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The Effect of Digitalization on Pharmaceutical Supply Chain Sustainability by Applying on Reverse Logistics of Pharmacies in Aswan

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Abstract

Pharmaceutical industry is one of the most sensitive industries related to human health and safety. Many Pharmacies today faced a critical problem of large stocks of medicines that are past their expiry dates. In low-income countries like Egypt, many such stagnant medicines are the result of low sales for their specific items due to incorrect planning of quantities ordered. If not adequately monitored or regulated, expired pharmaceuticals may be repackaged and sold as counterfeits or be dumped without any thought of the potential environmental damage which contradicts with the requirements of the world to move towards sustainability. This study aimed to identify the effect of digitalization on the pharmaceutical supply chain sustainability by applying on the reverse logistics of pharmacies in the city of Aswan, and reducing the volume of stagnant medicine in pharmacies that eventually becomes expired and requires disposal, which negatively affects the environment. The researcher used the descriptive analysis approach, a survey was designed and distributed to a sample of (300). The study reached many results, the most important that There is a statistically significant effect between the dimensions of digitalization (Administrative requirement, Tools & Equipment, Software and Network) and Pharmaceutical supply chain sustainability.

Keywords: Digitalization, Pharmaceutical Supply Chain, Sustainability, Reverse Logistic

1. Introduction

Digitalization has a credit to be one of the best smart solution to help firms adjust and overpass a pandemic of COVID-19 has had a significant impact on people, businesses, and the global economy (**Almeida et al.,2020).**

Referring to the following, Digital revolution becomes imperative to the business not only in pandemics but to overcome any challenges.

Some researchers also talked about the advent of a new goal to the 17 goals of the United Nations to be an 18th SDG called Digital Connection. The equitable distribution of digital wealth under the direction of the drivers is the main goal of digital connectivity (**Clark et al.,2022)**.

One of the most important drivers in digitalization is Enterprise resource planning "ERP" which is integrate the organization functions **(Aasi et al.,2021)**.

On the other hand, Sustainability concept become a trendy scope for all business sectors rather, it has become an issue that is not debatable for growth, effective usage of resources and take into account environment, social and economic **(Purvis et al., 2019)**.

It cannot be denied that digitalization is a smart tool to push a sustainability forward, Due to its resilience and intelligent performance, Actually Digitalization used in many industries to enhance its sustainable performance, According to **(Abideen et al., 2021)** There are many fields suffer from poverty in usage of digitalization for sustainability one of them is healthcare, Specifically in part of logistics, as an important part of healthcare industry is Pharmaceutical supply chain which is responsible for sells medicines to patients.

Pharmaceutical supply chain as part of the business sector has waste due to transactions made, returns carried by reverse logistics may be due to several reasons, whether patient death, excess medication at home, changing prescriptions, expired medications, or discontinued patient information about taking medications, adverse effects of medications, and prescription, order, or supply errors **(Abbas, Haidar, 2018).**

In this research, we will focus on expiry date medicines which end up to destroying and effect on environment negatively, by investigating if adopting digitalization through integrated Enterprise resource planning "ERP" can interface between pharmacies and suppliers to redistribute/ reallocate stockpiles of stagnant medicines to higher demand points to eliminate unsold until being expiry and harmful for environment.

2. Literature review

2.1 Studies related to research gap

Sazvar et al., (2022) the most recent pandemic COVID has amply demonstrated that the pharmaceutical supply chain (PSC) is one of the most significant healthcare supply chains. Due to the fact that PSCs release a significant amount of pharmaceutical waste into the environment every day, their effects on the environment and society are also apparent. The numerical outcomes demonstrate that the control of reverse flows results in proper waste management, earning money, and lowering both disposal costs and raw material consumption. Additionally, competition improves the performance of PSCs and the supply of goods to pharmacies.

Alshemari et al., (2020) Pharmaceutical waste is defined by the World Health Organization as unneeded pharmaceuticals, such as medicines, vaccines, sera, and expired, unused, spilled, and infected pharmaceutical items that should be disposed of properly. The number of prescriptions and patients as well as the use and overproduction of medications have all contributed to an increase in the volume of pharmaceutical waste. Unused, expired, and lost medications are a significant global challenge that necessitates a systemic strategy to address since they contribute to medical shortages, larger percentages of pharmaceutical waste, and higher disposal prices for medicines.

Abbas & Farooquie (2018) the main goal for any supply chain is to maximize the overall value created. Not every purchase and every delivery is final, pharmaceutical supply chain like any **another** industry have several reasons why a customer can decide to return the same item or service. Due to inventory excess, retailers return unsold goods to producers at the end of a selling season. As a result, a provision for another, comparable flow or chain that could transport these returned goods backwards must exist.

Kamba et al., (2017) pointed that in many low- and middle-income nations, there exist substantial supplies of expired medications. If not properly supervised or controlled, expired medications may be **repackaged** and sold as fakes or dumped without any consideration for the potential environmental harm. Reducing the rate of pharmaceutical expiry across the supply chain is necessary, as is ensuring the prompt and secure disposal of outdated medications. In order to increase inventory control and the accuracy of procurement forecasts, many low- and middle-income nations must: (i) strengthen their public systems for managing pharmaceuticals; and (ii) ease the burden on central medical stores through reimbursement and liberalization. schemes; (iii) tighten restrictions on drug donations; (iv) investigate ways to salvage officially expired medications through re-analysis and potential shelf-life extensions; (v) enforce safe drug disposal laws

more strictly; (vi) invest in a system for such disposal, perhaps based on ultra-high-temperature incinerators; and (vii) include user accountability for expired medications in the regular accountability regimes used by it.

2.2 Studies related to research gap solution

Ma & Kang (2022) according to the results, digital transformation has a favorable effect on the performance of sustainable supply chains, particularly those in the pharmaceutical industry. Its application in China is shown by the empirical study, which was carried out with Chinese pharmaceutical supply chain managers. The study improves theoretical research on information exchange and traceability elements of remote media and solves research gaps in related theories in pharmaceutical supply management. Pharmaceutical businesses must stay up with the adoption of block chain, IoT, big data, and other technologies as digital construction revolutionizes the healthcare industry. Future market dominance by precision medicine will call for supply chain management systems with effective collaborative features and lean traceability

Makaleng & Lambert (2021) confirmed that technology is one of the techniques employed by pharmaceutical businesses, however the technology used should be cutting-edge and up to date because the technology now in use is stale. For manufacturing pharmaceutical firms, technological resource capacity can efficiently diffuse product information through to the suitable functional components of the reverse logistics system. Because of this, technology is a crucial part of the procedures followed and the transactions made. The results ensured that having cutting-edge technology is crucial for helping with the difficulties their pharmaceutical companies' faces in reverse logistics.

Abideen et al., (2021) based on review technique for 96 publications from 2010 to 2021 were selected from the Web of Science core collection database examining areas that **have** benefited from technological capabilities, the results showed that a considerable amount of research has been done in the food, energy, manufacturing, and chemical sectors, and more focus has to be diverted towards healthcare, fashion, agriculture, and electronics.

Barna (2021) ensured that "digitalization" and "sustainable development" go hand in hand very closely since the more automated a company's internal processes are, the less wasteful its resource use and harmful effects on the environment are. **Organizations** have determined that ERP systems are the most suitable solution to ensure the digitization of operations and the sustainable development of the organization.

3. Problem Statement

Based on previous studies, **Sazvar et al. (2022), Alshemari, et al. (2020), Abbas & Farooquie (2018), Kamba et al., (2017)** in pharmaceutical supply chain some drugs will **remain** stagnant in pharmacies which ends up shelf life and be expired which is harmful to the environment.

4. Exploratory study

4.1 Procedures done in exploratory study

4.1.1 Literature review related to the research gap (Identifying problem)

Researcher reviewed the previous studies that were carried out by the researchers that have a close relationship with the research problem that have been referred previously in problem statement.

4.1.2 Reviewing/Consultation

At this phase of the exploratory study, the opinions of the experts were taken, which classified into (managers of current and former companies and pharmacists) both with a good reputation in addition to professors in the field of scientific research.

4.1.3 Analysis

Researcher made an analysis of all aspects that are directly related to the problem of the research, and an amount of data has been collected in the form of a questionnaire for (31) samples, which allowed greatly to the researcher to come out with the aim of the exploratory study and creating questions which investigate the drug stagnant problem that may be face the pharmacies in Aswan. The researcher designed a survey to extract the reality of this problem. The results prove the problem, there is a percentage of expired medicine ranges from 1 to 3% annually before retrieving the permitted part for companies.

According to exploratory study, the results ensured the gap that was mentioned in literature, pharmacies in Aswan faced a challenge of medicines accumulation.

5. Research Questions

According to the problem statement, the main research question, Can Digitalization affects Pharmaceutical supply chain sustainability?

- **The Secondary questions are:**

1. Can administration requirements affect Pharmaceutical supply chain sustainability?
2. Can tools & equipment affect Pharmaceutical supply chain sustainability?
3. Can software affect Pharmaceutical supply chain sustainability?
4. Can networks affect Pharmaceutical supply chain sustainability?

6. Research Objectives

1. To investigate the effect of digitalization on pharmaceutical supply chain sustainability.
2. To reduce the amount of pharmaceutical supply chain wastage.
3. To decrease the amount of expiry medicines in pharmacies.
4. To decrease the negative effect of pharmaceutical supply chain on environment.

7. Research Hypothesis

H.1 There is a significant relationship between digitalization and pharmaceutical supply chain sustainability

- **H.1.1** There is a significant relationship between administrative requirements and pharmaceutical supply chain sustainability
- **H.1.2** There is a significant relationship between tools & equipment and pharmaceutical supply chain sustainability
- **H.1.3** There is a significant relationship between software and pharmaceutical supply chain sustainability
- **H.1.4** There is a significant relationship between networks and pharmaceutical supply chain sustainability

8. Research Significance

8.1 Scientific research importance

The scientific importance of research, enriching the scientific library with scientific research related to digitalization and supply chains with a perspective related to reverse logistics in order to be a reference for researchers to gain benefits of conclusion and begin their researches based on recommendations.

8.2 Practical research importance

Research aim seek to investigate impact of Digitalization on pharmaceutical supply chain sustainability is an output for world trends in major of healthcare industry.

All of new trends in field of healthcare today calls for digitalize this industry to quick walk for sustainability, the last climate conference, COP 27, did not neglect the healthcare sector. Rather, it was among its activities to discuss the outputs of the goals that were set by the Sustainable Market Initiative, the goals stipulated, **(I)** Healthcare supply chain less environmental negative impact, **(II)** digitalization of health care, **(III)** Health care provided to the patient.

9. Research Methodology

Descriptive analysis methodology applied in this paper to test the research hypothesis and explain the dimensions related to digitalization (Administrative requirements, tools & equipment, software and networks) and its effect on pharmaceutical supply chain sustainability. Researcher designed a questionnaire

and analyzing output data to conclude the relation between digitalization and pharmaceutical supply chain sustainability.

9.1 Data

9.1.1 Primary Data

The researcher boosts a research problem with quantitative data by designing a survey distributed on pharmacist for measuring the problem and can determine the level of expiry in pharmacies. Researcher in conclusion conducted a quantitative method by distribute survey to test hypothesis.

9.1.2 Secondary Data

Secondary data in research will be the literature considered at previous studies which support the research objectives and uncover the relations between variables from a positivism point of view.

9.2 Population

The study population is represented in the pharmacies of Aswan Governorate, which numbered 1122 pharmacy located in the city and its affiliated centers according to letter from the Pharmacists Syndicate in Aswan.

9.3 Sample

According to the population, 300 pharmacy determined as a sample can represent the population with accurate conclusion data by 95% using Yamane technique **Taro, Y. (1967).**

10. Study Outline

In order to achieve the objectives of the study, the study is divided into a group of major sections, the theoretical framework of the study which included the concept of Digital mean, the difference between Digitization, Digitalization and Digital transformation, the impact of digitalization on business environment , the concept of Sustainability, the Pharmaceutical supply chain sustainability, and finally the digitalization and circular pharmaceutical supply chain sustainability the second section involved the literature review related to Digitalization , Pharmaceutical supply chain sustainability and the relation between them. The third section will discuss the results and the last section will be for conclusion, recommendations and future research.

11.Theoretical Framework

11.1 The Concept of Digital mean

Digital refers to a new method of connecting with customers or conducting a new way for doing business **(Berman 2012)** But according to **McKinney's** definition which stands on defining term digital on three key pillars: **(I)** Adding

value at the newest commercial frontiers **(II)** Improving the procedures that directly impact how customers are treated **(III)** Constructing the fundamental competencies that boost the entire business initiative.

11.2 The difference between Digitization, Digitalization and Digital transformation

Digitization and digitalization are two conceptual words that are frequently used synonymously in a variety of literary works. We will examine each phrase in depth and makes the case why it is useful for analysis to expressly distinguish between them. According to ***Brennen & Kreiss .(2016),*** the term **digitization** refers to process of turning analogue/physical information streams into digital ones. Digitization also defines "the action or process of digitizing; the conversion of analogue data (esp. in later use images, video, and text) into digital form. But **digitalization** "the adoption or expansion of the use of digital or computer technology by a company, sector of the economy, nation, etc." ***Oswald & Kleinemeier.(2017)*** defines digitalization as "the transition to a digital business and the usage of digital technologies to modify a business model and generate new revenue and value-producing opportunities.". We can conclude that digitalization and usage of new technology required to be digitized. **Rachinger et al.(2018)**

After explanation of digitization and digitalization we will shade the light on the digital transformation to can step by step compare between there similar terms by simple way, **Digital transformation** refer to Changes in jobs, business offerings, and working practices brought on by the use of digital technologies within an organization or in the environment in which the company operates. A change in organizational culture, leadership, mindsets, attitudes toward risks, and the propensity to accept ambiguity and constant change are also required as a result of the profound changes that digital transformation can bring about in organizational operations, products, processes, and business models. **Zoppelletto et al. (2023)**

11.3 The impact of digitalization on business environment

The corporate manner of working and business settings are already being impacted by digitalization. Neglecting digitalization could put businesses in danger of falling behind in today's fiercely competitive marketplaces. The entire operating environment and internal operations of a firm may be affected by digitalization. Additionally, digitization has the power to destroy existing businesses and create new ones by altering the roles of actors in a value chain. As an illustration, digitalization may substitute new intermediates for old ones in the supply chain. This might be as a result of growing use of mobile devices and direct customer access, for instance. As a result, there are three ways to look at how digitalization will affect an organization and what its aims should be **Parviainen et al., (2017)**

11.3.1 Internal efficiency

Internal efficiency includes increased quality, consistency, and efficiency of corporate processes through the removal of human stages and improvement of accuracy. By combining organized and unstructured data, improving perspectives of organizational data, and incorporating data from other sources, digitization can also offer a better real-time view on operations and results. Additionally, by automating repetitive tasks, digitalization can improve work satisfaction for employees and free up time for them to learn new skills. Digitalization also enhances compliance via uniformity of records and improves recovery via easier backups and distribution of storage.

11.3.2 External opportunities

External opportunities contain potential for new business models as well as enhanced response times and customer service. Innovative client offerings or new services may be made possible by new digital technology.

11.3.3 Disruptive changes

Disruptive changes include a company's operating environment changing as a result of digitalization; for instance, a company's current operations may become obsolete in the new environment (e.g., manual scanning of invoices replaced by electronic invoice). On the other side, digitization might lead to the emergence of entirely new industries, such as the operator of electronic invoices.

11.3.4 Digital transformation

The term "digital transformation" (DT) describes the changes brought about by digital technology in businesses. These changes occur when digital technologies and business processes are integrated to transform the organization. DT is now thought to be the force behind change in the corporate world. DT fundamentally enhances corporate performance from a dynamic capability standpoint by harmonizing strategic direction, marketing, customer behavior, and supply chain management.

11.4 Sustainability

According to **Render et al., (2020) "*The term sustainability refers to meeting the needs of the present without compromising the ability of future generations to meet their needs"***.

Numerous authors also use the terms "cleaner production," "pollution avoidance," "pollution control," "minimization of resource use," and "eco-design" to describe sustainability. **Sambhanthan, A. (2022)**. Because resources are limited and finite on earth as a result, resources should be handled sparingly and with care without lowering the standard of living. Sustainability, in essence, alludes to a better future for our children and grandchildren's healthier lives **(Robertson, 2021).** Therefore, sustainability is an issue of what resources—natural resources, environmental quality, and capital—we leave to future

generations. As we've seen, some natural resource loss is unavoidable, but according to many authors, this can be offset by more capital. Others, however, disagree with the notion that money can replace natural resources and believe that sustainability is about protecting the natural resources that are vital to our life. **Kuhlman & Farrington (2010).**

11.4.1 Sustainability Pillars

11.4.1.1 Environmental

According to **Morelli, J. (2011).** Environmental sustainability is "The ability of human society to meet its needs without going beyond the capacity of its supporting ecosystems to continue to regenerate the services necessary to meet those needs or by our actions diminishing those ecosystems is known as environmental sustainability. **Judge and Douglas (1998)** characterized an organization's environmental performance as its dedication to environmental excellence in order to meet societal expectations surrounding environmental concerns. An organization's environmental performance is measured by its capacity to help minimize solid waste, air and water pollution, as well as consumption of dangerous, hazardous, and toxic items and the frequency of environmental mishaps. **(Zhu et al., 2008). Maxwell and Van der Vorst (2003)** highlighted that a number of indicators, including a decrease in energy and material consumption, a decrease in air and water pollution, a reduction in or elimination of waste generation, and the usage of poisonous and harmful products, can be used to assess an organization's environmental performance.

11.4.1.2 Social

A business organization's configuration of social responsibility principles, social responsiveness procedures, and policies, programmes, and observable outcomes as they relate to the firm's societal relationships is referred to as social performance. **(Wood, 1991, p. 693).** A company's perceived involvement with social responsibility concerns is referred to as its "social performance." **(Wood, 1991)** such as management standards, concerns about health and safety, salaries and benefits, policies regarding equal chances, training and education, child labor, forced labor, freedom of association, and human rights and services **(Dixon et al., 2005; DETR, 1999).** Issues with access, equity, disturbance, safety, and health were categorized as social indicators. by **DETR (1999)**. **Sarkis et al. (2010)** studied a few social indices, including macrosocial concerns, stakeholder participation, external population, and internal human resources. According to researchers, the social component of sustainability is understudied and merits more research. **(Seuring and Müller, 2008)**

11.4.1.3 Economical

An organization's economic performance primarily focuses on its profitability and expansion. **(Judge and Douglas, 1998)**. **Daugherty et al. (2005)** showed that metrics including recovering value from products, cost containment, lowering inventory investment, and improving profitability and worker

productivity can be used to assess RL's economic success. **Diabat et al. (2013)** economic practices were divided into those that support strong or weak economic performance. They classified the advantages of GSCM practices, such as cost savings in material purchases, energy use, and waste treatment, as well as a decrease in discharge and environmental mishaps, as positive economic contributors. On the other hand, they classified expenditures associated with the adoption of GSCM techniques as unfavorable economic results. These costs included investment charges, the cost of buying environmentally friendly materials, as well as operational and training costs. While implementing GSCM methods may appear to be expensive and have a negative effect on economic performance in the short term, it can help enhance other performance in the long run. **(Diabat et al., 2013).**

11.5 Pharmaceutical Supply Chain Sustainability

The pharmaceutical is one of the biggest industries in the world that has significantly grown in the past two decades. In 2019 alone, the industry made a business of 1.25 trillion USD worldwide. According to a forecast, the preceding number is expected to rise to 1.59 billion USD in 2024 **(Statista, 2020)**. Due to the huge consumption of medicines worldwide, a considerable amount of waste is generated by the industry. According to the World Health Organization (WHO), pharmaceutical waste consists of all the unwanted pharmaceuticals that include unused, expired, spilled, contaminated pharmaceutical products, vaccines, medicines, and sera. These types of waste are not required and should be disposed of properly **(WHO, 1999)**. Essentially out of all the pharmaceutical waste, 85% of it is non-toxic, whereas the rest 15% is toxic **(WHO, 2018)**. The disposal of this waste requires the right waste management techniques **(Bungau et al., 2018)**. As the industry majorly contributes to society's health, the burden and responsibility of adopting sustainable practices fall the most on such industries. Therefore, these companies are willing to invest in eco driven technologies and practices. The inclination towards being sustainable benefits both the companies and the communities at large.

Due to rising pollution and waste production, enterprises all over the world are being forced to integrate the circular economy (CE) idea into their supply chains. Circular supply chain management is the combination of the CE method and supply chain management (CSCM). The pharmaceutical sector, among others, contributes to ecological deterioration. Therefore, a strong framework for CSCM adoption in a certain industry is crucial. **Khan & Ali (2022)**

The pharmaceutical sector needs the closed-loop supply chain inventory model because it encourages social, economic, and environmental sustainability. Many unneeded medications are thrown out, harming the environment. At the same time, some patients have trouble getting expensive prescription medications. The circular economy, which is concerned with the negative effects of employing fresh materials for environmentally destructive manufacturing processes, can be applied to the closed-loop supply chain. One application of the circular economy's guiding principle is the re-distribution or recycling of

unwanted medications. Drugs can be gathered, examined, and resold by pharmacies. **McRae & James (2016)** study reveals that if certain requirements, namely those pertaining to the quality and safety of the medications to be redistributed, were met, pharmacists can potentially redistribute medications in solid dosage forms (tablets and capsules).

The Circular Pharmaceutical Supply Chain (CPSC) has been suggested as a future strategy to support sustainability in the pharmaceutical area to reduce among others drug shortages and stockpiling. **Raijada et al., (2021)**

11.6 The Digitalization and Circular Pharmaceutical Supply Chain Sustainability

According to **Makaleng & Lambert. (2022)** the findings showed that technology is a tactic employed by pharmaceutical manufacturing companies, but that technology needs to be modern and cutting edge because the one now in use is antiquated. Technology-enabled resource capacity can efficiently disseminate product information for pharmaceutical manufacturing businesses by way of the suitable operational components of the reverse logistics system. Because of this, technology is a crucial part of the procedures followed and the transactions made. The respondents said that having cutting-edge technology is crucial for helping with the difficulties their company faces. According to the findings, 52.38% of respondents said it had a very high influence, while 42.06% said it does have an influence only 1.59% of the respondents thought it had a low influence, while 3.97% of the respondents said it has a medium influence.

Circular supply chain management (CSCM) has demonstrated to be a significant enabler of sustainable development. An approach to sustainable development and economic model reduction known as "circular thinking" reduces resource input, waste, emissions, and energy leaks while maintaining growth and profitability. Both the circular business model (CBM) and the circular supply chains' sustainability performance must be evaluated concurrently. The value proposition of the circular supply chain can aid in achieving sustainability goals, and CBMs come in a variety of complexity levels. Circular economy models and solutions have been developed with the aid of Industry 4.0 to transform products at the end of their lifecycle into new products with a variety of uses. Circular supply chain management may be made possible by the circular economy's embrace of digitalization technology. **Abideen et al.,(2021).**The full digitalization of the PSC, when even a single dose is traced in the digital system, would provide a better overview of the produced, consumed and unused/expired drug products. **Raijada et al.,(2021).** It is well known that the future growth of technology, business, and the economy will be significantly influenced by the digitalization of manufacturing practices. However, Pharmaceutical Industry “PI” has resisted digital deployment, which has slowed down the pace of digitization in the pharmaceutical industry. Digitalization in PI

can have a number of benefits, including lower production costs, better quality, and fewer capacity constraints. The majority of pharmaceutical companies have been hesitant to adopt digital manufacturing processes because they believed their people, systems, and data weren't ready. However, many businesses have started experimenting with digitalization after realizing that waiting is not an option. Although utilizing a digital platform can enhance procedures in a number of ways, such as data gathering, real-time sharing of trial findings, and the ability to track various aspects of supply chain. **Hole & McFalone.(2021).** According to **Ma, J. Y., Shi, L., & Kang, T. W. (2022)** the digital transformation has a positive impact on sustainable supply chain performance. Pharmaceutical supply chain sustainability enhanced by traceability and information sharing which facilitate the role of digitalization of supply chain.

12. Results & Discussion

In this section, Researcher represent the statistical analysis procedures and methods that were used to answer the questions and test hypotheses.

12.1 A statement of the numbers of survey lists distributed and received for the study sample

Table 2 explain the number of distributed questionnaires and the number of valid was obtained which indicates for correct roll response rate.

Table 1. A statement of the numbers of survey lists distributed and received for the study sample

Lists	The number
Number of distributed questionnaires	**300**
The obtained lists are valid for analysis	**275**
The number of incorrect listings	**25**
Correct roll response rate	**92 %**
non-response rate	**8 %**
Total	**100 %**

Table 2 shows that the number of correct lists that were entered and tested statistically is 275 survey lists, where the percentage of correct responses is about 92%, and this is a good response rate.

12.2 Reliability & Validity

To identify the validity and reliability of the tool used to measure sample responses, both of the internal consistency coefficient, which measures the correlation between questionnaire paragraphs and the Cronbach Alpha coefficient to measure the stability of the paragraphs and dimensions of the questionnaire are used.

Table 1 Reliability and Validity of Variables (The Effect of Digitalization on Pharmaceutical Supply Chain Sustainability) by using alpha Cronbach

Ser	Dimensions	Reliability	Validity
Digitalization			
x1	Administrative requirements	.761	.872
x2	Tools & equipment	.844	.918
x3	Software	.853	.923
x4	Networks	.864	.929
Total Dimensions : Digitalization X		**.823**	**.907**
Total Dimensions: Pharmaceutical supply chain sustainability Y		**.872**	**.933**
Total Dimensions: The Effect of Digitalization on Pharmaceutical Supply Chain Sustainability		**.857**	**.925**

Table 3 explain that:

The researcher used to check the reliability coefficient Cronbach Alpha, to measure the stability of the content variables of the study:

1. It was found that coefficient to check the total sample size (0.857), which indicates that the high degree of persistence of the study sample, which was reflected in its impact on Validity (Which represents the square root) was (0.925).
2. According to the independent variables (Digitalization) of the reliability coefficient has reached (0.823), Dependent variables (Pharmaceutical supply chain sustainability) and the reliability coefficient has reached (0.872).
3. The value of Cronbach Alpha coefficient is ranging between (0.761: 0.864) for the (**Independent variable "Digitalization**").

The Cronbach Alpha coefficient values of all dimensions are greater than (70%), which means a high degree of internal stability for all questionnaire paragraphs and therefore it can be said that the measures on which the study is based to measure questionnaire paragraphs have internal stability of their paragraphs, enabling us to rely on these answers to achieve the objectives of the study and analyze its results

12.3 Internal Consistency

The Person Correlation coefficient has been calculated to measure the internal consistency for the (**Digitalization**), and the results are as the follows:

Table 3 Internal consistency by used the coefficient of correlation Pearson For Dimensions independent variable (Digitalization)

N	Dimensions	Pearson Correlation	Sig.
1	Administrative requirements	.651**	Less than 0.01
2	Tools & equipment	.738**	Less than 0.01
3	Software	.825**	Less than 0.01
4	Networks	.926**	Less than 0.01

The previous table explains the following:

The results of the previous table show that the (**Digitalization**) Dimensions is strong, with a person's correlation coefficients ranging from (0.651 to .926), at less than 0.05.

Table 4 Internal consistency by used the coefficient of correlation Pearson For Statements dependent variable (Pharmaceutical Supply chain sustainability)

N	Statements	Pearson Correlation	Sig.
1	Pharmaceutical supply chain sustainability reduces the number of pharmaceutical waste returns.	.519*	Less than 0.05
2	Pharmaceutical supply chain sustainability reduces number of transportation and reduces CO2 emissions.	.726**	Less than 0.01
3	Pharmaceutical supply chain sustainability reduces stagnant stocks that are not delivered to customers.	.818**	Less than 0.01
4	Reverse logistics increases the volume of recycled materials in the pharmaceutical supply chain instead of disposing them.	.853**	Less than 0.01
5	Pharmaceutical supply chain sustainability raise the level of customer service provided by the company by solving the problems of "reducing" stagnant inventory.	.617**	Less than 0.01
6	Pharmaceutical supply chain sustainability makes it easier to trace recalls of drugs with safety concerns.	.538*	Less than 0.05
7	Pharmaceutical supply chain sustainability reduces unfulfilled customer demand.	.842**	Less than 0.01
8	Pharmaceutical supply chain sustainability reduces the cost of production losses and stabilize the level of production	.619**	Less than 0.01
9	Reverse logistics helps pharmaceutical companies improve their competitive position	.733**	Less than 0.01

The results of the previous table show that the (**Pharmaceutical supply chain sustainability**) **Statements** is strong and moderate, with a person's correlation coefficients ranging from (0.519 to 0.842), at less than 0.05.

12.4 Descriptive analysis for demographic variables

1- Pharmacy Location: (Kom Ombo/ Edfu/ Aswan)
2- Experience years: (less than 5 year/ from 5 less 10 year/ from 10 year +)
3- Establishment: (year or less / below/ from 1 year to 3/ from 3 years to above/more)

- **Locations**

Table 2 Frequency distribution statistics for variable "Pharmacy Location"

Items	Frequency	%	
Aswan	153	55.6	1
Kom Ombo	31	11.3	3
Edfu	91	33.1	2
Total	**275**	**100**	**-**

A sample study according to the variable of " **Pharmacy Location** " that most of the respondents in the **Location** (Aswan) which accounted by percentage (55.6%) came in the first place, then **Location** (Edfu), which accounted by percentage (33.1%), and finally **Location** (Kom Ombo) by percentage (11.3%), According to the responses of the sample.

From **Table 5** shows above, we find that the number of pharmacies responding to the survey is concentrated with the largest percentage (55.6%) in Aswan, and this is because Aswan is the capital and therefore it is the largest geographical location in terms of area and population, followed by Edfu with a rate of (33.1%), because it is the largest center in Aswan Governorate, then Kom Ombo.

- **Years of experience**

Table 6 Frequency distribution of the variable (Years of experience)

Items	Frequency	%	Rank
less than 5 year	111	40.4	1
from 5 to 10 year	95	34.5	2
from 10 year +	69	25.1	3
Total	**275**	**100**	**-**

According to the sample data for variable "**Years of experience**" most of the response (less than 5 year), with a percentage of (40.4%), then response (from 5 less 10 year), with a percentage of (34.5%), And finally response (from 10 year +), with a percentage of (25.1%), respectively According to the responses of the sample.

In the statistical distribution of years of experience according to **Table 7**, we find that (40.4%) of the sample's experience is from five years or less, and this is usually in the pharmacy except for one pharmacist manager who has the most experience, while the rest of the pharmacists or workers are newly graduated or under Training, and they are usually the ones who deal directly with the public, and therefore most of those who filled out the questionnaires were from them. On the other hand, this is confirmed by the fact that in small pharmacies, except for one, which does not require the appointment of assistants, the pharmacist director with high experience was interviewed, which was represented in (34.5%) and (25.1%).

- **Establishment**

Table 7 Frequency distribution of the variable (Establishment)

Items	Frequency	%	Rank
year or less /below	69	25.1	2
from 1 year to 3	43	15.6	3
From 3 years to above/more	163	59.3	1
Total	**275**	**100**	**-**

According to the sample data for variable "**Establishment**" most of the response (from 3 years to above/more), with a percentage of (59.3%), then response (year or less /below), with a percentage of (25.1%), and finally response (from 1 year to 3), with a percentage of (15.6%), respectively According to the responses of the sample. Referring to **Table 8**, we find that the largest percentage of the distribution is for pharmacies that were established from 3 years or more, and this serves our research and supports it with the credibility of the information, but the comment on this percentage is that the governmental instructions for establishment of pharmacies in Egypt stipulates that it must be between each pharmacy 100 meters makes the largest percentage of pharmacies that exceeded more than three years of establishment. As for the rest of the percentage, which represents three years or less, its percentage came as follows for two reasons, namely that the founding governmental instructions that was mentioned before making cities and centers was satisfied with the optimal number of pharmacies according to the instructions, and therefore Newly established pharmacies are opened in the new urban and service areas. As for the second reason, an idea has been developed in Egypt now, which is sub-leasing the pharmacy and managing it under the name of a large pharmacy within the chains of pharmacies.

12.5 Descriptive analysis for research variables

- **Independent Variable (Digitalization) and related four dimensions**

Table 3 Descriptive Statistical (Mean, Std. Deviation, Relative importance and rank) for the dimensions of (Digitalization)

Statements	Mean	Std. Deviation	Relative importance	Rank	Coefficient of variation
1- Administrative requirements					
1-The administration supports the policy of applying digitalization in the pharmacy.	3.50	.71	70	2	20.2
2-The pharmacy administration is working to provide a committee that supervises the digitalization project.	2.17	.32	43.40	7	14.7
3-The pharmacy administration is re-engineering the administrative,	2.89	.47	57.80	4	16.2

organizational procedures and technical operations to align with the good transformation.					
4-The pharmacy depends on exchanging reports electronically between management levels.	2.33	.41	46.60	5	17.5
5-There is an administrative team at a high level of organizational control responsible for strengthening and enhancing the use of the Internet and networks within the pharmacy.	2.29	.39	45.80	6	17
6-The pharmacy administration is working on training employees and preparing them to apply digitalization.	3.83	.50	76.60	1	13
7-The pharmacy provides sufficient financial support to implement digitalization.	2.95	.45	59	3	15.2
Mean Average	**2.85**	**.46**	**57.08%**	**-**	**16.1**
2- Tools & equipment					
8-Devices in pharmacy suitable for the digitalization project.	3.67	.36	73.40	1	9.8
9-Devices are updated regularly and continuously.	3.17	.57	63.40	3	17.9
10-The pharmacy can completely switch to the electronic system based on devices, computers and technological tools.	2.84	.64	56.80	4	22.5
11-The pharmacy depends on issuing instructions and decisions electronically.	2.49	.56	49.80	5	22.8
12-Devices are quickly repaired and maintained without delay.	3.28	.81	65.60	2	24.6
Mean Average	**3.09**	**.60**	**61.80%**	**-**	**19.4**
3- Software					
13-Software are available in the pharmacy contribute to the application of electronic administration.	٤,٠٥	.42	٨١	1	10.3
14-Software used is suitable with the nature of the services required to be provided in the pharmacy.	٣,٧١	.77	٧٤,٢٠	4	20.7
15-Pharmacies ERP system cover all functions such as purchasing and inventory management	٣,٥٠	.76	٧٠	6	21.7
16-Pharmacies use ERP systems to organize the flow of information for better utilization of resources	٣,٧٧	.72	٧٥,٤٠	2	19.1
17-The pharmacy ERP system accurately monitor information entry	٣,٧٢	.59	٧٤,٤٠	3	15.8
18-ERP software used in pharmacies contributes to providing explanatory information at the time of any errors	٣,٤٥	.62	٦٩,٠٠	7	17.9
19-Software works to reduce duplication of information	٣,٥٦	.67	٧١,٢٠	5	18.8

20-The software used in pharmacies synchronizes information	٣,٤٤	.8	٦٨,٨٠	8	23.2
Mean Average	**3.64**	**.66**	**72.98%**	**-**	**18.1**
4- Networks					
21-Networks help in transparency to provide high quality services.	3.60	.46	72	4	12.7
22-Networks linkage with software, help the participating parties to easily access the required information.	3.77	.43	75.40	2	11.4
23-Networks help by exchanging information electronically by transferring unified data between units and branches.	3.66	.54	73.20	3	14.7
24-Networks through the electronic exchange of information help to expand the knowledge database of pharmaceutical companies and pharmacies	3.95	.40	79	1	10.1
25-An internal internet network (Intranet) is available within the pharmacy that distributes data to the internal units/departments of the pharmacy.	2.62	.48	52.40	5	18.3
26-An external internet network (Extranet) is available to communicate and distribute information with the parties involved in the pharmaceutical supply chain.	2.04	.46	40.80	6	22.5
Mean Average	**3.54**	**.51**	**70.80%**	**-**	**14.4**
Total: Digitalization	**3.43**	**.80**	**68.60%**	**-**	**23.3**

Table 9 illustrated the following:

The general trend of the study sample is on a dimension (Digitalization), indicates that it is towards between the (Agreement) and (disagreement) with mean of (3.43), and the Std. Deviation (.80), with Relative importance (68.60%).

1. **<u>Administrative requirements:</u>**

- The general trend of the study sample is on a dimension (Administrative requirements), indicates that it is towards the (neutral and disagreement) with mean of (2.85), and the Std. Deviation (.46), with Relative importance (57.08%).
- The arithmetic mean ranged from (2.17 to 3.83), the relative importance ranged from (43.40% to 76.60%).

The most important statement are (The pharmacy administration is working on training employees and preparing them to apply digitalization), with Relative importance (76.60%) and the least important statement are (The pharmacy administration is working to provide a committee that supervises the digitalization project), with Relative importance (43.40%).

According to the responses of the study sample.

This dimension comes within the variable of the independent variable "digitalization", with a total average of (2.85), with an importance of (57%). This means that this dimension is neutral or rejected. This is due to the fact that the study sample, which is located in southern Upper Egypt, does not have sufficient administrative culture to deal with new technology developments and when looking at the phrases that have the largest percentage, we find that pharmacies support the idea of digitalization, staff training and funding but the problem lies in the phrases that deal with continuity and follow-up of development and how to deal with them in terms of providing consultants who monitor implementation and workflow correctly to get what it is supposed to be.

2. Tools & equipment

- The general trend of the study sample is on a dimension (**Tools & equipment**), indicates that it is towards the (neutral and agreement), with mean of (3.09), and the Std. Deviation (.60), with Relative importance (61.80%).
- The arithmetic mean ranged from (2.49 to 3.67), the relative importance ranged from (49.80 % to 73.40%)

The most important statement are (Devices in pharmacy suitable for the digitalization project) with (73.40%) relative importance and the least important statement are (The pharmacy depends on issuing instructions and decisions electronically), with Relative importance (49.80%).

According to the responses of the study sample

The second dimension of the independent variable “digitalization” with a total average of (30.9%) and importance (61.8%) which means approval or neutrality. Pharmacies already have the principled tools for the digitalization project, such as a reader, printer and label of barcode, which enables the pharmacy in principle to move forward towards digitalization but not fully transformation

3. Software

- The general trend of the study sample is on a dimension (Software), indicates that it is towards the (Agreement), with mean of (3.64), and the Std. Deviation (.66), with Relative importance (72.98%).
- The arithmetic mean ranged from (3.44 to 4.05), the relative importance ranged from (68.80 % to 81%)

The most Important statements are (Software are available in the pharmacy contribute to the application of electronic administration) with Relative importance (81%) and the

least important statement are (The software used in pharmacies synchronizes information), with Relative importance (68.80%).

According to the responses of the study sample

The third dimension of the independent variable "digitalization" comes with a total average of (30.9%) with an importance (92.98%) which means approval. Because most pharmacies today work on enterprise resource planning (ERP) programs that manage the pharmaceutical business and help it monitor flowing information and manage all logistical activities and transformation digitally or electronically. However, the obstacle for pharmacies is that there is no connection with companies, which improves synchronization and non-duplication of information and allows for transparency.

4. Networks

- The general trend of the study sample is on a dimension (Networks), indicates that it is towards the (neutral and agreement), with mean of (3.54), and the Std. Deviation (.51), with Relative importance (70.80%).
- The arithmetic mean ranged from (2.04 to 3.95), the relative importance ranged from (40.80 % to 79%)

The most important statements are (Networks through the electronic exchange of information help to expand the knowledge database of pharmaceutical companies and pharmacies) with Relative importance (79%) and the least important statement are (An external internet network (Extranet) is available to communicate and distribute information with the parties involved in the pharmaceutical supply chain), with Relative importance (40.80%).

According to the responses of the study sample

The fourth and final dimension of the independent variable "digitalization", and it reached a total average of (4.53%) with an importance of (8.70%), which means approval or neutral. This dimension is considered the origin of the researcher's goal in terms of applying digitalization by linking pharmacies with pharmaceutical companies, and the results of this dimension are very logical. Networks helps in exchanging of information between departments and external parties, but the problem or obstacle lies in the fact that most pharmacies either have an Intranet, but it is internal and works at the pharmacy level only and not outside with pharmaceutical companies, and there is no initiative or policy from companies or government policies urging transparency between pharmacies and Supplier companies.

- **Dependent Variable (Pharmaceutical supply chain sustainability) 9 statements**

Table 4 Descriptive Statistical (Mean, Std. Deviation, Relative importance and rank) about the phrases (Pharmaceutical supply chain sustainability)

Statements	Mean	Std. Deviation	Relative importance	Rank	Coefficient correlation
27-Pharmaceutical supply chain sustainability reduces the number of pharmaceutical waste returns.	3.66	.85	73.20	3	23.2
28-Pharmaceutical supply chain sustainability reduces number of transportation and reduces CO2 emissions.	3.73	.50	74.60	1	13.4
29-Pharmaceutical supply chain sustainability reduces stagnant stocks that are not delivered to customers.	3.60	.46	72	4	12.7
30-Reverse logistics increases the volume of recycled materials in the pharmaceutical supply chain instead of disposing them**.**	3.72	.41	74.40	2	11
31-Pharmaceutical supply chain sustainability raise the level of customer service provided by the company by solving the problems of "reducing" stagnant inventory.	3.55	.48	71	5	13.5
32-Pharmaceutical supply chain sustainability makes it easier to trace recalls of drugs with safety concerns.	3.17	.63	63.40	7	19.8
33-Pharmaceutical supply chain sustainability reduces unfulfilled customer demand.	3.43	.57	68.60	6	16.6
34-Pharmaceutical supply chain sustainability reduces the cost of production losses and stabilize the level of production	3.05	.72	61	8	23.6
35-Reverse logistics helps pharmaceutical companies improve their competitive position	2.42	.43	48.40	9	17.7
Total: Pharmaceutical supply chain sustainability	**3.37**	**.56**	**67.42%**	**-**	**16.6**

Table 10 illustrated the following

- The general trend of the study sample is on a dimension (Pharmaceutical supply chain sustainability), indicates that it is towards the (neutral and agreement), with mean of (3.37), and the Std. Deviation (.56), with Relative importance (67.42%).
- The arithmetic mean ranged from (2.42 to 3.73), the relative importance ranged from (48.40 % to 74.60%)

The most Important statements are (Pharmaceutical supply chain sustainability reduces number of transportation and reduces CO2 emissions) with Relative importance (74.60%) and the least important statement are (Pharmaceutical supply

chain sustainability reduces the cost of production losses and stabilize the level of production), (Reverse logistics helps pharmaceutical companies improve their competitive position), with Relative importance (48.40%).

According to the responses of the study sample

The dependent variable obtained an average total of (3.37) and a significance score of (67.42%). This means neutrality or approval. The comment on that is that sustainability for the pharmaceutical sector in Egypt, specifically in Upper Egypt, is a new matter. Pharmacists have primarily emphasized the first four statements. Which deals with the environmental aspect of reducing Co2 emissions by linking pharmacies with pharmaceutical companies, and thus knowing the size of stagnant and redistributing them instead of returning them to the company, in addition to increasing the volume of recycled materials in case of expiration. The social aspect came second, as pharmacists emphasized that sustainable supply chains can increase the level of customer service, trace products that have safety concerns, and quickly retrieve them. Finally, the economic side came, as pharmacists emphasized that sustainable supply chains can reduce the volume of unfulfilled orders and reduce production costs.

12.6 Hypothesis testing and results

The researcher concentrates on Hypotheses in order to address the objectives, of the study problem as follows:

- **Main Hypothesis**

H.1 There is a statistically significant relationship between Digitalization and Pharmaceutical supply chain sustainability.

- **Sub Hypotheses**

H.1.1 There is a statistically significant relationship between Administrative requirements and Pharmaceutical supply chain sustainability.

H.1.2 There is a statistically significant relationship between Tools & equipment and Pharmaceutical supply chain sustainability.

H.1.3 There is a statistically significant relationship between Software and Pharmaceutical supply chain sustainability.

H.1.4 There is a statistically significant relationship between Networks and Pharmaceutical supply chain sustainability.

12.6.1 Correlation between The Digitalization and Pharmaceutical supply chain sustainability

- **H.1 There is a statistically significant relationship between Digitalization and Pharmaceutical supply chain sustainability**

Table 5 Correlation between The Digitalization and Pharmaceutical supply chain sustainability by using Pearson correlation

Dimension	r	Sig.
Digitalization and Pharmaceutical supply chain sustainability	.831	.01**

Table 11 shows, there is significant positive relationship between (Digitalization) and (Pharmaceutical supply chain sustainability) where the correlation coefficient was (.831) with a significant less than (0.05).

Prove the hypothesis research:

We accept the statistical hypothesis there is strong relationship between The Digitalization and Pharmaceutical supply chain sustainability

12.6.2 Simple Liner Regression

Table 11 Effect the Digitalization on the Pharmaceutical supply chain sustainability by using simple Liner Regression

Independent variables	β	t. test		F. test		R^2
		Value	Sig.	Value	Sig.	
Constant	1.070	11.148	.01**	611.485	.01*	69.1%
Digitalization	.831	24.728	.01**			

Table 12 shows (**Digitalization**) explains (69.1%) of the total change in the dependent variable (**Pharmaceutical supply chain sustainability**), which have a significant significance and T-test confirmed the existence of a statistically significant impact of all dimensions (Digitalization) on the (Pharmaceutical supply chain sustainability), where the value of (t) equal to (24.728), and F- test equal (611.485) indicates the quality of the impact of the regression model with a level of significance less than 0.01.

- **H.1.1 There is a statistically significant relationship between Administrative requirements and Pharmaceutical supply chain sustainability**

Table 12 Effect the Administrative requirements on the Pharmaceutical supply chain sustainability by using simple Liner Regression

Independent variables	β	t. test		F. test		R^2
		Value	Sig.	Value	Sig.	
Constant	2.161	19.005	.01**	125.092	.01*	31.4%
Administrative requirements	.561	11.184	.01**			

Table 13 shows, There is significant positive relationship between (**Administrative requirements**) and (Pharmaceutical supply chain sustainability), where the value of correlation coefficient (0.561) at a significant level less than

(0.01), and explains (31.4%) of the total change in the dependent variable (Pharmaceutical supply chain sustainability), which have a significant significance, T-test confirmed the existence of a statistically significant impact of all dimensions (Administrative requirements) on the (Pharmaceutical supply chain sustainability), where the value of (t) equal to (11.184) and F- test equal (125.092) indicates the quality of the impact of the regression model with a level of significance less than 0.01.

H.1.2 There is a statistically significant relationship between Tools & equipment and Pharmaceutical supply chain sustainability.

Table 13 Effect the Tools & equipment on the Pharmaceutical supply chain sustainability by using simple Liner Regression

Independent variables	β	t. test		F. test		R^2
		Value	Sig.	Value	Sig.	
Constant	1.532	13.594	.01**	285.825	.01*	51.1%
Tools & equipment	.715	16.906	.01**			

Table 14 shows, There is significant positive relationship between (**Tools & equipment**) and (Pharmaceutical supply chain sustainability), where the value of correlation coefficient (0.715) at a significant level less than (0.01), and explains (51.1%) of the total change in the dependent variable (Pharmaceutical supply chain sustainability), which have a significant significance, T-test confirmed the existence of a statistically significant impact of all dimensions (Tools & equipment) on the (Pharmaceutical supply chain sustainability), where the value of (t) equal to (16.906) and F-test is (285.825) indicates the quality of the impact of the regression model with a level of significance less than 0.01.

H.1.3 There is a statistically significant relationship between Software and Pharmaceutical supply chain sustainability.

Table 14 Effect the Software on the Pharmaceutical supply chain sustainability by using simple Liner Regression

Independent variables	β	t. test		F. test		R^2
		Value	Sig.	Value	Sig.	
Constant	1.240	13.786	.01**	601.966	.01*	٦٨,٨%
Software	.829	24.535	.01**			

Table 15 shows, There is significant positive relationship between (**Software**) and (Pharmaceutical supply chain sustainability), where the value of correlation coefficient (0.829) at a significant level less than (0.01), and explains (68.8%) of the total change in the dependent variable (Pharmaceutical supply chain sustainability), which have a significant significance, T-test confirmed the existence of a statistically significant impact of all dimensions (Software) on the (Pharmaceutical supply chain sustainability), where the value of (t) equal to

(24.535) and F-test is (601.966), indicates the quality of the impact of the regression model with a level of significance less than 0.01.

- **H.1.4 There is a statistically significant relationship between Networks and Pharmaceutical supply chain sustainability.**

Table 15 Effect the Networks on the Pharmaceutical supply chain sustainability by using simple Liner Regression

Independent variables	β	t. test		F. test		R^2
		Value	Sig.	Value	Sig.	
Constant	.964	12.777	.01**	1086.030	.01*	٧٩,٩%
Networks	.894	32.955	.01**			

Table 16 shows, There is significant positive relationship between (**Network**) and (Pharmaceutical supply chain sustainability), where the value of correlation coefficient (0.894) at a significant level less than (0.01), and explains (79.9%) of the total change in the dependent variable (Pharmaceutical supply chain sustainability), which have a significant significance, T-test confirmed the existence of a statistically significant impact of all dimensions (network) on the (Pharmaceutical supply chain sustainability), where the value of (t) equal to (32.955) and F-test is (1086.030), indicates the quality of the impact of the regression model with a level of significance less than 0.01.

13. Research Limitations

- **Time Horizon**: Time horizon will be from Sep 2022 to Sep 2023.
- **Locations**: Research applied on pharmacies located in Aswan and and its affiliated centers Edfu and Kom ombo.

14. Discussion

Table 6 Similarity & difference between current and previous study

N0.	Author	Aim of previous study	Aim of current study	Similarity	Difference
1	**Sazvar et al. (2022)**	a scenario-based Multi-Objective Mixed-Integer Linear programming model is developed to design a sustainable CLPSC, which examines the three groups of reverse flows of expired medications (must be disposed of, can be remanufactured and can be recycled).	Investigating the effect of digitalization on pharmaceutical supply chain sustainability.	-Dependent variable -Application sector	-Independent variable -Methodology "Mixed-Integer Linear programming model"

Discussion Researcher detect a gap from this research before exploratory study done, the current study and the previous study agreed based on the results, improvement in the sustainability of the pharmaceutical sector will reduce negative environmental impacts, reduce costs, and enhance revenue generation through effective inventory management.					
2	**Barna (2021)**	The paper aims to investigate the relation between digitalization and ERP systems on the sustainable organization performance	Investigating the effect of digitalization on pharmaceutical supply chain sustainability.	-Independent variable - Using survey to test hypothesis	-Dependent variable - Methodology "Quantitative method" -Application sector
Discussion Previous study concludes that there is a very strong relationship between digitalization and sustainable development which align with current research results, Erp system is a software and current study model dimension number three is a software with positive significant effect on pharmaceutical supply chain sustainability					
3	**BOULAHFA, R. (2021)**	This study aims to demonstrate the impact of digitalization of the health sector as an independent variable on health service.	Investigating the effect of digitalization on pharmaceutical supply chain sustainability.	- Independent variable -descriptive analytical method - Using survey to test hypothesis. -Application sector	-Dependent variable
Discussion The previous study agreed with the current study. In terms of results, there is a statistically significant effect between administrative requirements, as a dimension of digitalization and healthcare services. And also a statistically significant effect between tools & equipment, as a dimension of digitalization and healthcare services.					
Nu.	**Previous study**	**Aim of previous study**	**Aim of current study**	**Similarity**	**Difference**
4	**Alshemari et al,. (2020).**	This study's aim was to realize whether the pharmaceutical supply chain may be sustainable and minimize waste by applying circular economy principles.	Investigating the effect of digitalization on pharmaceutical supply chain sustainability.	-Dependent variable -Application sector	-Independent variable - Methodology "detailed narrative literature review"
Discussion The previous study recommended the inclusion of additional skills for the sustainability of the pharmaceutical sector, including product development, technology improvement, and systems development in order to ensure greater consideration of the environment. Accordingly, the current study was based on the digitization of the pharmaceutical sector in order to reduce the volume of pharmaceutical waste. The most important statements that The opinion of the respondents gained importance that digitalization through information sharing and networks will help reduce carbon emission by reducing distributional efforts.					

15. Conclusion

Researcher proven that there is a strong relationship between digitalization and pharmaceutical supply chain sustainability, but with a difference in the impact of digitalization dimensions from high to low, the first was network dimension, then software, and finally tools and technological equipment. The first dimension of the study did not affect the administrative requirements in a strong way, as it had a weak effect, due to what was previously explained, namely the study sample, which is located in southern Upper Egypt, does not have sufficient administrative culture to deal with new technology developments.

16. Recommendations

In this section, the following (table 17) will introduce recommendations relied on conclusions for pharmaceutical field to enhance and develop implementation of digitalization which effect on pharmaceutical supply chain sustainability.

Table 7. Action plan for recommendations

Recommendation	Implementation	Entity of implementation	Time period
Aligning with Egypt vision 2030 for achieve digital transformation, Pharmaceutical sector should improve their knowledge about how to transfer into digital pharmaceutical business.	Must be activated courses about digitalization and how to implement.	Cooperation of Ministry of communication and information technology with Pharmacists Association.	3 years
Setting strict instructions and regulations regarding the digitalization of pharmacies and activating intranet and extranet networks for information transparency between pharmacies and medicine companies.	Constantly inspecting pharmacies and making sure that It have an intranet and extranet network.	Cooperation of Egyptian drug authority with Directorate of Health Affairs.	At Regular periods
Raising knowledge and awareness of the Bachelor of Pharmacy students during their studies at the university to understand how to manage pharmacy digitally.	Developing a scientific course at the Faculty of Pharmacy that deals with information systems and pharmaceutical systems, enabling the graduate.	Cooperation between Pharmacists Association and pharmacy colleges with Supreme Council of Universities.	until implementation

17. Future research

a. Studying the effect of digitalization on pharmaceutical supply chain sustainability in Delta governorates.
b. Studying the effect of Block chain on Pharmaceutical supply chain sustainability in Egypt.
c. Studying the effect of Artificial intelligence on Pharmaceutical supply chain sustainability in Egypt.
d. Studying the effect of Internet of things on Pharmaceutical supply chain sustainability in Egypt.
e. Studying the effect of Digital transformation on Pharmaceutical supply chain sustainability in Egypt
f. Studying the effect of digitalization on FMCGs supply chain sustainability companies in Egypt.
g. Studying the obstacles to the application of digitalization in Egypt.
h. Studying the effect of digitalization on another field in Egypt.

References:

Aasi, P., Gråhns, E., Geijer, R., & Rusu, L. (2021, December). Organizational Aspects in Achieving a Successful Digital Transformation: Case of an ERP System Change. In European, Mediterranean, and Middle Eastern Conference on Information Systems (pp. 653-666). Springer, Cham.

Abbas, H., & Farooquie, J. A. (2018). Framework for reverse logistics practices in pharmaceutical supply chains. *International Journal of Pure and Applied Mathematics*, 119(16), 2343-2358.

Abideen, A. Z., Pyeman, J., Sundram, V. P. K., Tseng, M. L., & Sorooshian, S. (2021). Leveraging capabilities of technology into a circular supply chain to build circular business models: A state-of-the-art systematic review. *Sustainability*, 13(16), 8997.

Ahmad, H. (2022). Factors affecting supply chain integration and customer satisfaction. Uncertain Supply Chain Management, 10(3), 1037-1040.

Alarcón, F., Cortés-Pellicer, P., Pérez-Perales, D., & Mengual-Recuerda, A. (2021). A reference model of reverse logistics process for improving sustainability in the supply chain. *Sustainability*, 13(18), 10383.

Almeida, F., Santos, J. D., & Monteiro, J. A. (2020). The challenges and opportunities in the digitalization of companies in a post-COVID-19 World. IEEE Engineering Management Review, 48(3), 97-103.

Alshemari, A., Breen, L., Quinn, G., & Sivarajah, U. (2020). Can we create a circular pharmaceutical supply chain (CPSC) to reduce medicines waste?. Pharmacy, 8(4), 221.

Barna, L. E. L. (2021). The impact of digitalization and ERP systems on the sustainable developmenet of the organization. Cactus-The tourism journal for research, education, culture and soul, 3(2), 40-46.

Berman SJ (2012) Digital transformation: opportunities to create new business models. Strateg Leadersh 40(2):16–24

Brennen, J. S., & Kreiss, D. (2016). Digitalization. The international encyclopedia of communication theory and philosophy, 1-11.

Bungau, S. et al., (2018). Aspects Regarding the Pharmaceutical Waste Management in Romania. Sustainability, 10(8), 2788.

Clark, S., MacLachlan, M., Marshall, K., Morahan, N., Carroll, C., Hand, K., ... & O'Sullivan, K. (2022). Including digital connection in the united nations sustainable development goals: A systems thinking approach for achieving the SDGs. Sustainability, 14(3), 1883.

Daugherty, P.J., Richey, R.G., Genchev, S.E. and Chen, H. (2005), "Reverse logistics: superior performance through focused resource commitments to information technology", Transportation Research Part E: Logistics and Transportation Review, Vol. 41 No. 2, pp. 77-92.

Detr (1999), "Sustainable distribution: a strategy", Office of the Deputy Prime Minister (ODPM).

Diabat, A., Khodaverdi, R. and Olfat, L. (2013), "An exploration of green supply chain practices and performances in an automotive industry", International Journal of Advanced Manufacturing Technology, Vol. 68 Nos 1-4, pp. 949-961.

Dixon, R., Mousa, G.A. and Woodhead, A. (2005), "The role of environmental initiatives in encouraging companies to engage in environmental reporting", European Management Journal, Vol. 23 No. 6, pp. 702-716

Domniku, M., & Ahmeti, M. (2021). The Impact of Digitalization on Business Strategy. Available at SSRN 3877098.

Hendriarto, P. (2021). Understanding of the role of digitalization to business model and innovation: economics and business review studies. Linguistics and Culture Review, 5(S1), 160-173.

Hole, G., Hole, A. S., & McFalone-Shaw, I. (2021). Digitalization in pharmaceutical industry: What to focus on under the digital implementation process?. International Journal of Pharmaceutics: X, 3, 100095.

Judge, W.Q. and Douglas, T.J. (1998), "Performance implications of incorporating natural environmental issues into the strategic planning process: an empirical assessment", Journal of Management Studies, Vol. 35 No. 2, pp. 241-262.

Khan, F., & Ali, Y. (2022). Implementation of the circular supply chain management in the pharmaceutical industry. Environment, Development and Sustainability, 24(12), 13705-13731.

Kuhlman, T., & Farrington, J. (2010). What is sustainability?. Sustainability, 2(11), 3436-3448.

Ma, J. Y., Shi, L., & Kang, T. W. (2022). The Effect of Digital Transformation on the Pharmaceutical Sustainable Supply Chain Performance: The Mediating Role of Information Sharing and Traceability Using Structural Equation Modeling. Sustainability, 15(1), 649.

Makaleng, M. S. M., & Lambert, K. (2022). Evaluation of reverse logistics in challenges within the manufacturing pharmaceutical companies.

Maxwell, D. and Van der Vorst, R. (2003), "Developing sustainable products and services", Journal of Cleaner Production, Vol. 11 No. 8, pp. 883-895.

McRae, D., Allman, M., & James, D. (2016). The redistribution of medicines: could it become a reality?. International Journal of Pharmacy Practice, 24(6), 411-418.

Morelli, J. (2011). Environmental sustainability: A definition for environmental professionals. Journal of environmental sustainability, 1(1), 2.

Oswald, G., & Kleinemeier, M. (2017). Shaping the digital enterprise. Cham: Springer International Publishing.

Parviainen, P., Tihinen, M., Kääriäinen, J., & Teppola, S. (2017). Tackling the digitalization challenge: how to benefit from digitalization in practice. International journal of information systems and project management, 5(1), 63-77

Purvis, B., Mao, Y., & Robinson, D. (2019). Three pillars of sustainability: in search of conceptual origins. Sustainability science, 14, 681-695.

Rachinger, M., Rauter, R., Müller, C., Vorraber, W., & Schirgi, E. (2018). Digitalization and its influence on business model innovation. Journal of Manufacturing Technology Management.

Raijada, D., Wac, K., Greisen, E., Rantanen, J., & Genina, N. (2021). Integration of personalized drug delivery systems into digital health. Advanced drug delivery reviews, 176, 113857.

Render, Barry, Heizer, Jay, Munson, Chuck. (2020). Operation Management : Sustainability and Supply Chain Management 12th. Ed. (13 th. Ed.). England: Pearson Education Limited.(pp. 225)

Ricardianto, P., Kholdun, A., Fachrey, K., Nofrisel, N., Agusinta, L., Setiawan, E., ... & Endri, E. (2022). Building green supply chain management in pharmaceutical companies in Indonesia. Uncertain Supply Chain Management, 10(2), 453-462.

Robertson, M. (2021). Sustainability principles and practice. Routledge.

Sambhanthan, A. (2022). A Glossary of Business Sustainability Concepts. In Research Anthology on Agile Software, Software Development, and Testing (pp. 67-83). IGI Global.

Sarkis, J., Helms, M.M. and Hervani, A.A. (2010), "Reverse logistics and social sustainability", Corporate Social Responsibility and Environmental Management, Vol. 17 No. 6, pp. 337-354.

Sazvar, Z., Zokaee, M., Tavakkoli-Moghaddam, R., Salari, S. A. S., & Nayeri, S. (2022). Designing a sustainable closed-loop pharmaceutical supply chain in a competitive market considering demand uncertainty, manufacturer's brand and waste management. Annals of Operations Research, 315(2), 2057-2088.

Seuring, S. and Müller, M. (2008), "From a literature review to a conceptual framework for sustainable supply chain management", Journal of Cleaner Production, Vol. 16 No. 15, pp. 1699-1710

Statista, 2020. Statista. [Online]. Available at: https://www.statista.com/statistics/280572/medicine-spending-worldwide/. [Accessed 30 November 2020].

WHO. (1999). Guidelines for Safe Disposal of Unwanted Pharmaceuticals in and After Emergencies. WHO.

WHO. (2018). World Health Organaization. [Online]. Available at: https://www.who.int/news-room/factsheets/detail/health-care-waste. [Accessed 29 November 2

Wood, D.J. (1991), "Corporate social performance revisited", Academy of Management Review, Vol. 16 No. 4, pp. 691-718.

Zhu, Q., Sarkis, J. and Lai, K.-H. (2008), "Confirmation of a measurement model for green supply chain management practices implementation", International Journal of Production Economics, Vol. 111 No. 2, pp. 261-273.

Zoppelletto, A., Orlandi, L. B., Zardini, A., Rossignoli, C., & Kraus, S. (2023). Organizational roles in the context of digital transformation: A micro-level perspective. Journal of Business Research, 157, 113563.