend is changing (Durst et al., 2024). SMEs are increasingly aware of adopting advanced technologies to foster growth and ensure sustainability in the competitive marketplace (Quero, 2016; Ramdani et al., 2021). This awareness gradually reduces the technology gap between large corporations and SMEs, highlighting a movement towards more significant technological equity in the business world.

According to data compiled by the Government of Spain (Ministry of Economic Affairs and Digital Transformation) in 2022, it is observed that SMEs show varying levels of technological adoption: the presence of Artificial Intelligence (AI) in these companies is around 15%, while the use of Big Data reaches approximately 18%. On the other hand, robotics is less prevalent, with around 9% of SMEs using this technology, and cybersecurity, essential today, is employed by around 89%. As for e-commerce, an industry in constant growth, approximately 30% of SMEs are involved in this type of commerce, representing an increase of 11% compared to 2021.

The European Union has set a target for its Digital Decade: by 2030, at least 75% of European companies should incorporate at least one of the critical technologies, such as cloud computing, AI, and big data. However, according to data from Spain in 2022, the adoption of these technologies stands at 31.8% for Cloud Computing, 13.9% for Big Data and 11.8% for AI, according to the National Observatory of Technology and Society of the Ministry of Economic Affairs and Transformation.

3.2.2. Benefits of Implementing New Technologies

Integrating technological tools automatically gives companies a stronger position in their respective sectors. This approach not only adds value to the company but also to its employees and customers (Silgado, 2021). Using these tools improves control over crucial operations such as planning, organising, directing and controlling, facilitating better business decisions. It contributes to achieving business objectives, competitiveness in the marketplace, and, most importantly, developing higher quality and quantity products and services to meet customer needs (Valecillos & Quintero, 2007).

First, implementing technologies improves operational efficiency by simplifying the acquisition of information and data, making it a quick and enriching task for management (Silgado, 2021). In addition to facilitating massive data collection, these technologies provide companies with more effective learning by allowing easy and personalised access to information and immediate feedback (Casanova, 2022).

In addition, to remain competitive, a company must provide high-quality products and services that outperform its competitors and are favourably perceived by customers. Introducing new technologies in production processes can significantly increase productivity (Acosta et al., 2016). It involves producing above the industry average and fully satisfying the needs of consumers, optimising available resources to reduce operating costs as much as possible (Córdoba Castrillón, 2015).

Improved decision-making and predictive analysis are also crucial aspects for the success of SMEs. Technological innovations play a fundamental role in supporting these functions by allowing more efficient management of the company's resources and services (Acosta et al., 2016). These tools simplify data management, facilitate timely and appropriate decision-making, resolve challenges, and provide a clear vision of monitoring internal processes (Silgado, 2021).

Finally, adopting innovative technologies can significantly expand market reach and im-

prove customer satisfaction. This is achieved by enhancing the company's internal and external communication and increasing collaboration, effectiveness, and customer satisfaction (Vega, 2019). Furthermore, these new technologies can anticipate and forecast trends in various areas, providing companies with a more profound knowledge of their consumers' needs and facilitating the expansion of their target market (Córdoba Castrillón, 2015).

3.2.3. Obstacles and Barriers to the Implementation of Technology in SMEs

Large corporations may appear more inclined towards innovation than SMEs; however, academic consensus underscores innovation's critical importance for the latter's survival and prosperity (Hervás-Oliver et al., 2021; Ramírez et al., 2022). Nonetheless, these companies face various obstacles when opting for new technologies, which may vary depending on their size, stage of development, experience, location, and sector (Hervás-Oliver et al., 2021). Among these challenges are financial constraints and resource scarcity, which may compromise their ability to invest in research and development and adopt new technologies (Ramírez et al., 2022). Additionally, the shortage of technical knowledge and skills in their personnel can hinder the implementation of innovative strategies and adaptation to rapid environmental changes (Ramírez et al., 2022). Data security and privacy concerns also pose significant challenges, as the widespread use of technologies has raised growing concerns about safeguarding personal information and preventing risks such as cyberattacks and fraud (Blume Moore, 2021).

Furthermore, resistance to organisational change, exacerbated by traditional administrative and leadership approaches, as well as by a lack of knowledge about how to manage the necessary changes to align the company with new technologies, can hinder the adoption of advanced technologies such as information systems (Viana, 1999; Valecillos & Quintero, 2007). Resistance to change arises from the imposition in the process and the uncertainty it provokes in people, which can lead to rigid and inflexible behaviours and conflicts in the organisational and de-velopmental environment (Firth, 2000; Valecillos & Quintero, 2007). In this regard, it is essential to implement effective change management strategies that promote an organisational culture receptive to innovation and facilitate adaptation to new technologies through staff training, promotion of participation, and transformational leadership (Firth, 2000; Valecillos & Quintero, 2007; Hervás-Oliver et al., 2021). Additionally, collaboration with academic institutions and support organisations can provide access to specialised resources and knowledge to facilitate adopting and applying new technologies in business (Valecillos & Quintero, 2007; Hervás-Oliver et al., 2021). In summary, while SMEs face various challenges when adopting new technologies, a broad spectrum of strategies and resources are available to overcome these barriers and capitalise on the benefits of technological innovation in the current business environment.

3.3. Legal and regulatory framework

In the continuously evolving digital landscape, the issues of privacy and data protection have gained significant traction in both societal and business realms. Within this context, various pivotal regulations have emerged as cornerstones governing privacy and data management on a global scale. These include the General Data Protection Regulation (GDPR) (EU) 2016/679 and Spain's Organic Law 3/2018 on Data Protection and Guarantee of Digital Rights (LOPD) (Ministry of Science and Innovation, 2023). Additionally, regulations such as the California Consumer Privacy Act (CCPA) and the Data Protection Act in the UK contribute to this regulatory framework (Ministry of Science and Innovation, 2023). These regulations are de-signed to ensure the confidentiality, integrity, and accessibility of personal data while providing clear guidelines for their handling and responsible utilisation. In an era of ubiquitous data collection and processing, compliance with these regulations is more critical than ever, given the substantial implications of non-compliance for individuals and organisations. Thus, recognising such regulations' pivotal role and influence in the contemporary landscape becomes imperative as they address increasingly pertinent actions in an ever-digitalizing world.

The legislative landscape surrounding e-commerce has assumed unprecedented importance in a milieu where online transactions have become integral facets of daily life and global commerce. As e-commerce and online transactions continue to burgeon, the necessity for tailored regulations and laws to address the attendant challenges and opportunities becomes glaringly apparent. Regions across the globe have responded to this exigency by formulating their unique regulatory frameworks and laws aimed at safeguarding the interests

of consumers and businesses alike. Notable examples encompass the UK Electronic Commerce Regulations, the US E-commerce Act, and the EU E-commerce Directive, among a plethora of others (Vera & Oficina Económica y Comercial de la Embajada de Es, 2022; Amandi, 2007). These regulations endeavour to balance consumer protection, online security, and trade facilitation within an ever-evolving digital milieu.

The pivotal role of ethics and responsibility in ensuring that technological advancements are redounded to benefit society cannot be overstated. Artificial intelligence, automation, and data analytics have revolutionised societal interactions, professional landscapes, and daily living. However, this rapid transformation has ushered in a host of ethical quandaries and concerns regarding these technologies' ethical deployment and utilisation. Regulatory measures and ethical frameworks have been developed to guide emerging technologies' judicious and re-sponsible implementation in response to these exigencies. An example in this domain is the EU's forthcoming Ethics Directive on Artificial Intelligence, which aims to provide com-prehensive guidelines for the ethical deployment of AI technologies (European Parliament, 2023). Nonetheless, the pace of technological evolution often outstrips the capacity of regulatory frameworks to keep abreast, necessitating ongoing collaboration among governmental bodies, businesses, academics, and society at large to ensure that emerging technologies are harnessed ethically and responsibly (Olcott Jr, Carrera Farran, Gallardo Echenique, & González Martínez, 2015).

Financing is essential for SMEs to leverage benefits from new technologies fully. This resource provides monetary support and constitutes a crucial strategic investment for developing, implementing, and maintaining innovative technological solutions. It is critical to consider that the particularities of each business, such as its size, financial needs, current resources, and ability to manage costs and risks, determine the access to different financing methods (Cassar, 2004).

Younger SMEs, for example, tend to rely less on external financing sources, instead opting for internal resources and short-term debt. In contrast, more mature SMEs often use various financial instruments. Small businesses, facing restrictions in generating internal revenue and limited capacity to issue shares, typically depend more heavily on bank loans (Moritz et al., 2016).

Furthermore, it is essential to highlight the influence of the economic environment and government policies on the availability and conditions of these financing options. Fluctuations in interest rates, credit policies, and incentive programmes can significantly alter the accessibility and attractiveness of different types of financing. For instance, tax incentives for technology investment can encourage SMEs to seek external financing to expand and modernise.

Obtaining financial support is a constant struggle for many businesses, although large enterprises present fewer problems in this respect, while SMEs often face these challenges much more frequently. The lack of funding is a barrier that can hinder the innovation and growth of SMEs. According to a study by Kumar and Rao, several significant barriers stand in the way of incorporating new technologies in SMEs (Kumar & Rao, 2015; Blach et al., 2020). The supply gap implies the limited availability of funds designated for SMEs, as financial institutions are often reluctant to finance these businesses. The demand gap refers to the discrepancy between the amount of financing that SMEs need and the amount available.

In contrast, the benevolence gap shows that some financial institutions may not be willing to finance SMEs. Moreover, the knowledge asymmetry gap highlights that SMEs may lack information and knowledge on how to access suitable sources of financing for their needs; on the other hand, it is noteworthy that the company will have more information about its product and its projection expectations than potential investors. However, it is essential to note that once the entrepreneur successfully demonstrates the viability of a profitable opportunity, it is typical for the business's financing needs to experience a significantly positive change (Shane, 2009).

Additionally, the adoption of advanced technologies requires not only capital but also strategic planning and effective management. Staff training and adapting business processes are essential to maximise the benefits of technological investments. Therefore, SMEs must con-sider these additional factors when planning their financing and technology growth strategies (Moritz et al., 2016).

Government entities and public financial institutions offer a variety of financing pro-grammes to support SMEs. These programmes may include preferential loans, short-term bank financing, credit lines, and loan guarantees specific to innovation, representing the

current primary source of funding for SMEs. However, the cost of capital remains high, particularly in the SME sector, where it faces an average cost of approximately double that of large enterprises. Regarding public financing, in Spain, the CDTI-E.P.E. is a Public Business Entity operating under the Ministry of Science and Innovation's mission to stimulate innovation and techno-logical advancement in the Spanish business sector. This entity is crucial in managing support and financial assistance applications for Spanish companies' research, development, and in-novation (R&D&I) projects (Ministry of Science and Innovation, 2023).

The government is also a relevant capital provider, granting subsidies and tax exemptions and promoting support for high-risk and large-scale projects. This entity encourages aid to SMEs as they recognise the significant influence that SMEs have on the economy and growth of their country (Baker & Welter, 2014)—according to a study conducted by Alexandra Moritz, a high percentage of SMEs in the study used short-term financing. This included bank overdrafts, credit card overdrafts, lines of credit (34.8%), and commercial credit (29.8%). On the other hand, 25.3% resorted to bank loans (Moritz et al., 2016).

Moreover, economic aid or grants are resources provided by government institutions, foundations, or non-profit entities to support specific projects or business activities. SMEs can use these funds for research, development, expansion, and other strategic actions. It is essential to highlight that, on many occasions, the repayment of these economic aids is not required (Moritz et al., 2016; Scholtens, 1999).

Private investors, also known as "business angels," are generally wealthy individuals who invest their capital in start-ups or growing companies in exchange for an equity stake. These investors bring capital, expertise, and networking opportunities to SMEs (Scholtens, 1999). Venture capital is a group of specialised financial intermediaries that finance SMEs. This group acts on behalf of its shareholders and invests in companies with high growth potential in ex-change for an equity stake. Their primary function is to understand the risks associated with specific companies, such as new or emerging ones, and specific economic sectors, such as high technology (Scholtens, 1999; Baker & Welter, 2014).

Crowdfunding and collective financing are terms used interchangeably to define the practice of obtaining financing from many people to support a project or company. However, there is a slight difference between the two concepts. Collective financing involves any form of financing that involves a group of people contributing funds, while crowdfunding, as the name suggests, is a financing model where many investors contribute small amounts of money to support a project in exchange for a reward or a stake in the project or company (Sanchez-Riofrio, 2018; Roig-Tierno et al., 2015).

4. Conclusions

This work aims to analyse in detail the crucial importance of innovation in SMEs, highlighting how these innovative activities act as catalysts for growth and competitiveness in the contemporary market. During this final degree project, we applied a systematic literature review methodology, selecting and evaluating various academic studies and examples of business success. This approach has allowed us to discern critical trends, identify effective strategies and recognise recurring challenges that SMEs face in their efforts to innovate. By integrating these findings, our research provides a comprehensive view of how innovation, when properly implemented and managed, can serve as a transformative driver for SMEs, driving their economic success and contributing to sustainable economic development and resilience in a constantly changing business environment.

It is essential to recognise that the strategic relevance of technological innovation in SMEs is decisive since it constitutes an essential engine of growth and competitiveness. Incorporating advanced technologies, ranging from automation solutions to artificial intelligence platforms and data analysis, can radically revolutionise the business models of these companies. This transformation significantly improves operational efficiency and resource optimisation, generates new market opportunities, and enables SMEs to compete globally. The effective integration of technological innovations is crucial for adaptation to a dynamic business environment, improving the ability to respond to changing market demands and new consumer trends.

On the other hand, our conclusions emphasise the importance of recognising and analysing the specific challenges that small and medium-sized enterprises (SMEs) face when implementing technological innovations. One of the most significant obstacles is financial restriction; SMEs often operate on limited budgets, which makes it challenging to invest in

advanced technologies, which can be financially demanding. Additionally, the need for more specialised human resources presents another considerable challenge. Many SMEs need more qualified personnel to develop, implement and manage advanced technological solutions, which is essential to capitalise on the benefits of innovation effectively.

Another significant barrier is culture. In many SMEs, there is resistance to change where traditional practices are deeply entrenched, resulting in a reluctance to adopt new technologies despite their potential benefits. Finally, SMEs often need help in scale and scope when trying to innovate. The ability to scale technology solutions and adapt them to the specific needs of an SME can be complex and require careful planning and strategy.

It is equally crucial to highlight how successful implementation of technological innovations can significantly catalyse productivity and operational efficiency. Integrating new technologies into business processes allows SMEs to automate routine tasks, reduce errors and optimise the use of time and resources. Adopting customer relationship management (CRM) systems and enterprise resource planning (ERP) solutions can significantly improve internal coordination, data-driven decision-making, and efficient supply chain management. Additionally, digital technology opens paths to new business models, such as e-commerce, that can expand market reach and improve customer interaction. Data analytics tools and artificial intelligence offer SMEs the ability to understand market trends and consumer behaviour patterns better, thereby facilitating more informed and strategic decision-making.

Additionally, it is essential to address the ethical and security considerations that accompany the implementation of new technologies. Data privacy and security emerge as crucial aspects in today's digital era. When adopting innovative technologies, SMEs must ensure that data collection, storage and use are carried out ethically and according to current regulations. This involves implementing robust cybersecurity systems to protect against data breaches and cyber-attacks, which can have severe financial consequences and damage the company's reputation.

Beyond legal compliance, a moral imperative is to protect customers' personal information. SMEs should adopt a stance of transparency in their data management practices, clearly communicating to customers how their data is used and obtaining explicit consent. This transparency and diligence in managing data privacy and security not only fulfills an ethical obligation but is also essential to building and maintaining the trust of customers and business partners.

In concluding this analysis of innovation in SMEs, it is imperative to look to the future and offer practical recommendations for those companies seeking to embark on technological innovation initiatives. SMEs must adopt an open and proactive mindset towards innovation, ensuring they are constantly updated on new technologies and market trends. It involves adopting emerging technologies, continuously training staff, and reviewing business processes to ensure their alignment with current technological solutions. Technologies such as artificial intelligence, the Internet of Things (IoT) and automation are anticipated to advance further, offering new opportunities for SMEs to improve their operational efficiency and create new value propositions. Furthermore, the growing importance of sustainability and corporate social responsibility could lead SMEs to innovate in technology and sustainable business practices. Therefore, SMEs should consider not only how they can implement current technology but also how they can prepare for future waves of innovation. It includes establishing a culture of learning and adaptability, investing in research and development, and seeking strategic collaborations to expand its innovation capacity. By doing so, SMEs will not only be able to keep up with the rapid pace of technological change but also play a vital role in shaping the future of the business landscape.

The literature review reveals that technological innovation is a critical factor for the growth and competitiveness of SMEs in today's market. Despite significant challenges, such as financial constraints and a lack of specialised human resources, implementing innovative technologies can radically transform business models, improve operational efficiency and open up new market opportunities. It is clear that SMEs that adopt a proactive mindset towards innovation, invest in continuous staff training and keep up with emerging technologies will be better positioned to navigate the rapidly changing business environment and contribute to sustainable economic development.

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Literature Review

Cotton in the Indo-Pacific: Historical Origins, Linguistic Diffusion, and Socioeconomic Impacts

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Abstract: This study investigates the historical origins, linguistic diffusion, and socioeconomic impacts of cotton (*Gossypium spp.*) in the Indo-Pacific region. By reviewing secondary data from historical texts, linguistic databases, and archaeological reports, the research explores how *Gossypium* species, domesticated in both the Old and New Worlds, spread through complex trade networks and cultural exchanges. The study analyzes the dissemination patterns of cotton-related terminology across various language families and examines the socioeconomic effects of cotton cultivation and trade, including its influence on labor systems, economic structures, and cultural practices. While the findings highlight cotton's significant role in shaping global markets and cultural inter-actions, the study's limitations – such as its reliance on secondary sources, a two-month research duration, and a focus on a specific geographical area – warrant cautious interpretation. These constraints may limit the comprehensiveness and depth of the analysis, suggesting the need for future research to incorporate primary data collection, a broader geographical scope, and an extended study period. Despite these limitations, the study contributes to a nuanced understanding of cotton's historical, economic, and cultural significance, emphasizing the need for sustainable agricultural practices in contemporary cotton production.

Keywords: archaeological; diffusion; terminology; economic; exchanges; linguistic; networks; etymology

1. Introduction

Cotton, a ubiquitous fibre in modern textiles, has a storied history that spans thousands of years and multiple continents. Its journey from wild species to domesticated crops revolutionized agriculture and industry, leaving an indelible mark on human civilization. This study explores cotton's (*Gossypium spp.*) historical origins, linguistic diffusion, and socioeconomic impacts in the Indo-Pacific region. By examining various interdisciplinary evidence, we seek to uncover the intricate processes that facilitated cotton's spread and integration into diverse cultures and economies.

Cotton domestication is a remarkable event in agricultural history, occurring independently in both the Old and New Worlds. In Southwest Asia and the Americas, early cultivators recognized the potential of *Gossypium* species for producing durable and versatile fibres. Archaeological discoveries from Mohenjo-Daro in the Indus Valley and coastal sites in Peru provide compelling evidence of early cotton cultivation and textile production dating back to ancient civilizations. These findings illustrate the ingenuity and adaptability of early agricultural societies in harnessing natural resources to meet their needs.

The spread of cotton from its centres of domestication was facilitated by a complex web of trade routes that connected distant regions. These routes were not merely conduits for goods but also vectors for cultural and technological exchanges. With its strategic geographical position, the Indo-Pacific region played a pivotal role in the dissemination of cotton. Maritime and overland trade routes linked the Indian subcontinent with Southeast Asia, China, the Middle East, and beyond. Along these routes, cotton and cotton-related knowledge were exchanged, influencing agricultural practices and textile production in numerous societies.

Linguistic evidence provides a unique lens through which to trace the diffusion of

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cotton. The analysis of cotton-related terminology across different languages reveals patterns of contact and exchange among various cultures. The work of scholars such as Johnson and Decker (1980) have shown that linguistic diffusion is often intertwined with trade and migration, reflecting the movement of people and ideas. By examining the etymology and distribution of cotton-related words, we can gain insights into the historical pathways of cotton spread and the interactions between different linguistic and cultural groups.

The socioeconomic impacts of cotton cultivation and trade are multi-dimensional. Cotton's desirable properties—absorbency, flammability, and durability – made it a highly sought-after commodity in ancient and medieval markets. Its production and trade catalyzed economic specialization, the growth of urban centres, and the formation of extensive trade networks. The works of Beckert (2017) and Olmstead and Rhode (2018) highlight how cotton became a cornerstone of global commerce, driving economic growth and industrialization. Cotton cultivation and trade brought significant socioeconomic transformations in the Indo-Pacific region, influencing livelihoods, social structures, and cultural practices.

This study adopts a multidisciplinary approach, integrating historical texts, linguistic analyses, archaeological evidence, and ethnographic studies to comprehensively understand cotton's role in the Indo-Pacific. By synthesizing these diverse strands of evidence, we aim to construct a nuanced narrative of cotton's historical significance. This narrative will illustrate how the independent domestication of cotton species and cultural and technological exchanges facilitated its spread and integration into various economic systems. Furthermore, it will highlight the profound socioeconomic impacts of cotton, shaping both local economies and global trade networks.

The objectives of this study are threefold: first, to trace the historical origins and domestication of *Gossypium* species in the Indo-Pacific; second, to explore the linguistic diffusion of cotton-related terminology and its implications for understanding cultural exchanges; and third, to analyze the socioeconomic impacts of cotton cultivation and trade on ancient and modern societies in the region. This study aims to contribute to a deeper understanding of cotton's role in human history and its enduring legacy in the Indo-Pacific by achieving these objectives. Specifically, it seeks to answer the following questions:

1. What are the historical origins and dissemination patterns of *Gossypium* species (cotton)?
2. How do linguistic and cultural exchanges explain the spread of cotton-related terms and technological practices in a socioeconomic context?
3. What socioeconomic impacts did the cultivation and trade of cotton have on economic structures and cultural interactions?

2. Materials and Methods

This study utilized a literature review to investigate cotton's historical origins, linguistic diffusion, and socioeconomic impacts (*Gossypium spp.*) in the Indo-Pacific region. The research was conducted over two months, focusing on primary sources accessed through online databases such as Google Scholar. No direct participants were involved; secondary data from historical texts, linguistic databases, and archaeological reports were used. Historical records provided information on cotton cultivation and trade, while linguistic databases were consulted to analyze cotton-related terminology across various language families, including Austronesian, Austroasiatic, Indo-European, and Amerindian. Additionally, reports from key archaeological sites in India, Peru, and Southeast Asia were reviewed to understand early cotton cultivation practices.

Data collection involved comprehensive searches of online databases for relevant literature and primary historical documents related to cotton. Linguistic analysis focused on the diffusion of cotton-related terms, tracing their spread across different languages. Archaeological findings were examined to provide context on early cotton use and cultivation. The data analysis comprised mapping the chronology of cotton's domestication and spread, comparing cot-ton-related terminology across language families, and assessing the economic and cultural impacts of cotton cultivation and trade. The study aimed to construct a coherent narrative of cotton's significance in shaping ancient and modern societies in the Indo-Pacific region by synthesizing insights from historical, linguistic, and socioeconomic perspectives.

The study has several limitations that should be considered when interpreting the findings. The research was conducted over two months, restricting the depth of exploration and analysis. This constraint may have limited the comprehensive coverage of all relevant sources and data. The study relies exclusively on secondary data sources, including historical

texts, linguistic databases, and archaeological reports. This reliance may introduce biases or gaps in the data, as the analysis depends on the availability and accuracy of existing records. The geographical focus on the Indo-Pacific region, while providing valuable insights, may not fully capture the global context of cotton's historical and cultural impact, potentially limiting the applicability of the findings to other regions. The linguistic analysis of cotton-related terminology across various language families is based on available linguistic databases and may not account for all nuances and variations within and between languages.

Moreover, the complexity of linguistic diffusion, influenced by multiple factors, poses challenges in providing a comprehensive analysis. The interpretation of archaeological data depends on the available evidence and the quality of the reports reviewed, potentially limiting the accuracy and completeness of the historical narrative. Finally, the study did not involve direct fieldwork or collecting new primary data, which may have provided additional insights or corroborated existing findings, thus restricting the ability to verify and expand upon secondary sources.

3. Results and Discussion

This section presents the findings and analysis of the study on cotton (*Gossypium spp.*) within the Indo-Pacific region, focusing on its historical origins, linguistic diffusion, and socioeconomic impacts. The study employed a multidisciplinary approach, integrating historical texts, linguistic databases, and archaeological reports to investigate cotton's spread and integration. We will first examine the historical patterns of cotton domestication and dissemination, then analyze how linguistic and cultural exchanges facilitated the diffusion of cotton-related terminology and practices. Finally, the socioeconomic effects of cotton cultivation and trade on regional and global economic structures will be discussed. This comprehensive analysis aims to provide a detailed understanding of cotton's influence on the economic and cultural development in the Indo-Pacific region.

3.1. Historical Origins and Dissemination of Gossypium Species

The domestication of *Gossypium species* – *G. herbaceum* and *G. arboreum* in Southwest Asia, and *G. hirsutum* and *G. barbadense* in the Americas – marks significant milestones in agricultural history. Archaeological evidence from sites such as Mohenjo-Daro (2300-1750 B.C.) and coastal Peru corroborates early cotton use and cultivation practices (Lee & Fang, 2015). These species' domestication and subsequent spread did not occur in isolation; a complex interplay of cultural exchanges, technological innovations, and economic demands facilitated it. This interplay highlights the interdependence of different regions and cultures in shaping agricultural practices.

The spread of Old World cotton to Africa and the Mediterranean is attributed to Islamic trade networks, while New World cotton species spread to the Pacific Islands, likely through prehistoric trade and migration (Johnson & Decker, 1980). For example, cotton textiles found in Egyptian tombs indicate that *G. herbaceum* had reached Africa by 500 B.C. Similarly, cotton fibres discovered in the Peruvian Andes provide evidence of cotton's significance in pre-Columbian South America. These findings underscore the role of trade networks in the diffusion of cotton cultivation practices, bridging diverse geographical and cultural landscapes.

Furthermore, the historical dissemination of *Gossypium* species underscores the significance of trade routes such as the Silk Road and maritime routes in the Indian Ocean and the South China Sea. These trade routes facilitated the movement of goods and the exchange of agricultural practices and technological innovations. This dissemination process was influenced by the economic incentives provided by cotton's versatile use in textiles and the cultural exchanges between trading partners. Thus, cotton's spread illustrates the dynamic nature of early global trade systems, where economic and cultural factors were deeply intertwined.

The independent domestication of cotton in various regions underscores its adaptability and significance as a crop. Olmstead and Rhode (2018) establish that Old World cotton species like *Gossypium herbaceum* and *Gossypium arboreum* were cultivated in the Indus Valley and other parts of South Asia, while New World species, *Gossypium hirsutum* and *Gossypium barbadense*, originated in Mesoamerica and South America. This information suggests that the practice of cotton cultivation arose independently in several geographically distinct areas, driven by local needs and innovations. Consequently, the parallel evolution of cotton cultivation in different regions reflects a universal recognition of its value and utility.

Johnson and Decker (1980) highlight the complex dissemination patterns of cotton, showing how terms and technological practices related to cotton spread through cultural exchanges and trade routes. For instance, the spread of Old World cotton to Africa and the Mediterranean is attributed to Islamic trade networks, while New World cotton species spread to the Pacific Islands, likely through prehistoric trade and migration. Baumgartner (2012) supports this by documenting early Chinese and Southeast Asian trade connections with the Philippines, particularly Cebu, which became a significant cotton cultivation and trade centre before Spanish colonization. This evidence suggests that the diffusion of cotton resulted from economic factors and cultural exchanges that fostered technological innovations.

Baumgartner (2012) explores the pre-Spanish cotton industry in Cebu, using Ramon Echevarria's work as a critical reference. Baumgartner points to Echevarria to draw the suggestion that southern Cebu was a significant cotton cultivation and weaving centre, attracting Chinese and Siamese traders. Testimonies from Spanish-era writers and governmental documents indicate a robust cotton industry in the Chinese trade during the Spanish conquest. However, Spanish trade restrictions and economic shifts caused the industry's decline. This decline illustrates the vulnerability of local industries to external economic and political forces.

According to Baumgartner (2012), Echevarria's archaeological exploration reveals Cebu's historical trade significance through abundant porcelainware, indicating a diverse and extensive trade network. While Echevarria posits cotton as the primary trade commodity, Fox suggests a broader geographical trade pattern with no significant Philippine entrepôts before the 15th century. Echevarria's analysis of early Chinese accounts offers interpretations of geographic names and trade descriptions, proposing Cebu as a significant pre-colonial trade hub. Despite inherent difficulties in transliterating Chinese ideograms, Echevarria's work opens new avenues for understanding the economic and cultural dynamics of Cebu's pre-colonial past. These insights reflect the complex and interconnected nature of pre-colonial trade networks.

Similarly, Riello (2016a) mentions that by the ninth and tenth centuries, finer Indian cotton cloths had reached the Middle East through Gulf ports, alongside other commodities like Islamic earthenware and Chinese porcelain. This highlights a well-established trade network that facilitated the spread of cotton textiles over vast distances. The mention of Potieh cotton varieties and the special variety of cotton traded to Tang China via the "cotton Road" exemplifies how specific cotton varieties travelled across Asia, indicating a diverse range of cotton products and a sophisticated distribution system. These trade dynamics reveal cotton's extensive reach and influence in early global markets.

Riello (2016a) elaborates on how cotton cultivation began in India and gradually spread to other regions, including China, the Middle East, and Africa, around 1000 CE. This spread created a global system of cotton production and trade, with India at its core due to the high quality of its cotton textiles. Riello's analysis underscores India's dominant role, noting that "India indeed emerged as a core area," and discusses the "First Cotton Revolution," a period when Indian cotton textiles achieved global relevance and dominated international markets (p. 66). This revolution illustrates India's centrality in the early global cotton economy.

Building on this, Riello (2016b) elucidates the extensive trade and popularity of Indian cotton textiles during what is described as "the first global age" (late 15th century to the late 18th century). Indian cotton had already established markets across the Indian Ocean before European traders like the Portuguese, English, Dutch, and French arrived. From the 1500s, Indian cotton began penetrating new markets, particularly in Europe and the Americas, marking a significant shift in consumer habits worldwide. Indian cotton evolved from regional trade to a global commodity, indicating a well-established production and trade system long before European colonization and industrialization. This shift underscores the transformative impact of cotton on global trade patterns and consumer behaviour.

Indian cotton textiles were dominant in international markets well before the Industrial Revolution. Riello (2022) notes that up to three-quarters of what was exported to Europe from Asia was Indian cotton. Indian cotton was also significant in intra-Asian trade. The dissemination patterns of cotton were shaped by the extensive trade networks established by the East India companies, which facilitated the movement of cotton from India to Europe and the Atlantic world. This historical narrative indicates that the origins of cotton cultivation and its global dissemination are deeply rooted in the pre-industrial period, emphasizing the role of Indian cotton in connecting diverse regions.

Furthermore, Riello (2022) tackles the English East India Company's London auction of 1660 as an example of Indian cotton's relevance. The textiles, including various Indian

kinds of cotton, demonstrate their pivotal role. Riello explores how regions like Gujarat, the Malabar coast, the Coromandel coast, and Madras played central roles in producing and exporting textiles such as chintz, calicoes, and baftas. His detailed examination of the English Company's interactions in these areas and the types of textiles acquired illustrates the intricate spread of cotton through colonial trade routes, highlighting its global dissemination.

Moreover, Riello (2022) tackles the transformation of British trade from wool to cotton during the 18th century. Integrating Indian and Atlantic Ocean trade routes was crucial in disseminating cotton. Initially reliant on re-exporting foreign cotton fabrics, Britain gradually transitioned to domestic production by the mid-18th century as its manufacturing capabilities improved. Riello notes the pivotal role of Indian cotton in British trade early on, evolving into European-made textiles as local production flourished. This progression illustrates how cotton, initially sourced from India, became integral to British commerce before domestic manufacturing and mechanization took precedence. This transformation highlights the adaptability of cotton to changing economic conditions and technological advancements.

In a different geographical context, Corbett et al. (2021) trace the origins of cotton in the American South, particularly emphasizing the development of Petit Gulf cotton, a hybrid strain derived from Mexican, Georgian, and Siamese varieties. This strain's adaptability to different soils and climates facilitated its widespread cultivation across the southern states, notably in the Mississippi River Valley and new slave states like Louisiana, Mississippi, Arkansas, and Texas. Eli Whitney's invention of the cotton gin in 1793 revolutionized cotton production, making it less labour-intensive and more efficient, thus significantly boosting its cultivation and dissemination. By 1860, the southern United States had produced two-thirds of the world's cotton, highlighting the rapid and extensive spread of cotton cultivation following the invention of the cotton gin. This innovation demonstrates the profound impact of technological advancements on agricultural productivity and economic expansion.

Lastly, Nagano (1998) examines the Japanese attempt to boost cotton production in the Philippines as part of their war effort and economic strategy. The Japanese introduced new seed varieties incompatible with the Philippine climate, underscoring the difficulties in adapting cotton agriculture to new environments. This period is critical for understanding how geopolitical factors influenced the spread and adaptation of cotton cultivation practices in Southeast Asia. The article details how the Japanese Military Administration (JMA) attempted to introduce and expand cotton cultivation in the Philippines, which was part of a broader strategy to secure raw materials during wartime. This dissemination was characterized by assigning Japanese private firms to oversee local cotton production, highlighting the region's significant cultural and economic exchange period. The production involved selecting various cotton varieties, such as "Batangas White" and "Ilocos White." It introduced types like "Kings Improved" from Korea and "Express" from North China, reflecting an intersection of local and imported agricultural practices. The Japanese plan to expand cotton cultivation from 2,000 to 455,000 hectares highlights a significant effort to reorganize and increase local production under wartime pressures (Nagano, 1998). This effort illustrates how colonial powers used their influence to alter agricultural patterns in their territories.

Cotton has a rich history, with its origins rooted in the domestication of various *Gossypium* species across different regions. Lee and Fang (2015) detail the significance of four domesticated cotton species, tracing their early uses and global dissemination. Archaeological evidence from sites like Mohenjo-Daro in Southwest Asia and coastal Peru suggests early cultivation and use of cotton, indicating its widespread significance. The technological advancements in ginning and spinning, such as Eli Whitney's cotton gin, played a crucial role in transforming cotton into a global commodity, facilitating its spread from its regions of origin to extra-tropical areas. This transformation was pivotal during the Industrial Revolution, where mechanized cotton production reshaped economies globally, highlighting cotton's role in trade and manufacturing from Alexander the Great's era to modern times. This historical overview emphasizes the interconnectedness of technological innovation, economic demand, and cultural exchange in the global dissemination of cotton.

The independent domestication and subsequent dissemination of cotton highlight the crop's vital role in various civilizations. The cotton spread through trade routes facilitated the commodity exchange and the transfer of agricultural practices and technological innovations. This exchange was driven by economic incentives and cultural interactions, shaping the development of textile industries and trade networks across different regions. Through this lens, the story of cotton becomes a testament to the dynamic and interconnected nature of human societies and their agricultural practices.

3.2. Linguistic Connections and Cultural Exchanges in the Socioeconomical Perspective

The exploration of linguistic and cultural exchanges reveals how cotton, as a commodity, traversed various socioeconomic landscapes, fostering both economic activities and cultural transformations. By examining the diffusion of 'cotton' terminology and associated technological practices, we uncover the intricate web of ancient trade networks and cultural interactions that facilitated the spread of cotton cultivation and textile technologies.

Linguistic analysis offers profound insights into the socioeconomic dimensions of cotton's diffusion. Johnson and Decker (1980) documented the diffusion of 'cotton' terminology from Indian and Polynesian languages, reflecting the extensive trade routes that connected diverse regions. The comparative study of semantic similarities between Indo-Aryan and Dravidian languages suggests shared technological practices in cotton cultivation and textile manufacturing, indicating a flow of knowledge essential for economic activities. This integration of cotton-related terminology into various languages highlights the historical intricacies of trade and cultural exchanges.

For instance, the Polynesian term "vavae" for cotton, traced back to Austroasiatic roots, underscores early contact and the spread of cotton cultivation knowledge (Johnson & Decker, 1980). This linguistic diffusion mirrors the socio-political dynamics, where correlations can be attributed to peaceful trade relations and periods of conflict and conquest. The widespread adoption of cotton-related terms illustrates the interconnectedness of ancient civilizations through trade, significantly impacting socioeconomic structures. The table below presents a comparative analysis of cotton-related terms across language families, underscoring the cultural significance of cotton.

Table 1. Comparative analysis of cotton-related terms across language families

Language Family	**Term for 'Cotton'**	**Term for 'Fire'**	**Notable Connections**
Austronesian	kapas	api	Everyday utility in cordage and textile
Austroasiatic	*bas	*ba	Shared roots in fibre and fire terminology
Indo-European	karpasa	*ker	Borrowings related to the textile trade
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Analyzing linguistic forms related to 'cotton', 'fire', and 'fibre' across various language families reveals regular consonant changes and notable semantic distinctions. These findings suggest significant cultural exchanges and technological transfers essential for the socioeconomic development of cotton cultivation and trade regions.

Significant regional adaptations and variations exist despite the broad diffusion of cotton-related terms. Beckert (2017) notes that while "cotton" has common roots in many languages, the technological practices associated with cotton processing and weaving evolved independently. This resulted in distinct regional textile traditions, reflecting diverse socioeconomic contexts. For example, the intricate textiles of the Indus Valley civilization showcase advanced cotton processing technologies, while pre-colonial Cebu's utilitarian fabrics highlight practical uses of cotton in daily life (Baumgartner, 2012).

This technological practice divergence underscores local innovations' role in shaping regional textile industries. Riello (2016b) highlights the categorization and names of different cotton fabrics by European traders and local producers, reflecting a transfer of terminology and knowledge. The Portuguese, for example, distinguished between different qualities of Indian cottons, such as 'semina', 'tafecira', 'salempuri', and 'percalos'. This nomenclature indicates a blend of linguistic influences and the integration of Indian cotton terms into European trade lexicons.

Additionally, the adaptation of cotton production techniques and patterns in various regions shows a significant cultural exchange driven by the economic value of these textiles. Names given to delicate Indian fabrics, such as "rosy cotton" and "morning sunrise clouds," reflect the cultural appreciation and descriptive terminology that emerged around these luxury items. The transfer of terms and practices is also seen in the widespread use of Indian

kalamkari (pen-work) textiles in Southeast Asia, known as ma'a, mawa, or mbesa. These exchanges facilitated the spread of products and the diffusion of cultural practices and terminologies associated with cotton textiles.

The extensive trade in Indian cotton textiles resulted in adopting and adapting various terms across different cultures. Terms such as "chintz" (referring to painted or printed cotton) and "calico" (used broadly for Indian cotton fabrics) became part of the vocabulary in European markets, indicating the integration of Indian textile culture. Moreover, technological practices associated with cotton production, such as dyeing and printing techniques, spread through these trade networks. The reference to "painted calico where dyes and mordants were applied by hand with a brush" (p. 94) illustrates the transfer of specialized knowledge from Indian artisans to European manufacturers. This cultural exchange involved linguistic assimilation and significant technological advancements that influenced the European textile industry and beyond (Riello, 2022).

The cultivation and trade of cotton significantly influenced both the economies of producing regions and the markets where it was consumed, particularly in the Atlantic context. Riello categorizes the Atlantic market into three central regions: West African markets, the West Indies, and the North American colonies. He notes that the European trade in textiles with West Africa was well-established even before British, French, and Dutch traders arrived in the mid-sixteenth century, emphasizing the scale and competitiveness of this trade. Cotton textiles played a pivotal role in the slave trade, with various types of cotton fabrics exchanged for enslaved individuals, thus integrating cotton deeply into the socioeconomic framework of the Atlantic economy (Riello, 2022).

Furthermore, Riello (2022) explores how the demand for cotton textiles in North America and the West Indies spurred economic growth and facilitated cultural exchanges. Riello highlights that consumption of textiles and household goods per capita in America exceeded that in England by threefold, illustrating the significant impact of cotton goods on colonial American society. The trade-in cotton textiles stimulated economic activity and influenced cultural practices and consumer preferences, leading to a transatlantic cultural exchange that reshaped social identities and economic behaviours.

The spread of cotton-related terms and technological practices is linked to the global trade networks established by European powers. European manufacturers, particularly in Britain, initially struggled to compete with Indian cotton and relied on imitations and adaptations. The prohibition of Indian loom-patterned cloth in 1721 encouraged the growth of domestic production, albeit with initial challenges in quality. Linguistic exchanges can be inferred from adopting and adapting terms related to cotton textiles and manufacturing practices. Riello highlights how technological and entrepreneurial challenges were met by innovative solutions such as printing on plain Indian cotton cloth or European-made linen, reflecting the cultural exchanges and adaptations necessary for developing a competitive domestic industry (Riello, 2022).

Turning to the Japanese interlude in the Philippines, the interaction between Japanese firms and local Filipino farmers necessitated a transfer of agricultural knowledge and technology. This exchange was mediated through contractual agreements where local farmers were engaged in cotton cultivation under the supervision of Japanese firms, such as Toyo Menka Co. and Taiwan Takushoku Co. These firms introduced new agricultural techniques and management practices, which inevitably led to the exchange of terminology and practices between the Japanese and Filipino agricultural workers. The involvement of Filipino technical staff and graduates from the University of the Philippines, Los Baños, indicates a significant exchange of knowledge and skills, fostering a shared understanding of cotton cultivation techniques and related linguistic terms. Japan's attempts to import spindles and looms and establish joint ventures with local corporations like the NDC and Daiwa Boseki Co. illustrate a form of technological diffusion (Nagano, 1998).

The spread of cotton cultivation and its associated technologies were deeply intertwined with linguistic and cultural exchanges. For instance, "cotton gin" entered the lexicon following Whitney's invention, illustrating how technological innovations drive language evolution. The phrase "to be sold down the river" emerged in this era, reflecting the forced migration of enslaved people from the upper southern states to the Deep South to cultivate cotton. Such linguistic developments were not just a reflection of new agricultural practices but also of the socioeconomic realities and cultural exchanges in the antebellum South. Additionally, the widespread cultivation and processing of cotton necessitated new agricultural practices and terminologies, further embedding cotton-related terms into the socioeconomic and cultural fabric of the region (Corbett et al., 2021).

The spread of cotton-related terms and technological practices can be traced through linguistic and cultural exchanges. Johnson and Decker (1980) provide a comparative analysis of linguistic forms related to cotton, documenting the spread of cotton-related terminology from an Indian nexus throughout Eurasia and the Indo-Pacific. Their study suggests that Polynesian terms for cotton may derive from Austroasiatic languages, indicating cultural linkages between cotton and fire-making. This linguistic diffusion reflects peaceful trade relations and periods of conflict, showcasing the complex socio-political dynamics. The integration of cotton-related terminology into multiple languages exemplifies the multifaceted nature of historical interactions and the role of cotton in these exchanges. The Meranaw traditional ballad tie-dye technique, as examined by Alauya (2020), further highlights the cultural significance of cotton in Indigenous practices, utilizing natural resources and plant fibres for weaving, which underscores the historical depth of cotton-related traditions.

The linguistic diffusion of cotton-related terms underscores the interconnectedness of ancient civilizations through trade and cultural exchange. By analyzing the commonalities and differences in these terms and considering the diverse technological adaptations, we gain a nuanced understanding of how cotton cultivation and processing spread globally. This synthesis of linguistic and cultural evidence highlights the role of cotton as both a commodity and a medium of cultural interaction, shaping the economic and social landscapes of various regions.

3.3. Socioeconomic Impacts

The cultivation and trade of cotton significantly influenced socioeconomic structures and cultural interactions globally and locally, with profound impacts on economic growth, industrialization, and cultural practices. Johnson and Decker (1980) highlight cotton's properties—absorbent, flammable, and durable—that revolutionized textile production and facilitated economic specialization. Furthermore, Beckert (2017) discusses how cotton drove economic growth and industrialization, particularly in the United States and Britain. The high demand for cotton textiles fueled the expansion of plantations and mills, creating vast economic networks and altering labour systems. Similarly, Olmstead and Rhode (2018) emphasize cotton as a cornerstone of global commerce, driving economic growth and industrialization, notably through the intensification of slavery in the American South.

In the Philippines, Baumgartner (2012) documents the pre-Spanish cotton industry in Cebu, which attracted international traders and facilitated economic exchanges. However, Spanish colonization and trade restrictions led to the decline of the industry. This decline is further evidenced by Amper (2014), who highlights the traditional use of cotton in Santander, Cebu, and its decline due to global and colonial influences. Despite globalization pressures, local practices in Santander have sustained cotton's presence, though production has drastically declined since the late 19th century. The study also underscores the medicinal use of cotton in Santander, where different parts of the plant were used in various remedies. Furthermore, Balisacan (1983) discusses the challenges faced by 20th-century efforts to revive cotton cultivation in the Philippines, including competition from synthetic fibres and policy inefficiencies. Despite these efforts to promote import substitution and increase domestic cotton production, the industry struggled to compete with cheaper synthetic alternatives.

India's dominance in cotton textile production brought economic prosperity and spurred high technological development rates. Riello (2016a) points out that technological advancements in cotton production, such as the spinning machine, allowed Europe to transition from being an importer to a producer of cotton textiles. Consequently, this shift marked the beginning of Europe's industrial dominance and reshaped global economic structures. This transformation was further facilitated by Europe's engagement with global markets and the establishment of cotton plantations in colonies, which provided a steady supply of raw materials for European industries. He emphasizes that the Industrial Revolution in Europe relied heavily on the global trade of cotton, transforming Europe's economic landscape and contributing to the "Great Divergence" between Europe and Asia. Riello (2016a) argues that cotton played a pivotal role in this divergence by transforming Europe's economic landscape, stating, "The story of cotton should be interpreted as one of economic and socio-cultural transformation that was as reliant on factors endogenous to Europe as it was on external stimuli" (p. 64).

Indian cotton textiles also held deep cultural significance and were integral to Southeast Asia's various social and ceremonial practices. These textiles were symbols of social prestige, embedded in rituals and traditions, such as curing diseases, death rites, sanctifying icons, and payment of services and taxes. This cultural significance is highlighted by Riello (2016b), who

contrasts the accessibility of Indian cotton textiles with the exclusivity of Chinese silks, noting that Indian cotton reached all social strata, from Chinese peasants to European housewives and enslaved Africans. This widespread availability marked a shift towards mass consumption and altered traditional consumption patterns by replacing materials like arrowroot and linen. Introducing Indian cotton into global markets also precipitated significant economic changes, fostering new market dynamics and consumer behaviours. For instance, Riello (2016b) notes that Indian cotton is affordable and high in quality, capable of serving both luxury and everyday needs. This duality, like Indian cotton – as both a luxury and an ordinary commodity – helped reshape economic structures by broadening the base of consumers and altering trade practices.

Moreover, integrating the Indian Ocean and Atlantic trade networks facilitated the exchange of raw materials and finished goods, bolstering European industrial growth. Riello (2022) discusses the "diamond-shape trade" system, highlighting the role of the Atlantic slave trade in the cotton economy and the interdependence of regions in the global cotton trade. He notes a decline in the importance of wool and a rise in cotton's prominence within British trade, which laid the groundwork for the Industrial Revolution. According to Riello, from 1675 to 1775, British trade underwent pivotal changes, diversifying exports to encompass metalware and cotton textiles. This transformation revolutionized British manufacturing and had broader economic implications, fostering international trade and reshaping socioeconomic structures. The growing demand for cotton textiles spurred the development of manufacturing hubs such as Manchester, identified by Riello as a pivotal location where an industry emerged producing affordable yet high-quality cloth for both domestic and Atlantic markets.

In the context of the Philippines under Japanese rule, Nagano (1998) examines the socioeconomic impacts of cotton production. The Japanese initiative to make the Philippines a significant cotton producer faced multiple obstacles, including climatic incompatibility, local resistance, and guerrilla activities. This effort disrupted agricultural practices and led to significant economic consequences, such as a severe rice shortage from converting rice lands to cotton cultivation. The introduction of cotton production disrupted existing agricultural practices, as seen in converting upland rice lands, sugarlands, and other crop areas into cotton fields. This shift had profound economic consequences, including a severe rice shortage from converting rice lands to cotton cultivation. The resistance from local landlords and peasants and guerrilla activities highlighted the cultural and political tensions arising from this economic imposition.

Furthermore, the economic relationship between Japanese firms and local farmers, characterized by contract growth, created a new socioeconomic dynamic where Japanese firms provided technical and financial support while local farmers managed the cultivation. This arrangement reflects a blend of economic dependence and collaboration that reshaped local agricultural economies and cultural interactions. Nagano (1998) details the significant strain on the Philippine economy due to Japan's ambitious but unrealistic cotton production goals. The failure to meet production targets led to a severe shortage of raw cotton, impacting the local textile industry and contributing to the scarcity of cotton goods for the Filipino population. The prioritization of cotton goods for the Japanese military over local needs exacerbated the economic hardships faced by the Filipino people, leading to inflated prices and widespread shortages. Additionally, the introduction of rationing systems and the creation of organizations like Primco and Nadisco were attempts to manage these shortages. However, they ultimately fell short due to continued scarcity and black market activities (Nagano, 1998).

The socioeconomic impacts of cotton cultivation were not limited to the Philippines. Cotton became the antebellum South's primary commercial crop in the United States, eclipsing tobacco, rice, and sugar in economic importance by the mid-19th century. Corbett et al. (2021) describe how the cotton boom transformed the Southern economy, making cotton the critical cash crop and leading to the extensive use of enslaved labour for its production. By 1860, 1.8 million out of 3.2 million enslaved people in the slave states were involved in cotton production, demonstrating the crop's central role in the region's economic structure. The economic success of cotton also fueled the Industrial Revolution, both in the United States and Great Britain, by providing raw materials for textile mills. Corbett et al. (2021) note that Southern cotton picked and processed by enslaved labourers was crucial in sustaining the textile industries in both regions. The socioeconomic impact extended to the development of transportation infrastructure, particularly steamboats, which became essential for transporting cotton along the Mississippi River to ports like New Orleans. This transportation revolution further integrated the southern economy into national and global

markets, with New Orleans emerging as a critical hub for cotton export to Europe, especially Great Britain. Moreover, the economic dependence on cotton solidified the institution of slavery in the South, leading to a domestic slave trade that forcibly relocated hundreds of thousands of enslaved people to cotton-growing regions. Corbett et al. (2021) vividly describe how this internal slave migration was one of the most significant forced movements of people in U.S. history, highlighting the profound human cost of cotton's economic success.

Balisacan (1983) also analyzes the Philippine national cotton development program initiated in the early 1970s to promote import substitution and address the significant outflow of $30 million annually for cotton lint imports. The research identified over 530,000 hectares suitable for cotton farming, with 150,000 hectares fitting into existing cropping systems, surpassing the 115,000 hectares needed for self-sufficiency. By 1980-81, cotton cultivation expanded to 17,000 hectares from a mere 194 hectares in 1974-75. The study examines the competitiveness of domestic cotton versus imports and the impact of government policies on domestic production. Balisacan delves into the historical trajectory of the Philippine cotton industry, tracing its roots to the pre-Hispanic era and highlighting significant periods such as the decline during Spanish colonization, revival attempts post-World War II, and the significant developments in the late 1960s and early 1970s. Legislative actions and the establishment of critical institutions like the Philippine Textile Research Institute in 1967 and the Philippine Cotton Corporation in 1973 marked a turning point, leading to increased research and development efforts and the identification of suitable cotton varieties.

The study also analyzes the economic and policy dynamics within the domestic raw cotton scenario. It notes the decline in cotton lint imports despite rising per capita income and population, attributed to competition from synthetic fibres. The introduction of synthetic fibres in the 1950s and the subsequent fluctuations in world cotton prices significantly influenced the local textile industry, leading to a decrease in cotton content in fabrics. However, post-1973, rising synthetic fibre prices led to an increase in cotton content in local fabrics. Balisacan critically examines the structure of incentives within the industry, focusing on nominal and effective protection rates. The study reveals that despite an average nominal protection rate of 28% from 1975 to 1981, domestic cotton production struggled due to the relatively high cost of production and lack of international competitiveness. The analysis suggests that government policies promoting cotton production often resulted in distorted incentives and inefficiencies within the sector.

In conclusion, the socioeconomic impacts of cotton cultivation and trade were multifaceted and profound. Globally, cotton drove economic growth and industrialization, transforming labour systems and trade networks. Locally, it influenced agricultural practices, cultural interactions, and economic structures, with regions like Cebu experiencing significant changes due to colonial policies and global market forces. Integrating global perspectives with regional analyses reveals a comprehensive view of cotton's transformative potential and vulnerability to external influences. Consequently, these historical insights offer valuable lessons for understanding global trade dynamics, economic development, and cultural change while highlighting the need for sustainable agricultural practices considering local contexts and global market trends.

4. Conclusions

Gossypium species (cotton) domestication and dissemination have deep historical roots, with *G. herbaceum* and *G. arboreum* domesticated in Southwest Asia and *G. hirsutum* and *G. barbadense* in the Americas. Archaeological evidence from sites like Mohenjo-Daro and coastal Peru shows early cotton use and cultivation. The spread of cotton was facilitated by complex trade networks, cultural exchanges, and technological innovations, such as Eli Whitney's cotton gin. Old World cotton spread to Africa and the Mediterranean through Islamic trade networks, while New World cotton reached the Pacific Islands. The significance of trade routes like the Silk Road and Indian Ocean maritime routes in disseminating cotton, alongside the independent domestication of cotton in different regions, underscores its adaptability and global economic importance. The role of Indian cotton in global trade, especially before and during the Industrial Revolution, highlights the crop's influence on global markets and economies. Additionally, Japan's efforts to boost cotton production in the Philippines during wartime exemplify the geopolitical impact on cotton agriculture. Cotton's history reflects a rich tapestry of technological innovation, economic demand, and cultural exchange across diverse civilizations.

Linguistic and cultural exchanges were crucial in spreading cotton-related terms and

technological practices across various socioeconomic landscapes. The diffusion of 'cotton' terminology, documented by Johnson and Decker (1980), highlights the extensive trade networks connecting diverse regions. For instance, the Polynesian term "vavae" for cotton, traced to Austroasiatic roots, signifies early contacts and knowledge transfer. Comparative studies of semantic similarities between Indo-Aryan and Dravidian languages suggest shared technological practices in cotton cultivation and textile manufacturing, crucial for economic activities. The adoption of cotton-related terms, such as "chintz" and "calico," into European languages reflects the integration of Indian textile culture into global markets. Technological advancements, like the cotton gin, and the cultural adaptation of production techniques, such as Japanese agricultural practices in the Philippines, further illustrate these exchanges. The linguistic diffusion of cotton-related terms, alongside cultural practices, underscores the interconnectedness of ancient civilizations and their economic and social structures. This linguistic and cultural evidence synthesis reveals how cotton, as both a commodity and a cultural element, was influenced and shaped by different regions' socioeconomic and cultural dynamics.

The cultivation and trade of cotton had profound socioeconomic impacts on economic structures and cultural interactions globally and locally. Cotton's properties, as highlighted by Johnson and Decker (1980), revolutionized textile production and facilitated economic specialization, driving growth and industrialization, especially in the United States and Britain. This demand expanded plantations and mills, transforming labour systems and creating vast economic networks. In the Philippines, the pre-Spanish cotton industry in Cebu attracted international traders but declined under Spanish colonization, with global market forces further challenging local production. India's dominance in cotton textiles spurred technological advancements, significantly contributing to Europe's Industrial Revolution and reshaping global economic structures, as Riello (2016a) describes. Indian cotton textiles also held cultural significance, influencing Southeast Asia's social and ceremonial practices and fostering new market dynamics and consumer behaviours. The integration of global trade networks, including the "diamond-shape trade" system involving the Atlantic slave trade, facilitated economic growth and cultural exchange, as Riello (2022) noted. In the antebellum South, cotton became the primary commercial crop, entrenching the institution of slavery and integrating the region into global markets, a transformation vividly described by Corbett et al. (2021). In the Philippines, Japanese efforts to establish cotton production during occupation faced numerous challenges, impacting local agricultural practices and the economy, as Nagano (1998) detailed. Despite efforts to revive cotton cultivation in the Philippines in the 20th century, as analyzed by Balisacan (1983), the industry struggled against synthetic fibre competition and policy inefficiencies. These complex socioeconomic impacts underscore cotton's role in shaping global trade dynamics, economic development, and cultural interactions, highlighting the need for sustainable agricultural practices considering local and global contexts.

In conclusion, the study sheds light on the historical origins, linguistic diffusion, and socioeconomic impacts of cotton (*Gossypium spp.*) in the Indo-Pacific region. The findings highlight cotton's significant role in shaping economic structures and cultural interactions through widespread cultivation and trade. The analysis of linguistic and cultural exchanges reveals the extensive reach and integration of cotton-related terminology and technological practices across diverse civilizations, underscoring cotton's adaptability and influence in global markets. However, it is essential to acknowledge the study's limitations, such as the reliance on secondary sources, the restricted timeframe of two months, and the focus on a specific geographical region. These constraints influenced the comprehensiveness and depth of the findings, as well as the accuracy of the linguistic analysis. The absence of new primary data collection and the potential biases in historical texts and reports further emphasize the need for cautious interpretation. Given these limitations, future research should consider a broader geographical scope and longer study duration, incorporate primary data collection, and include fieldwork to validate and expand the existing knowledge. By addressing these limitations, future studies can provide a more comprehensive and nuanced understanding of cotton's historical, economic, and cultural significance across different regions and periods.

Future researchers should investigate the regional variations and technological innovations associated with the domestication and dissemination of *Gossypium* species, exploring the distinct agricultural practices and textile technologies that emerged across different cultures. Investigating the role of ancient trade networks, such as the Silk Road and Indian Ocean maritime routes, in the spread of cotton can offer valuable insights into the interconnectedness of ancient economies and cultures. Researchers should also examine the

linguistic diffusion of cotton-related terminology and its implications for understanding cultural exchanges and technological transfers. Additionally, a comparative analysis of the socioeconomic impacts of cotton cultivation across different regions, especially regarding labour systems and economic specialization, could provide a more nuanced understanding of its global influence. Further studies on the geopolitical aspects of cotton agriculture, such as Japan's wartime efforts in the Philippines, can shed light on the interplay between political agendas and agricultural practices. Finally, an interdisciplinary approach that integrates archaeological, linguistic, and historical evidence can offer a comprehensive view of cotton's role in shaping global economic and cultural landscapes, emphasizing the need for sustainable practices in contemporary cotton production.

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Research Article

Financial Inclusion, Poverty Reduction, and Economic Growth in Nigeria: An Empirical Study Using SVAR Approach (1980-2020)

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Abstract: This study examines the empirical analysis of financial inclusion, poverty reduction and economic growth in Nigeria from 1981 to 2020 using the Structural Vector Auto-Regressive (SVAR) model for analysis, with Gross Domestic Product (GDP) as dependent variable and Branches of Commercial Banks (CBBA), Automated Teller Machine (ATMAD), Mobile Phone-Based Transactions and Broad Money Supply (MS) as explanatory variables. The findings of the study reveal that the unit root test shows that Real Gross Domestic Product (RGDP), Commercial Bank Branches (CBB), Money Supply (MS) and Poverty Rate (PR) are stationary at first difference. The results also reveal that in Nigeria, availability and access to money have a positive shock impact on RGDP, and CBB also has a favourable shock effect on RGDP in Nigeria. However, the PR has a negative impact on the RGDP. Therefore, the study recommends that the government should increase its efforts to promote financial inclusion and the Central Bank of Nigeria (CBN) should make commercial banks increase not only their branches but also increase the number of Automated Teller Machines (ATMs).

Keywords: financial inclusion; poverty reduction; economic growth; structural VAR model

1. Introduction

In 2015, the leaders of 193 countries pledged to reduce inequality through Sustainable Development Goals (SDGs) under Goal number 10. Without curbing inequality, meeting SDG goal 1, which is to eliminate poverty, will be impossible. Policymakers and experts all across the world now place more emphasis on financial inclusion. This is a result of its efficient role as a driver of the economy, and also, the promise it holds as a tool for economic development, particularly in the area of wealth creation, employment generation, poverty reduction, improving welfare and general standard of living (Charles-Anyaogu, 2020). Therefore, increasing the poor and marginalized groups' access to financial services is now a global concern (Igwe et al., 2021). This is because it is anticipated that everyone will benefit from economic progress. As such, governments have put in several programs and schemes which are expected to reach a large proportion of the populace. Financial inclusion is a policy that has been recognized to target most of the population (Zhang et al., 2009). A comprehensive financial system is necessary to make resource allocation easier and lower the cost of capital (Migap et al., 2015). Financial inclusion facilitates and accelerates economic growth, job creation, and development (Hassan et al., 2019).

Additionally, having simple access to financial services can enhance daily transactions and decrease the use of informal credits, which are frequently abusive (Akhil, 2016). Financial inclusion has favourable effects on people's income levels and, consequently, on the economy as a whole (Wakdok, 2018). Enhancing financial inclusion modernizes agriculture, promotes innovation, surges entrepreneurship and increases growth (Kelkar, 2010). For low-income groups, access to credit creates entrepreneurship as well as investment opportunities, output increases and hence growth increases (Islam & Mamun, 2011).

Fewer economic activities would be able to be supported in an underdeveloped financial system, where funds are less accessible and that too at greater costs, hence restricting the resulting economic growth. The industrialized financial systems have trouble providing low-income groups with the means to pay for their consumption and other necessities. Poor

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people are generally excluded by formal financial institutions due to a lack of required securities needed for the purpose (World Bank, 2008). Therefore, they have to resort to high-cost informal sources such as moneylenders, thereby leading to the benefits of growth getting concentrated in the hands of those already served by the formal financial system (Reserve Bank of India, 2008).

It is believed that if the poor have access to banking services and benefit from credit supply is financially included. It is further confirmed that the process of financial service is the anti-poverty strategy. Furthermore, poverty reduction means economic growth and an increase in well-being (Magaji & Musa, 2015).

Financial inclusion is attained in the Nigerian context when people have simple access to a wide range of formal financial services that cater to their needs and are offered at reasonable prices (CBN, 2012). It appears that 91 million people in a nation of 140 million are served by informal financial institutions. 82.1 million of these were women and 85.8 million were men. Nigeria's population is anticipated to reach 221.4 million by 2020 using a population growth rate of 3.2%, which is the same rate as the Commission used in 1991 and 2006, respectively. What hope is there for financial inclusion with a potential reduction in poverty using these informal financial service providers, taking into account the amount of savings they can mobilize and the value of loans/credits that they can disburse or give, if the only sources of financial services available to the rural people in Nigeria are informal sources such as money lenders, self-help groups, and rotational savings associations that have been with the poor for decades. For instance, to enhance financial inclusion in Nigeria, banks maintain low minimum account balances to encourage the underprivileged to open accounts even when the bank does not directly profit from such accounts (Magaji et al., 2022).

To this end the research questions that arise are:

What is the relationship between financial inclusion, poverty reduction and economic growth in Nigeria?

What is the impact of financial inclusion on poverty reduction and economic growth in Nigeria?

Therefore, the objective of this study is to check the empirical relationship between financial inclusion, poverty reduction and economic growth in Nigeria from 1981 to 2020, using the SVAR approach.

2. Literature Review

2.1. Conceptual Review

2.1.1. Financial Inclusion

According to Odi and Ogonna (2014), financial inclusion refers to ongoing, significant, cost-effective, and pertinent financial services for the underprivileged. More so, financial inclusion is the condition in which those who can utilize financial services have access to high-quality financial services that are provided at reasonable costs, with appropriate care taken to maintain the client's dignity. It is also a state where everyone has access to the financial services and products they want to manage their money well. Financial aptitude and financial literacy are required to attain it (Lindsay & Gillespie, 2009). Financial inclusion is a condition in which everyone has access to a variety of high-quality financial services that are provided to clients who have the financial means to pay for them in a stable, competitive market, with ease, dignity, and consumer protection (Abbas & Atanda, 2019). From the foregoing, we view financial inclusion as a situation where everyone is not marginalized in financial services.

2.2.2. Poverty

Obadan (1997) claims that there are many different aspects of poverty, such as a lack of purchasing power, risk exposure, malnutrition, a high mortality rate, a short life expectancy, a lack of access to social and economic services, etc. Hunger, malnutrition, poor health, limited or no access to education and other basic services, an increase in morbidity and mortality from illness, homelessness, an insufficient, unsafe, and degraded environment, as well as social exclusion and discrimination, are just a few ways that poverty manifests itself (Shaba et al., 2018). A lack of economic growth, ongoing structural imbalances, sluggish Gross Domestic Product (GDP) growth, high population growth rates, underdevelopment of industries and factors of production, degradation of natural resources, obstacles to rural development as the engine of the economy, and limited access for the vast majority of the population to essential social services are believed to be the main causes of poverty (Magaji

& Musa, 2015). Poverty is thought to be a constraint on people's ability to purchase goods and their standard of living (Aluko & Magaji, 2020). Poverty is caused by several interrelated factors, such as a lack of resources, a need, a pattern of deprivation, a lack of entitlements and fundamental security, dependency, exclusion, social class, economic status, and intolerable hardship (Magaji et al., 2022). Magaji and Adamu (2010) defined poverty as a noteworthy lack of well-being, including the absence of the required abilities, assets, opportunities, and security to make a meaningful contribution to society.

2.2.3. Economic Growth

Economic growth is the rise in the market value of the products an economy produces over time African Economic Outlook, (2016). It is typically expressed as the per cent rate of growth in real gross domestic product, or real GDP. However, the growth ratio of real GDP to population, also known as per capita income, is of greater significance. Intensive growth is the term used to describe a rise in per capita income. Extensive growth is defined as GDP growth that is solely the result of population or geographic expansion (Gordon, 1999). Economic growth refers to the increase of a nation's potential GDP or output, and a significant body of research has been devoted to illuminating how this goal can be attained (Fadare, 2010).

2.2. Theoretical Framework

To underpin this work, Finance Growth Theory is used below:

2.2.1. Finance Growth Theory

The finance-growth theory is used as the theoretical foundation for this study since it holds that financial development, through the "supply-leading" or "demand-following" effect, generates a dynamic, productive environment for growth. This theory also acknowledges that a significant cause of ongoing economic inequality and slow growth is a lack of access to finance. Since income inequality and poverty must be reduced to accelerate growth, access to a safe, simple, and affordable source of finance is recognized as a necessary condition. This promotes equality, enables those who are economically and socially excluded to integrate better into the economy, and helps them actively contribute to development while protecting them from economic shocks (Serrao et al., 2012).

The extremely low level of financial literacy in Nigeria, especially among rural residents, is one of the main obstacles to financial inclusion, making it difficult for business owners to provide banking and other financial services (Magaji et al., 2019). Additionally, the country still has a low level of information and telecommunications literacy, which makes it challenging to acquire financial services (Magaji et al., 2023). The degree of comprehension of financial transactions and the capacity of the illiterate to take advantage of the opportunities in financial services are occasionally hampered by the inadequacy and inappropriateness of awareness efforts (Aina & Oluyombo, 2014). The disparity between the target population's language and the language of instruction is crucial to awareness and lowers communication effectiveness (Magaji & Aliyu, 2007). Financial services cannot be used efficiently by a population that lacks knowledge (Migap et al., 2015).

2.3. Empirical Review

The relationship between financial inclusion, economic growth, and poverty reduction has been the subject of empirical studies. As an illustration, (Afolabi, 2020). Between 1981 and 2017 in Nigeria, the impact of financial inclusion on inclusive growth is examined. The number of bank branches, GDP per person, private sector credit-to-GDP ratio, money supply-to-GDP ratio, and rural loans were among the many factors considered in the study. The Auto-Regressive Distributed Lag (ARDL) model was additionally applied. According to the study, financial inclusion, in the form of rural loans, bank branch count, and liquidity level, has a positive and significant impact on inclusive growth in both the short and long terms, but interest rates serve as a barrier to growth that is inclusive. The Central Bank of Nigeria (CBN) is advised to put financial policies into effect through market-based interest rates, which will surely have an impact on the money supply and, as a result, increase the degree of financial inclusion. The SVAR method, however, can have different outcomes. The years up to 2020 were not included in this study.

Omar & Inaba, however, attempt to clarify whether financial inclusion lessens poverty and income disparity in developing nations in 2020. Their analysis makes use of annual, imbalanced panel data from 2004 to 2016. By combining a variety of financial sector outreach measures, they create a novel index of financial inclusion. According to the study's findings,

the level of financial inclusion in developing nations is highly influenced by factors such as per capita income, the percentage of internet users, the age dependency ratio, inflation, and income inequality. The degree to which financial inclusion has an impact on reducing poverty is not, however, demonstrated by this study. Despite the focus on poverty reduction in this study, the year 2020 was not included in the time frame.

However, Dahiya and Kumar (2020) investigated the relationship between financial inclusion and economic growth in India and discovered that financial inclusion is essential for the long-term growth and development of a country where all societal groups have access to financial services at a reasonable price. Utilization, penetration, and accessibility were the three financial inclusion dimensions used in the study. From 2005 to 2017, they discovered a connection between financial inclusion and economic growth in India. The Bayesian Vector Auto Regression model is used in the study to explain how financial inclusion and economic growth are related. The results indicate that economic growth and financial inclusion in India have a significant relationship. This study was conducted about India and employs a distinct technique.

The rapid expansion of digital financial inclusion in China has significantly increased the accessibility and affordability of financial services and contributed to higher economic growth in China, according to Ahmad and Khan's investigation into the relationship between digital financial inclusion and economic growth in China in 2021. Based on coverage depth, level of digitalization, and usage breadth, their analysis employs the NW Proxy of digital financial inclusion. The results demonstrate that human capital and digital financial inclusion have a major impact on China's provisional economic growth, and they call for increased investment in these areas. The study's time frame was from 2010 to 2020, however, China, not Nigeria, was the focus of the investigation.

Due to the inadequacies in the previous research, it is necessary to do a study that includes Nigeria and the variables of financial inclusion, poverty, and economic growth. This study will use SVAR modelling to determine the effect of financial inclusion on poverty reduction in Nigeria.

3. Materials and Methods

This study examines the Empirical Analysis of Financial Inclusion, Poverty Reduction and Economic Growth in Nigeria from 1981 to 2020 using SVAR methodology. To specify the model, the study adopts the model of Musa, Magaji, and Salisu (2023) in their study Relationship between Financial Inclusion and Economic Growth in Nigeria:

GDP = F (CBBA, ATMAD, MBPT, FDI) (3.1)

Where;

GDP = Gross Domestic Product

CBBA = Branches of Commercial Banks

ATMAD = Automated Teller Machine

MBPT = Mobile Phone-Based Transactions

MS = Broad Money Supply

By dropping some variables in their model and adding new variables, the model of this study is as follows:

$$RGDP = F(MS, CBB, PR) \quad (3.2)$$

Where:

RGDP = Real Gross Domestic Product

MS = Broad Money Supply

CBB = Commercial Bank branches

PR = Poverty rate

Table 1 shows measurement, sources and description of variables in details.

Table 1. Measurement, sources and description of variables.

Variables	Brief description of variable	Sources of data	Period	*A priori* expectation
RGDP	Real Gross Domestic Product. Measured at local currency unit (LCU)	World Development Indicators	1981-2020	+
CBB	Number of commercial Bank Branches	CBN Statistical Bulletin	1981-2020	+
PR	The poverty rate is measured by international measuring standards like the $1 and $2 per day	World Development Indicators	1981-2020	-
MS	Financial Deepening Index expressed as Broad Money Supply to percentage to GDP	World Development Indicators	1981-2020	+

3.1. Structural Vector Auto-Regressive (SVAR) Model

To fulfil the goals of the research endeavour, the study used SVAR to quantify the effects of financial inclusion and poverty reduction on economic growth in Nigeria. The purpose of SVAR analysis is to ascertain the relationships between the variables rather than to ascertain the parameters (Enders, 2015). To meet its objectives, the study employed structural VAR to assess how financial inclusion and poverty reduction affected Nigeria's economic growth. As a result, it treats every variable as having endogenous potential. Using VAR, an econometrics tool, you can visualize how dynamically stationary variables interact with one another. VAR is a model that solely uses endogenous variables and permits the variables to depend on sources other than their lags (Enders, 2015).

$$Y_t = b_{10} - b_{12}Z_t + \gamma_{11}y_{t-1}\gamma_{12}Z_{t-1}\varepsilon_{yt} \quad (3.3)$$

$$Z_t = b_{20} - b_{21}\,y_t + \gamma_{21}y_{t-1} + \gamma_{22}z_{t-1} + \varepsilon_{Zt} \quad (3.4)$$

Yt and zt are dependent variables from equations (3.3) and (3.4), and b12 and b21 quantify the simultaneous effects of zt on yt and yt on zt, respectively. The structural errors are represented by the coefficients yt and zt, while εyt and εzt represent the lagged relationship between the variables.

Where the C1 is the impulse responses of y_{t-1} to a unit shock in ε_t.

$$MS_t = \alpha_{10} - \alpha_{20}\,CBB_t - \alpha_{30}\,PR_t - \alpha_{40}\,RGDP_t + \sum_{t-1}^{p}\beta_{10}^{t}\,MS_{t-1} + \beta_{10}^{t}\,CBB_{t-1} + \beta_{12}^{t}\,PR_{t-1} + \beta_{133}^{t}\,RGDP + \mu_t^{MS} \quad (3.5)$$

$$CBB_t = \alpha_{20} - \alpha_{30}\,MS_t - \alpha_{40}\,PR_t - \alpha_{50}\,RGDP_t + \sum_{t-1}^{p}\beta_{20}^{t}\,CBB_{t-1} + \beta_{30}^{t}\,MS_{t-1} + \beta_{40}^{t}\,PR_{t-1} + \beta_{50}^{t}\,RGDP_{t-1}\,\mu_t^{CB} \quad (3.6)$$

$$PR_t = \alpha_{30} - \alpha_{40}\,MS_t - \alpha_{40}\,CBB_t - \alpha_{50}\,RGDP_t + \sum_{t-1}^{p}\beta_{30}^{t}\,PR_{t-1} + \beta_{40}^{t}\,MS_{t-1} + \beta_{50}^{t}\,CBB_{t-1} + + \beta_{50}^{t}\,RGDP_{t-1}\,\mu_t^{PR} \quad (3.7)$$

$$RGDP_t = \alpha_{40} - \alpha_{50}\,MS_t - \alpha_{60}\,CBB_t - \alpha_{70}\,PR_t + \sum_{t-1}^{p}\beta_{40}^{t}RGDP_{t-1} + \beta_{50}^{t}\,MS_{t-1} + \beta_{60}^{t}\,CBB_{t-1} + \beta_{70}^{t}\,PR_{t-1}\;\mu_t^{GDP} \quad (3.8)$$

3.2. Identification of Restrictions

Identification of constraints is a crucial step in determining if impulse response functions provide accurate structural interpretations when examining the dynamic consequences of a VAR model. This is accomplished by placing the proper contemporaneous constraints on the model's parameters, which are often driven by economic theory and a priori expectations. This enables the structural shocks from the reduced form VAR model to be recovered.

The structural shocks: $e^{FD1}\,e^{CBB}\,e^{PR}e^{RGDP}$ are orthogonal. According to this supposition, the variance-covariance matrix is calculated utilizing orthogonality constraints and error normalization. Financial deepening is affected by the change in commercial bank branches and poverty rate but is not affected by the change in real gross domestic product. Therefore, A_{14}= 0. The commercial bank branch is assumed to be affected by changes in the poverty rate but is not affected by the change in financial deepening and real gross domestic

product therefore A_2 and A_{24}= 0. The poverty rate is affected by the changes in financial deepening and commercial bank branches. Therefore, A_{34}= 0. Real gross domestic products are affected by the changes in financial deepening, commercial bank branches and poverty rate.

The rationale behind the identification scheme is to develop SVAR models for financial inclusion, and poverty rate on economic growth in Nigeria that embody sensible economic interpretations and generate from impulse responses and variance decomposition. However, the study can impose 6 restrictions on the matrix for the SVAR model.

$$\begin{bmatrix} FD1 \\ CBB \\ PR \\ RGDP \end{bmatrix} = \begin{bmatrix} C_1 \\ C_2 \\ C_3 \\ C_4 \end{bmatrix} \begin{bmatrix} 1 & A_{12} & A_{13} & A_{14} \\ A_{21} & 1 & A_{23} & A_{24} \\ A_{31} & A_{32} & 1 & A_{34} \\ A_{41} & A_{42} & A_{43} & 1 \end{bmatrix} \begin{bmatrix} FD1_{t-1} \\ CBB_{t-1} \\ PR_{t-1} \\ RGDP_{t-1} \end{bmatrix} + \begin{bmatrix} 1 & \alpha_{12} & \alpha_{13} & 0 \\ 0 & 1 & \alpha_{23} & 0 \\ \alpha_{31} & \alpha_{32} & 1 & 0 \\ \alpha_{41} & \alpha_{42} & \alpha_{43} & 1 \end{bmatrix} \begin{bmatrix} U_t^{FD1} \\ U_t^{CBB} \\ U_t^{PR} \\ U_t^{RGDP} \end{bmatrix}$$

Where

$$A = \begin{bmatrix} 1 & A_{12} & A_{13} & A_{14} \\ A_{21} & 1 & A_{23} & A_{24} \\ A_{31} & A_{32} & 1 & A_{34} \\ A_{41} & A_{42} & A_{43} & 1 \end{bmatrix}, C = \begin{bmatrix} C_1 \\ C_2 \\ C_3 \\ C_4 \end{bmatrix}, Z = \begin{bmatrix} FD1 \\ CBB \\ PR \\ RGDP \end{bmatrix}, Z_{t-1} \begin{bmatrix} FD1_{t-1} \\ CBB_{t-1} \\ PR_{t-1} \\ RGDP_{t-1} \end{bmatrix}, U_t = \begin{bmatrix} \begin{bmatrix} U_t^{FD1} \\ U_t^{CBB} \\ U_t^{PR} \\ U_t^{RGDP} \end{bmatrix} \end{bmatrix}$$

$$and\ a = \begin{bmatrix} a_{11} & a_{12} & a_{13} & a_{14} \\ a_{21} & a_{22} & a_{23} & a_{24} \\ a_{31} & a_{32} & a_{33} & a_{34} \\ a_{41} & a_{42} & a_{43} & a_{44} \end{bmatrix} \ such\ that\ U_t \sim iid\ (0, \alpha^2)$$

A is a 4 by 4 matrix of the parameters to be estimated and identified with 1 as a diagonal element. C is a 4 by 1 vector of constants. A is a 4 by 1 matrix of the coefficients of lagged variables. And is a 4 by 1 vector of the structural/ orthogonal zed errors, which are assumed to be serially uncorrelated with a mean of zero and a constant variance.

4. Results and Discussion

4.1. Descriptive Statistics

The descriptive statistics applied in the study are shown in Table 2 and it illustrates that the standard deviations of the variables utilized are not considerably different from their means, except for the poverty rate (5.554603). RGDP, the money supply, and the poverty rate are all positively skewed and less than one, while the commercial bank branch and the money supply are both negatively skewed and less than one. This indicates that all the variables used are regularly distributed. Because all of the variables included have values less than 3, the Kurtosis in the table demonstrates that they are all regularly distributed. All of the variables employed were determined to be regularly distributed by the Jarque-Bera test for normality since their p-values were more than 5%, which is the threshold at which the null hypothesis must be rejected.

Table 2. Descriptive statistics.

Statistics	LRGDP	LCBB	LMS	PR
Mean	5.622215	3.331655	1.187891	23.93500
Median	5.535047	3.237292	1.129151	23.60000
Maximum	5.999595	3.764101	1.437414	32.90000
Minimum	5.263785	2.793790	0.957288	12.10000
Std. Dev.	0.255950	0.311647	0.149989	5.554603
Skewness	0.147048	-0.077643	0.370895	-0.432554
Kurtosis	1.468914	1.600352	1.592157	2.935100
Jarque-Bera	4.051195	3.305212	4.220455	1.254372
Probability	0.131915	0.191550	0.121210	0.534093
Sum	224.8886	133.2662	47.51564	957.4000
Sum Sq. Dev.	2.554904	3.787825	0.877373	1203.291

Observations	40	40	40	40

Source: Researcher computation using E-views 10, 2023.

4.2. Unit Root Test

The study evaluated unit root tests of Phillips Perron and Augment Dickey-Fuller to determine the variables' order of integration. Table 3 presents the result of the ADF and PP unit root test. It clearly shows that RGDP, CBB, MS and PR are stationary at the first difference that is, are (I) processes in both ADF and PP tests.

Table 3. Augment Dickey-Fuller (ADF) and Phillips Perron (PP) unit root test.

	Test at level		**Test at first difference**		**Order of Integration**
Variables	**ADF test**	**PP test**	**ADF test**	**PP test**	
Long Run GDP	-0.761801	-0.434123	-4.036978	-3.975280	I(1)
Long Run CBB	-1.345945	-1.354757	-6.613456	-6.615706	I(1)
MS	-1.558242	-0.816385	-4.530998	-4.875958	I(1)
PR	-0.762689	-0.153510	-3.073519*	-3.058159*	I(1)

Source: Researcher computation using E-views 10, 2023.

*Asterisk:** indicates a stationary 5% level of significance.

4.3. SVAR Stability Test

SVAR stability test was used to check whether all of the Eigenvalues are less than one or whether all of the moduli fit inside the unit circle. As seen in Figure 1, the unit circle encompasses all of the moduli. As a result, it may be inferred that the SVAR model is stable and that the shocks' effects are calculable and constrained. SVAR thus satisfies its criteria.

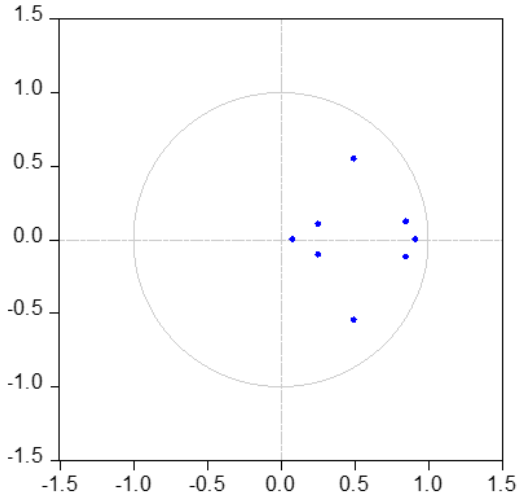

Figure 1. SVAR stability test.

Source: Researcher computation using E-views 10, 2023.

From Figure 1, if all of a VAR model's moduli, or characteristic polynomials, are less than unity and fall within a unit circle, the model is considered to be stable.

4.4. Impulse Response Functions (IRF)

The unconstrained VAR technique's Impulse Response Functions are a helpful tool for looking at how the variables in this study interact with one another (IRFs). They show how certain variables react to systemic disturbances brought on by other variables. IFRs provide a visual depiction of the behaviour of variables in response to shocks when they are presented visually. The outcomes are displayed in Figure 2 below.

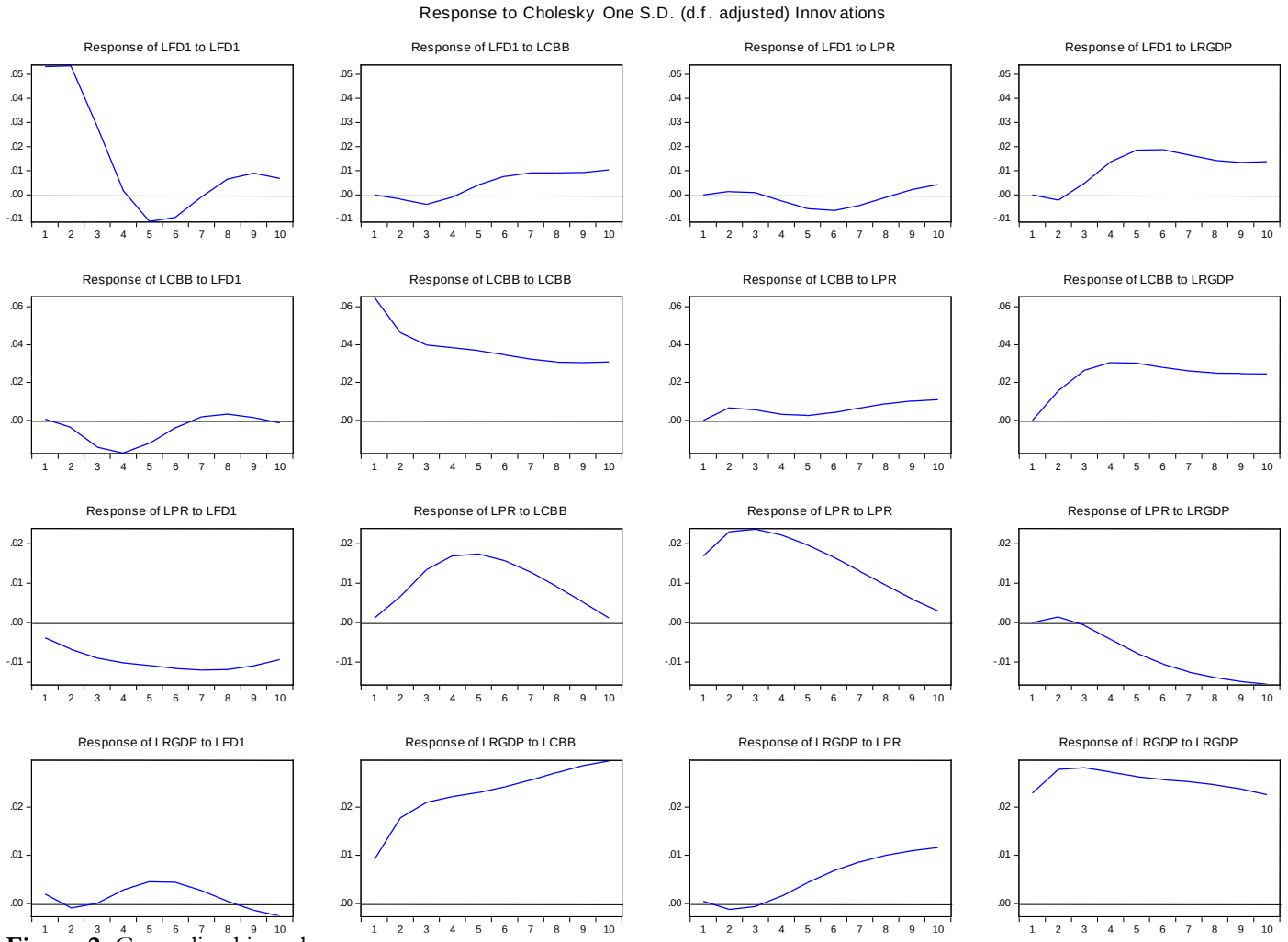

Figure 2. Generalized impulse response.
Source: Researcher computation using E-views 10, 2023.

Utilizing orthogonalized impulse response functions, dynamic changes of each to one standard error shock to each other variable are investigated, notably to the real gross domestic product (GDP) (IFRs). demonstrated in Figure 4.2. There are four shocks namely; financial deepening to proxied to money supply (shock 1), commercial bank branch (shock 2), poverty rate (shock 3) and real gross domestic product shock (shock 4). Each shock occurs over a 10-period time.

The one-unit response of the money supply shock to itself was positive in periods one through four, negative in periods five through seven, and positive in period eight, according to the impulse response functions (IFRs) in Figure 2. Money supply reacts negatively to commercial bank branches in periods one through four before quickly turning positive in periods five through ten. The shock effect of the money supply on the poverty rate was positive from 1 to 3 and negative from 4 to 8 before dying out. All other things being equal, the one-unit standard deviation shock of money supply to real gross domestic product, which is negative in periods 1 to 2 and swiftly transforms to positive up to period 10, indicates that RGDP is rising with the expansion in money supply in Nigeria.

In periods 1 through 6, commercial bank branches respond to increases in the money supply adversely, positively in periods 7 through 9, and negatively over time. The commercial bank branch has responded well to the poverty rate during the entire horizon period. The commercial bank branch has a positive impact on real gross domestic product for the whole horizon period, demonstrating this branch's beneficial influence on RGDP.

The relation of the poverty rate to the money supply is consistently negative. The shock that the poverty rate has on the commercial bank branch is positive across the entire horizon. A rise in the poverty rate will result in a fall in real gross domestic product, according to one-unit standard deviation shock of the poverty rate to real gross domestic product, which is positive in periods 1 and 2 and quickly turns negative up to period 10.

Real GDP responds to the money supply adversely in periods two to three, positively in periods four to eight, and then negatively thereafter. Throughout the whole horizon period, there has been positive real GDP innovation in commercial bank branches. RGDP reacts negatively to the poverty rate in periods 1 through 3 and then positively after that.

4.5. Diagnostic Test

The diagnostic test is carried out to examine the consistency and dependability of the model's estimated coefficients. Other tests include Serial Correlation, Heteroscedasticity and Normality, and SVAR Stability.

Table 4. Post-estimation test.

Residual serial correlation LM tests		
Lags	LM-Stat	Prob
1	14.43499	0.5700
2	9.782306	0.8792
3	7.982799	0.9500
Residual heteroscedasticity tests		
Chi-square	Df	
177.6126	160	0.1617
Jarque-Bera	Df	
10.13836	8	0.2554

Source: Researcher computation using E-views 10, 2023.

As can be seen from Table 4.3, the model does not pass the tests for serial correlation, heteroskedasticity, and normality because their p-values are higher than 5%.

5. Conclusions

The study looks at how Nigeria's economic growth has changed from 1981 to 2020 as a result of financial inclusion and efforts to reduce poverty. The results of the impulse response functions demonstrated that the money supply had a direct impact on Nigeria's actual gross domestic product. The real gross domestic product of Nigeria benefits from a commercial bank branch. RGDP in Nigeria is negatively impacted by the poverty rate. Financial inclusion not only fosters economic growth, as recommended in the literature but also helps to implement stability policy (monetary policy) in Nigeria. The government should make an effort to encourage financial inclusion. Appropriate and severe actions must be taken if financial inclusion in Nigeria is to be increased. There will be fewer people living in poverty as a result and more opportunities for lucrative jobs.

Based on the finding of the study, financial inclusion plays significant role in poverty in growth of the Nigerian economic by making it possible for people to have access to money so as to finance their small and medium scale business. Also, it is found that there's great relationship between financial inclusion, poverty reduction and economic growth in Nigerian during the period of the study.

The study faces some limitations such as lack of money to get people views with regard to financial inclusion, as such, the research resolved to use primary data.

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Research Article

Assessing the Mediating Role of Life Satisfaction in the Nexus Between Financial Behavior and Financial Well-being

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Abstract: This quantitative non-experimental correlational study mainly aim to investigate the mediating effect of life satisfaction in the relationship between financial behavior and financial well-being of college students in the Davao Region. The data were collected online through Google Forms using adopted instruments. The respondents were chosen through stratified random selection. The measuring model underwent validity and reliability tests. Descriptive statistics were utilized to define the constructs in the study. The hypothesized mediation model was assessed by mediation analysis utilizing the standard algorithm bootstrapping of SmartPLS 4.0. Further, the study was anchored to the Theory of Planned Behavior, Life Satisfaction Theory, and the Behavioral Life-Cycle Hypothesis. The results indicated that the variables of the research satisfy both validity and reliability tests. The findings revealed that the students have moderate levels of life satisfaction and financial well-being while they demonstrate high levels of financial behavior.

Keywords: financial behavior; financial well-being; life satisfaction; college students; theory of planned behavior

1. Introduction

Financial well-being, one of the six major components of a broader and more complex concept of well-being (Van Praag et al., 2023), can be defined as a state of being wherein a person can fully meet current and ongoing financial obligations, can feel secure in their financial future, and is able to make choices that allow enjoyment in life (Netemeyer et al., 2017). Among college students, financial issues arise from diverse factors, including personal financial challenges frequently linked to unsound financial behavior, often a consequence of low financial literacy among students (Lusardi & Tufano, 2015; Chikezie & Sabri, 2017). Furthermore, student financial well-being, as said by Xiao et al. (2009), is crucial since it affects their overall satisfaction level with life and their financial situation after graduation. The results from a study by Sabri and Falahati (2012) discovered that people with lower financial well-being cannot afford to buy necessities and cannot manage their finances. Moreover, many young adults first experience how to manage their finances and expose themselves to the consumer credit market and real-world debt problems during their college years (Brown et al., 2013; Sotiropoulos et al., 2012).

The relationship between financial conduct and life satisfaction is a topic of great interest, as the financial choices individuals make can significantly impact their entire well-being. Financial behavior, which includes activities pertaining to budgeting, saving, spending, and investing, has a significant impact on determining an individual's financial situation. Research indicates that engaging in beneficial financial habits, such as practicing careful saving and appropriate spending, is linked to increased levels of life satisfaction (Brown & Gray, 2014). Conversely, making hasty financial choices and experiencing stress related to debt might lead to decreased levels of life satisfaction (Drentea & Reynolds, 2012). Furthermore, there is a strong correlation between better levels of financial education and improved financial practices, which in turn leads to increased life satisfaction (Hastings et al., 2013). Gaining a comprehensive understanding of the complex relationship between financial conduct and life satisfaction offers useful insights for individuals, policymakers, and financial

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educators who seek to improve overall well-being.

The correlation between financial behavior and financial well-being is intricate and multifaceted. Financial behavior encompasses individuals' decisions regarding their finances, including budgeting, saving, investing, and spending patterns (Obenza et al., 2024c). This behavior, in turn, significantly influences an individual's overall financial well-being. Research in behavioral economics, as articulated by Thaler and Sunstein (2008), underscores how subtle changes in the presentation of choices can impact financial decision-making. Additionally, psychological factors, as outlined in the Theory of Planned Behavior (Ajzen, 1991), highlight the role of attitudes, subjective norms, and perceived behavioral control in shaping financial behavior, ultimately affecting financial well-being. The positive correlation between financial literacy and improved financial behavior, contributing to enhanced financial well-being, is well-documented (Lusardi & Mitchell, 2014). Social and economic factors, such as income and social support networks, also play a pivotal role in shaping financial behavior and, consequently, influencing financial well-being (Dew, 2007). Understanding this relationship aids in developing strategies and interventions to promote positive financial behaviors, thereby contributing to improved financial well-being.

The relationship between life satisfaction and financial well-being is complex, reflecting the interconnected nature of financial and subjective well-being. Financial well-being, characterized by a sense of security and contentment in one's financial situation, is integral to overall life satisfaction. Research indicates a positive association between higher income or financial stability levels and increased life satisfaction (Diener & Oishi, 2005). However, the relationship extends beyond mere income levels, encompassing factors such as financial security, effective financial management, and the ability to meet financial goals. Conversely, financial stress, debt burdens, and economic hardships have been linked to lower life satisfaction (Drentea & Reynolds, 2012). The interplay between life satisfaction and financial well-being underscores the importance of a holistic approach to well-being that considers both the emotional and financial dimensions of individuals' lives.

Despite the significant growth in the field of study of financial well-being and financial behavior, there remains a distinct gap in comprehending the intricate connection between life satisfaction, financial behavior, and the overall financial well-being of university students. Moreover, many studies have also correlated financial behavior to financial well-being (Obenza et al., 2024a; Sabri et al., 2023; Mathew & Kumar, 2022), measuring the financial well-being of students (Philippas & Avdoulas, 2019; Chikezie & Sabri, 2017; Norvilitis et al., 2019; Obenza et al., 2024b; Setiyani & Solichatun, 2019). Our research aims to fill this information gap by investigating the relationship between financial literacy and the financial well-being of college students, with a particular emphasis on the intermediary influence of financial behavior. By analyzing how financial knowledge translates into financial actions and ultimately affects overall financial well-being, our research seeks to provide valuable insights into the field. This broad analysis tries to uncover the key elements that contribute to college students' financial well-being.

The significance of a study examining the relationship between financial well-being, financial behavior, and life satisfaction among college students, particularly when considering life satisfaction as a mediating factor, extends across various domains. For educational institutions, these insights hold the potential to inform the development of targeted financial literacy programs, ensuring students acquire the skills needed for responsible financial behaviors. Additionally, recognizing life satisfaction as a mediator underscores the holistic impact of financial well-being on students' overall sense of fulfillment and happiness. Understanding these dynamics can contribute to creating a supportive campus environment that addresses financial challenges and promotes student well-being. From a policy perspective, the study provides a foundation for crafting interventions that support students in managing their finances effectively, potentially influencing academic success and retention rates. Moreover, the research contributes to the broader academic discourse by advancing our understanding of the intricate relationship between financial factors and subjective well-being, offering avenues for future exploration and refinement of theoretical frameworks in the context of college students' experiences. Ultimately, the study's significance lies in its potential to guide practical interventions, foster positive financial behaviors, and enhance the overall well-being of college students.

Research Questions

1) Is there a relationship between financial behavior and life satisfaction?
2) Is there a relationship between financial behavior and financial well-being?

3) Is there a relationship between life satisfaction and financial well-being?

4) Does life satisfaction mediate the relationship between financial behavior and financial well-being?

2. Materials and Methods

2.1. Research Design

This study utilized a quantitative research design, specifically employing a non-experimental correlational approach to assess the relationship between variables, focusing on the connection between financial behavior and the financial well-being of college students, mediated by their life satisfaction. According to Creswell and Creswell (2022), the quantitative research approach involves systematically gathering, examining, and understanding data, often through surveys or experimental studies. This design employs a systematic approach to examine the connections between variables in order to assess objective hypotheses. It utilizes numerical data for statistical analysis and measurable results. Mediation analysis in research examines how a mediating variable affects the relationship between two other variables. It measures the causal sequence in which an initial variable affects a mediating variable, which in turn affects a de-pendent variable (Kim, 2016).

2.2. Sample

A priori power analysis using G*Power 3.1.9.6 (Faul et al., 2007) determined that a sample size of N = 89 is required to achieve 80% power for detecting a medium effect (f2 = 0.15) at a significance level of =.05 in testing the hypothesis about the role of life satisfaction in mediating the relationship between financial behavior and financial well-being. The computed noncentrality parameter was 3.6537652 with two predictors in the model, critical t was 1.9879342, and degrees of freedom (Df) were 86. Our actual sample size of N = 200 exceeds this threshold, enhancing the robustness of our study. The research was conducted in the Davao Region, Philippines, and involved students from various universities and colleges in the area. Further, the respondents were chosen using stratified random sampling, a type of probability sampling involving dividing the total population into similar groups (Hayes, 2023).

2.3. Instruments and Procedure

The study utilized adopted questionnaires. The instrument used to assess financial behavior was adopted from Xiao et al. (2008), the life satisfaction scale was adopted from Diener et al. (1985), and the financial well-being scale was adopted from Klepfer et al. (2020). All instruments were in the form of a 5-point Likert scale, which was reviewed and validated by experts. The researchers converted the instrument into an online survey using Google Forms. It was then distributed using social media platforms among the target respondents in the Davao region.

2.4. Data Analysis

The data were analyzed using descriptive and inferential statistics. Primarily, all constructs were subjected to validity and reliability tests. Cronbach's Alpha and Composite reliability were used to assess construct reliability, while heterotrait-monotrait ratio (HTMT) and average variance extracted (AVE) were used to assess construct validity. Descriptive statistics such as mean and standard deviation were also used to describe the respondents' life satisfaction status, financial behavior, and financial well-being. Further, the hypothesized mediation model was assessed using standard algorithm bootstrapping in SmartPLS 4.0 software.

3. Results and Discussion

Table 1 presents the validity and reliability of the measurement model in the study. The evaluation was carried out using Cronbach's alpha (α), composite reliability, average variance extracted (AVE), and heterotrait-monotrait ratio (HTMT). The evaluation of the measurement model is the initial step before conducting mediation analysis (Hair et al., 2019).

As shown in the table below, the constructs - financial management behavior, financial well-being, and life satisfaction obtained α values of 0.807, 0.911, and 0.850 indicating that they all possess internal consistency. Their composite reliability values entail the same. Cronbach's alpha values, which are equal to or more than 0.7, indicate acceptable levels of internal consistency (Taber, 2018). Diamantopoulos et al. (2012) further specify that α values

between 0.60 and 0.70 are acceptable, 0.71 and 0.90 are tolerable to good, and values greater than 0.95 could possibly entail redundancy problems with the items in the measurement model.

The convergent validity of the measurement model was also ascertained by computing the average variance extracted (AVE). The AVE values of all constructs surpassed the 0.5 thresholds, affirming robust convergent validity for financial behavior (0.510), financial well-being (0.495), and life satisfaction (0.624). According to Fornell and Larcker (1981) and Hair et al. (2019), an AVE value of at least 0.50 or ideally higher indicates that the constructs of the measurement model account for at least 50% or more of the variability in the construct's elements. Further, the discriminant validity was also assessed using the heterotrait-monotrait ratio (HTMT). The HTMT values obtained by all constructs are less than 0.85, which falls within an acceptable range for discriminant validity. According to Henseler et al. (2014), all ratios below the 0.85 threshold indicate good discriminant validity.

Table 1. Reliability and validity of the measurement model.

Variables	Cronbach's Alpha	Composite reliability (rho a)	Composite reliability (rho c)	Average variance extracted
Financial Behavior	0.807	0.808	0.863	0.510
Financial Well-Being	0.911	0.914	0.924	0.495
Life Satisfaction	0.85	0.875	0.829	0.624
Discriminant Validity		**Heterotrait-monotrait ratio (HTMT)**		
Financial Well-Being<-> Financial Behavior		0.328		
Life Satisfaction<-> Financial Behavior		0.539		
Life Satisfaction<-> Financial Well-Being		0.563		

The results presented in Table 2 offer a comprehensive snapshot of the participants' financial well-being, specific financial behaviors, and overall life satisfaction. The moderate mean for Financial Well-Being (Mean = 3.36, SD = 0.672) indicates a balanced level of financial health within the sample. This substantiates the findings of Obenza et al. (2024b), who opined that university students in Region XI, Philippines, demonstrated moderate or average levels of financial well-being. The financial well-being of college students is a critical area of research, as it impacts their overall mental health, academic performance, and future financial stability (Bartholomae & Fox, 2021; Robb, 2017; Bemel et al., 2016; Lone & Bhat, 2022).

Notably, the high means for FB-Expense Management (Mean = 3.69, SD = 0.936) and FB-Saving (Mean = 3.52, SD = 0.938) reflect commendable financial practices, highlighting efficient expense management and a strong inclination toward saving. However, the moderate mean for FB-Balance Control (Mean = 3.14, SD = 1.151) suggests a more moderate level of control over financial balance. The high mean for Financial Behavior (Mean = 3.45, SD = 0.81) reinforces respondents' overall positive financial practices. This is similar to the findings of Obenza et al. (2024c), who found that university students have moderate levels of financial management behavior. Further, financial behavior is shaped and influenced by several factors, such as financial literacy and education (Ergün, 2018; Mireku et al., 2023), personality traits (Obenza et al., 2024c), access to technology (Damayanti & Indriayu, 2020), and social factors such as peer influence and stress (Bamforth et al., 2018).

In addition, the moderate mean for Life Satisfaction (Mean = 4.39, SD = 1.302) suggests that there is an average level of contentment in life. Life satisfaction among students is an important measure of their general well-being and considerably influences their academic achievement, mental well-being, and social interactions (Antaramian, 2017; Slavinski et al., 2021). In addition, a strong correlation exists between high life satisfaction and improved mental well-being, which manifests as reduced levels of anxiety, depression, and behavioral issues. According to Zhang et al. (2014) and State & Kern (2017), students who have a high level of life satisfaction also tend to have greater self-esteem and experience fewer psychiatric symptoms.

Including a third variable, referred to as a mediator, makes the complex mediation process clearer by establishing the relationship between the predictor and criterion variables. (Bhandari, 2021; Hayes et al., 2011). This study used life satisfaction as a mediator to explore the complex relationship between college students' financial behavior and financial well-being. The researchers thoroughly analyzed the mediation model using the standard bootstrapping approach in the SmartPLS 4.0 software.

Table 2. Status of college students' financial behavior, financial well-being, and life satisfaction

Variables	N	Mean	SD	Description
Financial Well-Being	200	3.36	0.672	Moderate
FB- Expense Management	200	3.69	0.936	High
FB-Balance Control	200	3.14	1.151	Moderate
FB-Saving	200	3.52	0.938	High
Financial Behavior	200	3.45	0.81	High
Life Satisfaction	200	3.39	1.302	Moderate

Table 3 shows the direct effect of Financial Behavior on Financial Well-Being (FB -> FWB) (β = 0.059, $\bar{x}$= 0.056, σ= 0.078, |O/STDEV|=0.746, p=0.456). This indicates that the direct effect of Financial Behavior on Financial Well-Being is not statistically significant, as the P-value is greater than the conventional threshold of 0.05. The effect size (f^2) is 0.004, which is considered very small according to Cohen's (1988) guidelines. These findings negate those of Obenza et al. (2023d), Sabri et al. (2023), and Mathew and Kumar (2022). Their study also discovered that personal financial behavior could be an important component in defining financial well-being. They also noted that while positive financial behavior enhances the level of financial well-being, failure to manage finances contributes to financial problems. In short, this study concludes that how you behave in terms of finances has an effect on your financial well-being.

Conversely, the direct effect of Financial Behavior on Life Satisfaction (FB -> LS) is highly significant (β = 0.461, $\bar{x}$= 0.464, σ= 0.057, f2= 0.269 |O/STDEV|=8.150, p=0.000). The relationship between financial behavior and life satisfaction has been a subject of extensive research. Various studies have explored how financial management, financial stress, and financial satisfaction influence overall well-being and life satisfaction (Xiao et al., 2009; Baryla-Matejczuk et al., 2020). Moreover, positive financial behaviors, such as saving and investing, contribute to financial satisfaction, which in turn enhances life satisfaction (Aboagye & Jung, 2018; Tahir et al., 2022).

The direct effect of Life Satisfaction on Financial Well-Being (β = 0.499, $\bar{x}$ = 0.508, σ = 0.054, |O/STDEV| = 9.174, p = 0.000) demonstrates a substantial and statistically significant relationship. Life satisfaction emerges as a robust predictor of financial well-being, consistent with findings from previous studies (Yeo & Lee, 2019; Brzozowski & Visano, 2017). Financial satisfaction, shaped by income, wealth, and various social factors, serves as a key contributor to overall life satisfaction (D'Ambrosio et al., 2019). The availability of liquid assets and the practice of sound financial behaviors further strengthen this association (Yeo & Lee, 2019). Additionally, social capital and support networks play a pivotal role in mediating the connection between financial well-being and life satisfaction, particularly in older populations (Brzozowski & Visano, 2017; Ryou et al., 2023). This complex interplay highlights the multifaceted nature of financial well-being and its broader impacts on life satisfaction.

As shown in Table 3, the indirect effect of Financial Behavior on Financial Well-Being (FB -> FWB) through Life Satisfaction (LS) is significant, with an original sample value of 0.230, a T-statistic of 5.550, and a P-value of 0.000. This indicates that Life Satisfaction serves as a significant mediator in the relationship between Financial Behavior and Financial Well-Being. Thus, a full mediation exists in the model. Moreover, the total effect of Financial Behavior on Financial Well-Being (FB -> FWB), combining both direct and indirect effects, is also significant, with an original sample value of 0.288, a T-statistic of 3.788, and a P-value of 0.000.

As evident in Table 3, the R^2 value for the model is 0.279, indicating that approximately 27.9% of the variance in Financial Well-Being can be explained by Financial Behavior and Life Satisfaction. The adjusted R^2 value is 0.271, which accounts for the number of predictors in the model.

These results can be comprehensively understood through the lens of several theoretical frameworks: the Theory of Planned Behavior (TPB), the Life Satisfaction Theory, and the Behavioral Life-Cycle Hypothesis.

The TPB posits that individual behavior is driven by behavioral intentions, which are influenced by attitudes toward the behavior, subjective norms, and perceived behavioral control (Ajzen, 1991). In this context, positive financial behaviors, such as budgeting, saving, and prudent spending, are likely shaped by favorable attitudes towards financial management, societal norms that value financial responsibility, and an individual's perceived control over

their financial situation. These positive financial behaviors lead to financial satisfaction, which enhances life satisfaction, ultimately contributing to greater financial well-being. This aligns with findings from Xiao et al.(2009) and Kavita et al.(2021), who demonstrated that positive financial behaviors contribute to both financial satisfaction and life satisfaction among college students, which in turn impacts financial well-being.

Table 3. Direct effects, indirect effects, and total effects of variables.

Hypothesis values	Original Sample	Sample Mean	Standard Deviation	f^2	T statistics |O/STDEV|	P
Direct Effects						
FB -> FWB	0.059	0.056	0.078	0.004	0.746	0.456
FB -> LS	0.461	0.464	0.057	0.269	8.150	0.000
LS -> FWB	0.499	0.508	0.054	0.271	9.174	0.000
Indirect Effects						
FB -> FWB	0.230	0.237	0.041		5.550	0.000
Total Effects						
FB -> FWB	0.288	0.293	0.076		3.788	0.000
			R^2=0.279			
			Adjusted R^2=0.271			

Legend: FB (Financial Behavior), FWB (Financial Well-Being), LF (Life Satisfaction).
Note: f 2 is Cohen's (1988) effect size: 0.02=small, 0.15=medium, 0.35=large.

The Life Satisfaction Theory centers around the comprehensive cognitive evaluation of an individual's quality of life, which is determined by their self-established criteria (Diener et al., 1985). This hypothesis posits that life satisfaction mediates the connection between financial activity and financial well-being. The study found a strong mediation effect, indicating that those who participated in positive financial behaviors had higher levels of money contentment, leading to an overall increase in life satisfaction. Subsequently, this heightened sense of contentment in life leads to enhanced financial prosperity. The research conducted by Atatsi et al. (2023) further confirms this idea, demonstrating that financial contentment acts as a mediator in the connection between financial management techniques and life satisfaction, ultimately resulting in improved financial well-being.

The Behavioral Life-Cycle Hypothesis combines psychological aspects with conventional economic models, proposing that individuals strategically manage their consumption and savings patterns by considering their lifetime resources while also being impacted by psychological characteristics such as self-control (Shefrin & Thaler, 1988). This theory elucidates the relationship between financial habits, which are impacted by psychological factors, and their impact on life satisfaction, ultimately leading to financial well-being. The research conducted by Baryła-Matejczuk et al. (2020) emphasized the importance of positive financial behaviors, such as saving and investing, for enhancing life happiness, which subsequently impacts financial well-being. This supports the theory that making wise financial decisions throughout one's life leads to increased satisfaction with both finances and overall life, ultimately boosting financial well-being.

Empirical studies further validate these theoretical interpretations. Xiao et al. (2009) discovered that engaging in positive financial behaviors directly impacts financial contentment, which in turn leads to improved life satisfaction among college students. Baryła-Matejczuk et al. (2020) established that adopting good financial management habits substantially influences both life satisfaction and relationship quality in couples. This relationship is mediated by financial satisfaction. Atatsi et al. (2023) demonstrated that financial contentment acts as a mediator between financial management practices and life satisfaction in secondary school teachers, resulting in enhanced financial well-being.

In addition, Totenhagen et al. (2019) and Kiaei et al. (2022) emphasized the crucial importance of financial education and literacy in improving financial behaviors, leading to increased financial contentment and overall life satisfaction. These studies emphasize the significance of positive financial habits and financial happiness in enhancing life satisfaction and overall financial well-being.

The study found that life satisfaction is a significant mediator between financial behavior and financial well-being, and a full mediation effect was observed. This implies that the

relationship between financial behavior and financial well-being is influenced by life satisfaction. These findings are consistent with theoretical frameworks such as the Theory of Planned Behavior, Life Satisfaction Theory, and the Behavioral Life-Cycle Hypothesis. These frame-works emphasize the interconnectedness between financial behavior, life satisfaction, and overall well-being. The findings also corroborate previous studies that emphasize the crucial significance of positive financial behaviors in augmenting life happiness and eventually enhancing financial well-being. This study provides useful insights into the dynamics of financial behavior and its broader implications for college students' financial and life happiness.

4. Conclusions

In conclusion, the findings of this study highlight the significant role that life satisfaction plays as a full mediator in the relationship between people's financial behaviors and their overall financial well-being. A full knowledge of the ways in which financial behaviors influence life happiness and, as a result, financial well-being can be obtained through the integration of the Theory of Planned Behavior, the Life Happiness Theory, and the Behavioral Life-Cycle Hypothesis. These theoretical ideas are supported by empirical evidence from various research, which highlights the necessity of encouraging positive financial behaviors and financial contentment to improve both life happiness and financial well-being.

Although this study offers vital insights into how life satisfaction mediates the relationship between financial behavior and financial well-being, it is important to acknowledge its limitations. The use of self-reported data may give rise to biases, such as social desirability bias and recollection bias, which could potentially impact the accuracy of the reported financial habits and levels of life satisfaction. Furthermore, the sample may lack representativeness, therefore constraining the capacity to generalize the findings to the broader population. Subsequent investigations should take into account varied and more extensive samples in order to improve the applicability of the findings. Although the study combines multiple theoretical frameworks, it is important to consider that there may be more unexplored elements, such as cultural in-fluences or personality qualities, that substantially impact the relationship between financial behavior, life satisfaction, and financial well-being.

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Research Article

Enhancing the efficiency of management of transport enterprises: modern trends and challenges

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Abstract: This research examines the modern trends and challenges in enhancing the efficiency of management in transport enterprises, with a focus on the Ukrainian perspective and the impact of the ongoing war. The study highlights key trends such as digital transformation, sustainability efforts, and the increasing use of data-driven decision-making, which are reshaping the transport industry in Ukraine. The integration of technologies like AI-based route optimization and real-time tracking has become important in overcoming operational challenges caused by the war, including disrupted supply chains, damaged infrastructure, and heightened security risks. These innovations are enabling transport enterprises to minimize costs, optimize routes, and ensure service continuity despite the unstable environment. This paper investigates how Ukrainian transport enterprises are adapting to these modern trends while addressing the complex challenges posed by the war. It emphasizes the need for a flexible and resilient management approach that leverages digital tools, sustainability practices, and data analytics to enhance operational efficiency. The findings highlight that a systemic approach, supported by innovation and adaptability, is essential for overcoming the impact of war and ensuring the long-term viability of transport sector of Ukraine.

Keywords: internal and external factors factor; challenge; trend; model; performance; war

1. Introduction

Under the conditions of the further crisis development in economy, the unpredictability of the dynamics of social processes is effective activities of transport enterprises (Borca et al., 2021). Their ability to adapt is a key factor of ensuring the stability of functioning and formation preconditions for the progressive enhancement of the transport industry and the economy of Ukraine as a whole (Maystro & Krykhtina, 2021). Considering that the internal source of development of enterprises is related to its potential, it is important to conduct a systemic and complex study of patterns of functioning, mechanisms of development, factors of formation and realization of potential of transport enterprises. The results and their possible practical application are necessary condition for the effective functionality of the transport system of the state.

Effective management ensures that resources such as vehicles, fuel, labour, and infrastructure are optimally utilized (Moeinaddini & Habibian, 2023). This leads to cost savings through reduced waste, better fuel efficiency, and minimized downtime for vehicle maintenance (Branco et al., 2023; Camisón-Haba & Clemente-Almendros, 2019; Kulbovskyi et al., 2021). Streamlining logistics, improving scheduling, and optimizing routes, transport enterprises can also enhance productivity, enabling them to handle larger volumes of goods or passengers without a corresponding increase in costs. These improvements directly impact profitability, which is especially important in an industry where margins can be tight.

Moreover, efficient management fosters better service quality and customer satisfaction (Mikuličić et al., 2024). Timely and reliable deliveries or transportation services are critical in meeting customer expectations and building long-term business relationships. Well-managed transport enterprises can adapt to changing market conditions, such as fluctuations in demand or fuel prices, ensuring that services remain competitive (Al Sharyani & Ullah, 2024). Additionally, implementing modern technologies, such as real-time tracking systems and data analytics, allows for better decision-making and quicker responses to disruptions, further

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enhancing service reliability (Holovina, 2023; Kostrzewski et al., 2022). Ultimately, efficient management in transport enterprises is vital for maintaining a competitive edge in a fast-paced and dynamic industry.

The problems of the research on management of transport enterprises are being updated. According to the data about the current stage of economic development in Ukraine, social relations, and the formation of the knowledge economy (Zrybnieva et al., 2023). Importantly, the following features of management of transport enterprises are taken into consideration: change of civilizational values, growth of social consciousness, strengthening of the role of human in the management and production processes, transformation of knowledge and information, awareness of environmental threat, the necessity of continuous innovative development (Agustian et al., 2023). These features indicate the importance of humanizing factors in the activities of enterprises, as well as in the environment that surrounds them, and the need for a radical change in formation and realization of their potential (Din et al., 2023).

The generation of new approaches to the formation and realization of potential of transport enterprises is of great importance, because their activity is associated with significant danger, economic effects, and a high level of environmental pollution (Borca et al., 2021). In addition, the consequences of their functioning concern not only the participants of the transportation process, but also other economic subjects – clients, passengers, pedestrians, etc. (Mikuličić et al., 2024) At the same time, the orientation towards European integration processes forms additional requirements for transport enterprises regarding mandatory compliance with social standards or principles of environmentally safe activities (Lebedeva & Shkuropadska, 2024).

Therefore, the *purpose of the research* is to develop theoretical and methodological principles and practical recommendations regarding efficiency of management of transport enterprises.

To achieve this purpose, the following objectives were formulated:

- to investigate the essence of management of transport enterprise;
- to determine the modern trends to organize the efficient management of transport enterprise;
- to investigate the challenges of management of transport enterprise, paying the special attention to Ukraine;
- to investigate the optimal model of efficient management of transport enterprise in Ukraine during war;

2. Materials and Methods

The theoretical and methodological basis of the research is general scientific and special methods (Dzwigol, 2022; Pozzebon & de Souza Bido, 2019). The basis of process of research devoted to the enhancing the efficiency of transport enterprises required a systematic approach (Alarcón-Bernal et al., 2019; Chiu et al., 2020; Lima, 2017). It involved the analysis of transport enterprises as complex and interrelated systems. This approach allowed us to examine the organization as a whole, including its subsystems such as logistics, human resources, financial management, and technology integration. Identifying the interactions and dependencies among these subsystems, it was possible develop a comprehensive understanding of how each component influences the efficiency of management. This holistic perspective enabled the identification of inefficiencies within the broader system and offers insights into optimizing enterprise-wide practices. Additionally, a systemic approach promoted the study of external factors impacting transport enterprises, such as market dynamics, regulatory frameworks, and environmental considerations. Since the enterprise is a part of a larger ecosystem, this approach allowed us to explore how external influences – such as fluctuations in fuel prices, changes in legislation, or shifts in consumer demand – affect internal operations. The systemic approach also facilitated the identification of potential risks and the formulation of strategic responses to them. As a result, it helped to present how transport enterprises adapt to changing conditions while maintaining efficiency and competitiveness in a dynamic market environment.

Within the systemic approach, the following methods were used in the research process:

methods of formal and dialectical logic, methods of systemic analysis and synthesis – for critical analysis of the provisions of Ukrainian and foreign scientists who researched the modern trends used to organize the efficient management of transport enterprises;

dialectical and abstract logical methods – for study of the evolution of theoretical

approaches, generalization of scientific data and deepening the scientific and theoretical fundamental of the efficient management of transport enterprises;

methods of scientific abstraction, induction and deduction – when defining the economic concepts that clarify the role and explain the specifics of management of transport enterprises;

methods of economic analysis (grouping, comparison, average and relative values, series of dynamics, detailing, coefficient analysis) – for the assessment of components of efficient management of transport enterprises and the presentation of potential opportunities of transport enterprises;

methods of decomposition and analysis of hierarchies – for substantiation of challenges of management of transport enterprise;

graphic method – for visualization of research results.

3. Results and Discussion

3.1. The essence of management of transport enterprise and its modern trends

To analyze the modern trends used to organize the efficient management of transport enterprise, it is important to clarify the structure of such enterprise (Boldyreva et al., 2012; Prokudin et al., 2023). Typically, it consists of several departments, each responsible for specific functions crucial to the operation (Kiefer et al., 2022). At the top is the executive management, supported by senior managers overseeing various operational areas such as finance, human resources, and strategy. Beneath this, the core departments usually include operations, logistics, fleet management, and maintenance. The operations department is responsible for planning and executing transportation services, coordinating schedules, routes, and deliveries. Fleet management oversees the vehicles or transport assets, ensuring they are properly utilized, maintained, and replaced as necessary. The maintenance department ensures that vehicles are in good working condition, minimizing downtime and maximizing efficiency (Kulbovskyi et al., 2021). Also, transport enterprises often include departments focused on customer service, and safety. Together, these departments work in an interconnected way to ensure the smooth and efficient functioning of the transport enterprise.

The efficient management of a transport enterprise relies on certain components that ensure smooth operations and optimal performance (Prokudin et al., 2023). One of the most important components is strategic planning, which involves setting long-term goals, analyzing market trends, and developing strategies to remain competitive (Marunych et al., 2021). This includes effective route planning, fleet optimization, and the integration of new technologies like GPS tracking and telematics to monitor vehicle performance. Additionally, financial management plays a critical role by overseeing budgeting, cost control, and investments in new infrastructure or vehicles, ensuring the enterprise maintains profitability while expanding its services (Bobyl et al., 2024).

Another crucial component is human resource management, which focuses on hiring, training, and retaining qualified personnel, such as drivers, maintenance staff, and managers (Din et al., 2023 Kulbovskyi et al., 2021). Efficient human resource management ensures that the workforce is skilled, motivated, and aligned with the company's goals. Logistics management is also a key part of operational efficiency, dealing with the planning, implementation, and monitoring of the flow of goods and services (Lebedeva & Shkuropadska, 2024). Combined with maintenance and safety protocols, which ensure that vehicles are regularly serviced and meet safety regulations, these components work together to reduce downtime, enhance service reliability, and ensure customer satisfaction (Kucharčíková et al., 2018).

It is worth mentioning that the efficient management of transport enterprise is affected by internal and external factors (figure 1). Internal factors directly impact the day-to-day functioning of a transport enterprise and include the management structure, workforce competency, and technological infrastructure (Bobyl et al., 2024; Flores-Ureba et al., 2024; Marunych et al., 2021). The efficiency of leadership and decision-making processes within the management hierarchy is crucial (Chmyr & Koriekhov, 2023; Grinerud et al., 2021; Prokudin et al., 2023). For example, clear communication between top management and operational staff can streamline processes, reduce delays, and improve response times. Similarly, the competence of the workforce – including drivers, maintenance staff, and office personnel – affects operational efficiency (Kucharčíková et al., 2018). Obviously, well-trained employees ensure high service quality, reduce accidents, and enhance customer satisfaction. The use of

technology, such as fleet management systems, real-time tracking, and automated scheduling, enhances efficiency by reducing manual errors and optimizing vehicle usage and fuel consumption (Shapovalov et al., 2021).

External factors, often beyond the control of the enterprise, also significantly affect management efficiency. Other external factors include legal regulations in the field of transport and logistics (Lykholat & Neviadomskyi, 2022), market conditions (Al Sharyani & Ullah, 2024), or infrastructure quality – such as road conditions, traffic congestion, and availability of maintenance facilities (Kyriacou et al., 2019) – impacts delivery times and vehicle performance, influencing the overall efficiency of transport operations.

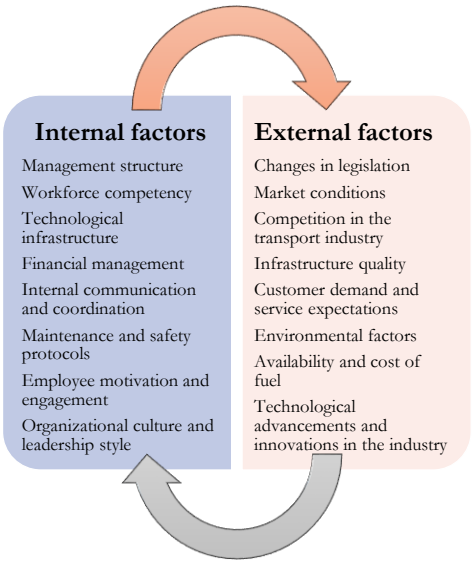

Figure 1. Factors of efficient management of transport enterprise.

Currently, a number of works are devoted to investigation of modern trends of the efficient management of transport enterprise (Speranza, 2018; Wang & Sarkis, 2021). It was found that modern trends in the efficient management of transport enterprises are increasingly shaped by digital transformation (Cichosz et al., 2020). Advanced technologies like AI-powered route optimization, telematics, and GPS tracking allow transport managers to gain real-time insights into fleet operations, helping to minimize fuel consumption, reduce delays, and improve overall service efficiency (Geske et al., 2024). AI-based tools can also predict maintenance needs by analyzing vehicle performance data, reducing downtime through preventive repairs. These technologies offer greater control over operational logistics, improving decision-making and allowing for the automation of routine tasks such as scheduling and dispatching, which leads to increased productivity and cost savings.

Another significant trend is the sustainability movement, where transport enterprises are increasingly prioritizing eco-friendly practices to meet both regulatory demands and consumer expectations (Agustian et al., 2023). This includes the adoption of electric and hybrid vehicles, which reduce fuel consumption and lower carbon emissions. Many companies are also using smart logistics systems to optimize delivery routes and reduce unnecessary mileage, contributing to environmental conservation efforts (Liu et al., 2024). Sustainable fleet management not only helps businesses comply with environmental regulations but also enhances their reputation, making them more attractive to environmentally conscious customers and investors (Zhang et al., 2019). And, of course, the trend of data-driven decision-making is transforming how transport enterprises manage their operations (Aubakirova, 2024). With the rise of big data and advanced analytics, companies can now collect and analyze large amounts of information from their fleet and market environments to inform strategic decisions. This data can reveal patterns in consumer behavior, operational bottlenecks, and cost inefficiencies. Using predictive analytics, transport enterprises can forecast demand, adjust operations accordingly, and make real-time decisions that improve service efficiency. This trend encourages agility, enabling transport enterprises to respond quickly to market changes and operational challenges.

At the same time, a transport enterprise faces a number of challenges affecting efficient management. Further, we will describe these challenges, paying the special attention towards Ukraine.

3.2. The challenges of management of transport enterprise

The management of a transport enterprise faces several operational challenges, particularly in maintaining efficiency and service quality across multiple functions. One of the major challenges is fleet management, which requires ensuring that vehicles are properly maintained, utilized effectively, and replaced at the right time to avoid unnecessary costs or service disruptions (Kotsialos & Vassilakopoulou, 2023). This involves arranging the maintenance schedules, optimizing the vehicle usage, and managing the fuel efficiency. Additionally, transport enterprises often deal with logistical complexities like unpredictable traffic patterns, delays due to weather conditions, or sudden route changes, which can negatively affect delivery timelines and overall operational efficiency.

Another significant challenge is regulatory compliance, as transport enterprises must adhere to a wide range of local, national, and international laws (Lykholat & Neviadomskyi, 2022). These regulations cover areas such as vehicle safety, environmental standards, labor laws, and transportation licenses. Frequent changes in legislation, such as stricter emissions standards or new labor requirements, can increase operational costs and require significant adjustments in management processes. Failure to comply with these regulations can result in fines, legal issues, or reputational damage, further complicating the management process.

In addition to operational and regulatory challenges, transport enterprises must address external factors like fluctuating fuel prices (Milewska & Milewski, 2022; Musa et al., 2024), economic instability (Kliestik et al., 2022), and infrastructure limitations (Moeinaddini & Habibian, 2023). Rising fuel costs can significantly impact the profitability of a transport enterprise, requiring constant adjustments in budgeting and pricing strategies. In some regions, outdated or inadequate infrastructure can lead to delays, increased vehicle wear, and higher maintenance costs. Furthermore, competition in the transport industry forces managers to constantly innovate and improve efficiency while delivering high-quality service to maintain a competitive edge (Chmyr & Koriekhov, 2023). These external pressures demand a flexible, adaptive management approach to sustain long-term success (Sumbal et al., 2023). Table 1 analyses the challenges of management of transport enterprise according to literature review.

Table 1. The challenges of management of transport enterprise.

Challenge	Impact on the efficiency of management	Authors
Fleet management	optimizing vehicle utilization; ensuring timely maintenance; enabling real-time monitoring of vehicle performance; improvement of routing and fuel efficiency; enhancing higher safety standards.	Chmyr & Koriekhov, 2023; Kotsialos & Vassilakopoulou, 2023
Regulatory compliance	imposing strict adherence to safety, environmental, and labor regulations; severe penalties, legal liabilities, and reputational damage; affecting strategic planning and resource allocation.	Lykholat & Neviadomskyi, 2022
Logistical complexities	creating challenges in route planning, load optimization, and delivery scheduling; continuous investment in training and infrastructure.	González-Moralejo, 2024; Lebedeva & Shkuropadska, 2024; Wang et al., 2020
Rising fuel costs	increasing operational expenses; adjustment of pricing strategies and seeking cost-saving measures to maintain profitability.	Milewska & Milewski, 2022
Economic instability	creating uncertainty in demand; leading to unpredictable revenue streams and challenging budgeting	Kliestik et al., 2022

	processes; rising operational costs.	
Infrastructure limitations	causing delays and inefficiencies in the transportation; leading to increased operational costs and diminished service reliability; complicating route planning.	Flores-Ureba et al., 2024; Marunych et al., 2021; Moeinaddini & Habibian, 2023
Technological adaptation	improvement of operational efficiency through the integration of advanced tools; route optimization, vehicle maintenance, and resource allocation; enhancing service quality and reducing costs.	Chmyr & Dziuba, 2019; Holovina, 2023; Kostrzewski et al., 2022
Safety and risk management	ensuring the well-being of drivers, cargo, and equipment; mitigating accidents; lowering insurance costs; improving service quality.	Chmyr & Dziuba, 2019; Kucharčíková et al., 2018
Supply chain disruptions	causing delays in the delivery of goods and increased operational costs.	Mehmood et al., 2024; Milewska & Milewski, 2022
Environmental sustainability	disrupting operations and affecting delivery schedules; necessity to invest in eco-friendly technologies.	Borca et al., 2021
Customer expectations	adopting advanced technologies; improvement of communication strategies to enhance the customer experience.	Mikuličić et al., 2024

The management of transport enterprises in Ukraine faces unprecedented challenges due to the ongoing war, significantly disrupting operational efficiency and service reliability (Khatser & Mikhailik, 2024; Lebedeva & Shkuropadska, 2024; Rudyk et al., 2023). One of the most pressing challenges is the destruction of infrastructure, including roads, bridges, and railway lines, which has been targeted in military actions. This destruction leads to increased transportation times, higher costs for repairs and rerouting, and logistical complexities as managers must find alternative paths for delivery. Additionally, the threat of military activities poses safety concerns for drivers and personnel, leading to heightened operational risks and the need for comprehensive safety measures (González-Moralejo, 2024).

Another significant challenge is the disruption of supply chains, exacerbated by the war's impact on production and distribution networks (Gao & Xu, 2024; Křenková et al., 2023). With many suppliers facing their own operational challenges or being located in conflict zones, transport enterprises struggle to secure consistent access to necessary goods and resources (Chmyr, 2022; Srai et al., 2023). This unpredictability requires transport managers to adapt quickly, often resulting in increased costs for sourcing alternatives or relying on less efficient transportation methods (Chmyr & Koriekhov, 2023; Khatser & Mikhailik, 2024). Furthermore, the volatility in fuel prices, driven by the instability of the region, adds another layer of complexity, forcing companies to continuously adjust their budgets and operational plans.

The findings showed that the war has resulted in a reduced workforce, as many individuals are either serving in the military or have fled the country seeking safety (Rudyk et al., 2023). This labor shortage places immense pressure on remaining employees and can lead to burnout, increased turnover, and challenges in maintaining service quality. Transport enterprises must not only find ways to attract and retain talent in a difficult environment but also invest in training and development to ensure their workforce is equipped to handle the evolving challenges of the industry (Cherviakova, 2024; Chmyr & Koriekhov, 2023). Consequently, the management of transport enterprises in Ukraine during the war requires a

combination of strategic planning, innovation, and resilience to navigate these multifaceted challenges effectively (Chmyr, 2022; Marunych et al., 2021). Figure 2 shows challenges of management of transport enterprise in Ukraine during war.

Figure 2. The challenges of management of transport enterprise in Ukraine during war.

Considering the information about the modern trends of efficient management of transport enterprise and the challenges faced by Ukrainian transport enterprises during war, it is possible to draw the optimal model of efficient management of transport enterprise in Ukraine.

3.3. The optimal model of efficient management of transport enterprise in Ukraine during war

An optimal model of efficient management for transport enterprises in Ukraine during the war must integrate strategic planning, real-time data analysis, and robust operational frameworks to navigate the challenges posed by the ongoing conflict (Khatser & Mikhailik, 2024). This model should prioritize safety, resource allocation, and the maintenance of service quality while considering the unique circumstances faced by the transport sector (Lebedeva & Shkuropadska, 2024; Rudyk et al., 2023). By focusing on critical areas such as vehicle maintenance and repair, enterprises can ensure fleet reliability and enhance overall efficiency (Chmyr & Shelukhin, 2020).

One of the foundational elements of this model is the establishment of a comprehensive vehicle maintenance program (Shatilo et al., 2023). Regular maintenance schedules should be created based on usage patterns, manufacturer recommendations, and the specific operational conditions of each vehicle. Given the potential for increased wear and tear due to adverse conditions, including rough terrain and limited access to repair facilities, proactive maintenance becomes vital in preventing breakdowns and ensuring operational continuity (Dachkovsky & Kondratiuk, 2020). This program should include detailed checklists for routine inspections, as well as a system for tracking maintenance history to identify patterns and predict future needs.

Incorporating real-time monitoring systems is essential for optimizing vehicle maintenance and repair in this model (Riaboshtan, 2021; Sirko et al., 2022). Utilizing telematics and GPS technology allows transport managers to gather data on vehicle performance, fuel consumption, and usage patterns. This information can be analyzed to identify issues before they escalate into costly repairs. For example, abnormal fuel consumption or engine performance may signal the need for maintenance, allowing for timely interventions that reduce the risk of breakdowns in conflict zones. This proactive approach to vehicle management helps minimize downtime and maintain service levels during challenging circumstances.

Another critical aspect of the optimal management model is establishing collaborative partnerships with local repair shops and service providers (Chmyr & Shelukhin, 2020). Given the ongoing conflict, access to authorized dealerships and service centers may be limited, necessitating relationships with reliable local mechanics who can perform necessary repairs and maintenance (Gritsuk et al., 2024). Transport enterprises should monitor these partners

to ensure they meet safety and quality standards while also providing timely and effective service (Smachylo et al., 2018). This collaborative approach can help mitigate the challenges posed by limited resources and infrastructure disruptions, allowing for more efficient maintenance and repair processes.

In addition to vehicle maintenance, effective inventory management for spare parts and repair supplies is vital for maintaining operational efficiency (Rudyk et al., 2023). The model should include a system for monitoring stock levels of critical components, such as tires, batteries, and engine parts, to ensure they are readily available when needed. Given the unpredictability of supply chains during wartime, transport managers must develop contingency plans for sourcing these materials from multiple suppliers, both locally and from outside the conflict zone. This strategic approach helps minimize delays in repairs and ensures that vehicles remain operational, contributing to the overall reliability of the transport enterprise (Gritsuk et al., 2024).

Also, training and development programs for maintenance personnel should be incorporated into the optimal model (Khatser & Mikhailik, 2024). Considering the challenges of retaining skilled labor during the war, investing in the training of existing staff can enhance the overall competency and efficiency of the workforce. Programs should focus on both technical skills related to vehicle maintenance and soft skills necessary for navigating the complexities of operating in a conflict environment (Shatilo et al., 2023). Empowering employees with the knowledge and skills required to perform maintenance and repairs effectively, transport enterprises can bolster their resilience and adaptability in the face of ongoing challenges (Smachylo et al., 2018).

Besides, the findings demonstrated that an effective communication strategy should be implemented to keep all stakeholders informed and engaged (Glapiak, 2023; Sirko et al., 2022). This includes regular updates for employees about safety protocols, maintenance schedules, and operational changes due to the evolving situation. Additionally, maintaining open lines of communication with customers is essential to manage expectations and provide transparency about service disruptions or delays. By fostering a culture of collaboration and information sharing, transport enterprises can enhance their overall operational efficiency and resilience during these challenging times, ultimately ensuring their continued viability in the face of adversity.

5. Conclusions

In conclusion, enhancing the efficiency of management within transport enterprises is crucial, particularly in the context of modern trends and challenges exacerbated by the ongoing war in Ukraine. This research highlights the multifaceted nature of the transport sector, emphasizing the need for strategic adaptability to navigate the complexities introduced by infrastructural damage, supply chain disruptions, and economic instability. The integration of advanced technologies, such as telematics and real-time data analysis, plays a pivotal role in optimizing fleet management, ensuring proactive vehicle maintenance, and enhancing operational resilience.

The research underscores the importance of fostering collaboration with local service providers and suppliers to mitigate challenges arising from the conflict. Establishing strong partnerships allows transport enterprises to maintain service reliability while navigating the uncertainties of the market. Additionally, prioritizing employee training and development not only empowers the workforce but also ensures that organizations can respond effectively to the unique demands of operating in a war-affected environment.

It is important to state that the successful management of transport enterprises hinges on the ability to balance operational efficiency with safety and reliability. By adopting a comprehensive approach that encompasses proactive maintenance, inventory management, and effective communication, transport enterprises can enhance their capacity to withstand external shocks and maintain service quality. As the industry continues to evolve, the insights derived from this research provide a foundation for developing resilient management practices that address both current challenges and future opportunities. Moving forward, it is essential for transport enterprises to remain agile, continuously adapting to emerging trends while prioritizing the well-being of their employees and customers. Through strategic innovation and collaboration, the transport sector in Ukraine can emerge from these challenges stronger and more efficient, contributing to the nation's recovery and economic stability.

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