

THE IMPACT OF INFORMATION TECHNOLOGY ON THE INTEGRATION OF SUPPLY CHAINS IN THE YEMENI PHARMACEUTICAL MANUFACTURING COMPANIES

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DOI: 10.5281/zenodo.10976818

Abstract

The current study aimed to determine the impact of information technology on the integration of supply chains in the Yemeni pharmaceutical manufacturing companies. The researcher used the descriptive analytical approach, and to collect field data, the researcher relied on the questionnaire tool. The size of the study population was (2106) male and female employees, and a sample was taken using the proportional stratified random sampling method amounting (251) male and female employees. The most prominent results were that the level of availability of information technology in the pharmaceutical manufacturing companies under study is high in all its dimensions, and the level of availability of supply chain integration in pharmaceutical manufacturing companies is high. The study results also revealed that the level of availability of information technology in the Yemeni pharmaceutical manufacturing sector from the point of view of the employees was high, as it obtained an arithmetic mean of (5.50) with a standard deviation of (0.87) and a rate of (78.6%). The study also showed that the level of availability of supply chain integration in the pharmaceutical manufacturing sector from the point of view of the employees in general was high, as it obtained an arithmetic mean of (5.48) and a standard deviation of (0.89), at a rate of (78.3%). There is also a statistically significant impact at the level of ($\alpha \leq 0.05$) for information technology in its dimensions (human resources, equipment, databases, software, communication networks, Information security of the integration of supply chains in the Yemeni pharmaceutical manufacturing companies.

Keywords: Information Technology, Supply Chains, Yemeni Pharmaceutical Manufacturing Companies.

INTRODUCTION

(Nawah, 2023) believes that information technology has assisted, in recent decades, increase the productivity of institutions with different activities, and this is due to the rapid developments, globalization, and the emergence of giant entities, which can support the production process, sale of goods, and provision of services, and this is due to the tremendous capabilities that technology offers in data processing, communication, modern software and remote work through Internet and used databases by providing speed in completing work with high quality and accuracy. Organizations are also speeding to install internal networks to transfer information in a safe manner between the organization's employees.

(Husam, 2017) believes that the boundaries of the supply chain extend beyond the organization to suppliers, customers, and organizations participating in the supply chain. Hence, information and communication technology systems may be internal to one organization to work on integrating the activities of this organization, influenced by the methods of communication and interaction between different groups within the organization, or external, which includes many parties to facilitate the flow, transfer and exchange of information between these parties, and thus good coordination between the members of the chain by supporting decisions for each organization in coordination between them and the organizations within the chain.

Supply chain management is sound management practices which, if applied in an organization, means that it possesses one or more of the following capabilities compared to its competitors, and these capabilities are (low prices, high quality, high flexibility, on-time delivery) and these in turn will enhance the overall performance of the organization, and it can lead to high levels of performance and customer satisfaction (Heizer & Render, 2017, 452).

There is no doubt that paying attention to the pharmaceutical products and services and increasing their level of quality is based on an important fact, that is a healthy human being is the foundation and goal of the development efforts. Despite the tremendous developments in the information sector, administrative practices and work systems need continuous development and improvement, through employing information technology and supply chain integration to improve product quality in pharmaceutical manufacturing companies.

Yemeni pharmaceutical companies in Yemen have become a model of the local industry with quality and competitive price. It is a modern industry that operates according to modern medical technologies that conform to specifications, and there are many companies that produce medicines in Yemen with international specifications, and they are considered among the most successful companies that manufacture and produce medicines with the testimony of international organizations concerned with manufacturing quality, Ministry of Health, Standards and Metrology Authority, and pharmacies. There is no more developed industry in Yemen than the pharmaceutical industry, and development efforts are proceeding according to a scientific and thoughtful vision (Al-Sanab, 2017, p. 9).

The main objective of the study is to identify the impact of information technology on the integration of supply chains in the Yemeni pharmaceutical manufacturing companies in Sana'a.

Theoretical and procedural concepts and definitions:

I. Information technology:

The systematic, organized method that we follow when using various knowledge after arranging and organizing it in a special system in order to obtain appropriate solutions for some scientific tasks (Al-Wadi, 2011).

The constituent dimensions of the regulatory climate are defined as follows:

- 1. The first dimension Human Resources:** They are competent individuals with skills in the field of information systems and information technology who are responsible for operating the systems and maintaining them in the organization (Al-Samarrai and Al-Zoubi, 2004, 5).
- 2. The second dimension the Equipment and Devices:** They are the physical components of a computer system, and can be classified as the devices, components, and physical media used in the processes through which data and information pass (Beynon, 2009, 137).
- 3. The third dimension the Software:** Instructions written in computer language that specify the operations performed by the computer and control the physical components of the computer (Nadia, 2011).

- 4. The fourth dimension Database:** It is an organized set of electronically stored data controlled by a computer, and based on a set of previously defined relationships between data that relate to a specific task (Alter, 2002).
- 5. The fifth dimension communication Networks:** A group of different computers that are connected to each other through units for connecting media, networking programs, data transfer media, and peripheral devices so that any computer can benefit from any integrated network data (Kandili and Al-Samarrai, 2009).
- 6. The sixth dimension Information Security:** Protecting information and its important elements, including the systems and devices that use, store, and transmit this information (Whitman & Mattord, 2011).

II. Supply Chains:

All activities related to the flow and transformation of raw materials into final products and their delivery to the final consumer, in addition to the flow of information (Wheelen and Hunger, D. 2012)

- 1. The first dimension Integration with customers:** They are all the links that express the practices that companies adopt for the purpose of managing and resolving complaints received from the customer, improving customer satisfaction, and providing high-end and distinguished products to satisfy his needs and desires to reach his level of happiness (Refai, 24,2006).
- 2. The second dimension Integration with suppliers:** Cooperation in reducing costs, improving the quality of purchased materials, reducing the time required for product development, and improving access to and application of technology (Wynstra et al., 2001).
- 3. The third dimension Internal integration:** They are all the activities and operations carried out by the company to ensure the quality of products and customer service and provide them at the appropriate place and time (Al-Manaseer, 8,2016).

Research Model of the Study

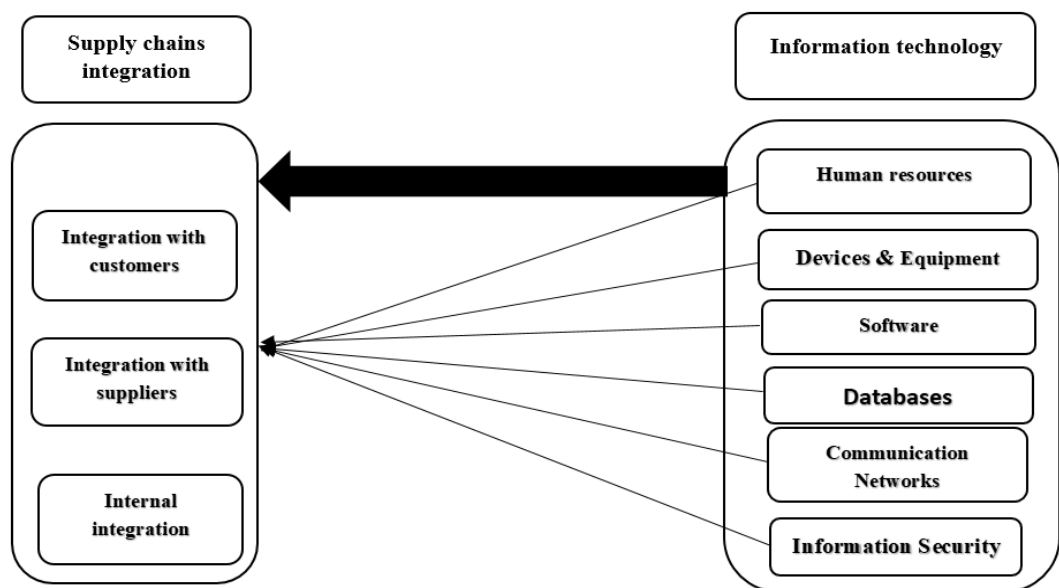


Figure 1: Research model of the study

Study hypotheses:

Main hypothesis: There is a statistically significant impact of information technology on the integration of supply chains in the Yemeni pharmaceutical manufacturing companies.

The following sub-hypotheses branch out from this main hypothesis:

Sub-Hypothesis 1: There is a statistically significant impact of human resources on the integration of supply chains in the Yemeni pharmaceutical manufacturing companies.

Sub-Hypothesis 2: There is a statistically significant impact of devices and equipment on the integration of supply chains in the Yemeni pharmaceutical manufacturing companies.

Sub-Hypothesis 3: There is a statistically significant impact of software on the integration of supply chains in the Yemeni pharmaceutical manufacturing companies.

Sub-Hypothesis 4: There is a statistically significant impact of databases on the integration of supply chains in the Yemeni pharmaceutical manufacturing companies.

Sub-Hypothesis 5: There is a statistically significant impact of communication networks on the integration of supply chains in the Yemeni pharmaceutical manufacturing companies.

Sub-Hypothesis 6: There is a statistically significant impact of information security on the integration of supply chains in the Yemeni pharmaceutical manufacturing companies.

METHODOLOGY

The study relied on the descriptive analytical approach, and due to the difference in the number of employees in companies, a proportional stratified random sample was chosen, with (251) individuals. The sample included the following categories: (executive directors/deputies, department directors, department heads, specialists). The questionnaire was distributed on the study sample in the Yemeni pharmaceutical manufacturing companies; Where (280) questionnaires were distributed in (8) companies, and (265) questionnaires were returned, representing (94.64%) of the total questionnaires distributed, and after examining the questionnaires and excluding questionnaires whose answers were incomplete and not suitable for analysis, the number of questionnaires suitable for analysis became (251) questionnaires, representing (94.71%) of the total questionnaires retrieved, which is equivalent to (89.64%) of the total questionnaires distributed. This is a high percentage and sufficient to generalize the results of this sample to the study population, and the data was analyzed using the SPSS26 program.

STUDY RESULTS AND DISCUSSION

Table 1: Results related to the sample’s opinions about the average of items for each dimension of information technology

Variable		Arithmetical mean	Standard deviation	Availability rate	Rank	Application level
Information Technology	Human resources	5.57	1.00	79.6%	2	High
	Devices and equipment	5.47	1.03	78.1%	4	High
	Software	5.41	1.00	77.3%	5	High
	Databases	5.56	0.92	79.4%	3	High
	Communication Networks	5.38	0.99	76.9%	6	High
	Information Security	5.64	0.94	80.5%	1	High
Average Information technology		5.50	0.87	78.6%		High

Based on Table (1), the total average of the “Information Technology” variable was equal to (5.50) and its standard deviation was (0.87), and that Information Technology as a variable achieved a high percentage, which means that pharmaceutical companies seek to pay attention to information security before human resources because the presence of qualified human resources to complete the work with the required quality; may not be feasible in the absence of information security, and if information security is available, the role of human resources comes in information security and then databases for easy access to customer and supplier data, in addition to companies’ interest in modern and developed devices and equipment to facilitate production work and improve the quality of the products and software that operate these devices and provide communication networks for rapid exchange of information between different departments.

The total average of the “Human Resources” dimension was (5.57) and its standard deviation was (1.00). This result explains that there is an interest among pharmaceutical manufacturing companies in the human resources dimension, whether in terms of the dimension in general or through the paragraphs. It is clear that the paragraph related to the availability of qualified staff to deal with software, networks, and databases was the highest available among the paragraphs, which explains the awareness of these Companies of the importance of the qualified human resource, which will lead to the integration of supply chains in companies. The least interest of pharmaceutical manufacturing companies was the availability of efficiency and effectiveness of the individuals in charge of the systems, and this is due to the cost of attracting qualified personnel to deal with modern systems and technology.

We can notice that the information security dimension ranked highest in terms of the study sample’s approval of it, as the approval rate reached (80.5%), with an average of (5.64) and a standard deviation of (0.94). This result indicates the keenness of the companies under study to limit access to confidential private data of the companies, and using adequate technical means to maintain the security of their data, and companies were less interested in providing strong protection systems to protect their data and information from hacking.

It was followed by databases with an arithmetic average of (5.56) and a standard deviation of (0.92). This result indicates that the companies under study possess

detailed databases about their customers, fast obtaining them when required, and their consistence with the requirements of users. Pharmaceutical companies were less interested in having clear and accurate databases about their suppliers. .

Followed by devices and equipment with an arithmetic average of (5.47) and a standard deviation of (1.03). This is attributed to the interest of these companies to acquire modern devices and equipment, as they are considered an essential part in completing the work of these companies and increasing their production capacity and thus improving the quality of the products. The companies' interest was less in periodic maintenance of computers and acquisition of modern and fast computers.

While software dimension came with an arithmetic average of (5.41) and a standard deviation of (1.00). This result indicates that companies rely on advanced and updated software to follow up on their customers' affairs according to their business needs, which in turn leads to competition with other companies in terms of the quality of their products. Such companies were less interested in software which facilitates the process of exchanging information between administrative levels.

While the communication networks dimension came in the lowest rank in terms of the study sample's approval of it, as the approval rate reached (76.9%), with an average of (5.38) and a standard deviation of (0.99). This result indicates that pharmaceutical manufacturing companies have a high interest in providing appropriate server devices for storing data and speed transfer of data between the company's departments and management, and the availability of appropriate network devices and communication lines to improve its business and products. These Companies were less interested in providing an Internet network available to everyone. This means that there is an interest in achieving all dimensions of information technology that were used as measures for this study, and that pharmaceutical companies need to pay attention to the security of their information about drug formulations

This means that pharmaceutical companies need to pay attention to information security before human resources because the presence of qualified human resources can complete work with the required quality. It may not be useful in the absence of information security, and if information security is available, the role of human resources comes in information security and then databases for easy access to customer and supplier data, in addition to companies' interest in modern and developed devices and equipment to facilitate production work and improve the quality of the products and software that operates these devices and availability of communications networks for rapid exchange of information between different departments.

Table 2: Results related to the sample's opinions about the average of items for each dimension of supply chains

Variable		Arithmetical mean	standard deviation	Availability rate	Rank	Practice level
Supply Chains Integration	Integration with customers	5.52	0.94	78.8%	2	high
	Integration with suppliers	5.37	0.94	76.7%	3	high
	Internal integration	5.55	0.98	79.3%	1	high
Average supply chains		5.48	0.89	78.3%		high

Based on Table (2), the total mean of the variable “Supply Chain Integration” was equal to (5.48) and its standard deviation was (0.89) and that supply chain integration as a variable was achieved at a high rate of (78.3%).

We can notice that the internal integration dimension came in first place in terms of the study sample’s approval, as the approval rate for it reached (79.3%), with an average of (5.55) and a standard deviation of (0.98). This result indicates that the pharmaceutical manufacturing companies under study possess appropriate warehouses to store materials and orders, it is concerned with having an appropriate network suitable for transporting materials in a safe manner, and using multi-functional teams when developing a new product, in addition to the company’s departments working in high coordination. These Companies were less concerned with the company’s departments working in a team spirit and the ability to accurately forecast demand.

It was followed by integration with customers, with an arithmetic average that ranked in second place in terms of the study sample’s approval of it, as the approval rate for it reached (78.8%), with an average of (5.52) and a standard deviation of (0.94). This result confirms the interest of the Yemeni pharmaceutical manufacturing companies under study in building excellent relationships with its customers, providing products that meet the needs and desires of their customers, and taking the opinions of their customers in product development processes. The least interest of companies was in sharing market information with their customers, and in the company management’s participation with its major customers in product development processes.

While the dimension of integration with suppliers ranked lowest in terms of the study sample’s approval, as the approval rate for it reached (76.7%), with an average of (5.37) and a standard deviation of (0.94). This result indicates that these companies work to build excellent relationships with suppliers, and providing suppliers with information during production and supply processes. The least interest of the companies was in companies sharing their information with suppliers through information technology, and the lack of interest of such companies in having a high degree of strategic partnership with suppliers and companies having a high degree of joint planning to obtain a fast response from Suppliers.

This means that there is an interest in practicing supply chain integration by paying attention to integrating operations and integrating with suppliers and customers. This is due to the intensity of competition in pharmaceutical manufacturing companies and providing their products to the market with high quality.

Results of the study hypotheses:

To determine the paths, estimates of the relationships of the structural model (path coefficients) are obtained, which represent the hypothesized relationships between the study variables. The values of the path coefficients are almost uniform and range between (-1 and +1), and the closer the value of the estimated path coefficients is to (+1), they form strong positive relationships. Likewise, for negative relationships, the closer they are to (-1) the stronger a negative relationship is formed. These values are usually statistically significant. However, if the value of the estimated coefficients is closer to zero, they indicate weaker values, and with regard to values that are very close from zero or very low, it is usually not much different from zero (Hair et al. 2017,217).

Main hypothesis:

Which states: “There is a statistically significant impact of information technology on the integration of supply chains in the Yemeni pharmaceutical manufacturing companies”.

Table 3: Path coefficients for the main hypothesis

Path	Beta	Standard deviation	T	Significance
Information Technology -> Supply Chain Integration	0.894	0.013	69.303	0.000

It is clear from Table (3) that there is a statistically significant impact of information technology on the integration of supply chains. The value of the beta coefficient was (0.894), which indicates the presence of a statistically significant impact of information technology on the integration of supply chains in pharmaceutical manufacturing companies, and assuming that the neutralizing of the impact of any other variables will lead to an increase in the level of availability of information technology in the pharmaceutical manufacturing companies under study by one degree (89.4%) from the practice of supply chain integration.

T showed an additional significant value as it reached (69.303), which is a value more than 2, which enhances the beta value in terms of accepting the main hypothesis.

From Table (3), it is clear that there is a statistically significant impact of information technology on the integration of supply chains, as the value of the beta regression coefficient was (0.849) and the value of t (69.303) was statistically significant at a significance level of less than (0.05), and therefore we accept the main hypothesis.

Based on the above, we can say that there is a statistically significant impact of information technology on the integration of supply chains in the Yemeni pharmaceutical manufacturing companies, and thus the main hypothesis is accepted.

Also, from the above, we can say that the goal related to know the impact of information technology on the integration of supply chains in the Yemeni pharmaceutical manufacturing companies has been achieved.

First: Testing the first sub-hypothesis of the main hypothesis

Which states that “There is a statistically significant impact of human resources on the integration of supply chains in the Yemeni pharmaceutical manufacturing companies”.

Table 4: Path coefficients for the first sub-hypothesis of the main hypothesis

Path	Beta	Standard deviation	T	Significance
Human Resources -> Supply Chain Integration	-0.042	0.061	0.697	0.243

From Table (4), which shows the values of the path coefficients for the first sub-hypothesis of the main hypothesis, it is clear that:

The value of the beta coefficient was (-0.042), which indicates that there is no statistically significant impact of human resources on the integration of supply chains in the Yemeni pharmaceutical manufacturing companies, which means that a single value increase in human resources reduces the impact of supply chain integration by (0.42%).

The value of (T) was not statistically significant at a significance level less than (0.05); as it reached (0.697), and therefore we reject the first sub-hypothesis of the main hypothesis, means that the human resources variable does not have a significant and direct impact on supply chain integration.

Second: Testing the second sub-hypothesis of the main hypothesis:

Which states: “There is a statistically significant impact of devices and equipment on the integration of supply chains in the Yemeni pharmaceutical manufacturing companies”.

Table 5: Path coefficients for the second sub-hypothesis of the main hypothesis

Path	Beta	Standard deviation	T	Significance
Devices and equipment -> supply chain integration	0.316	0.062	5.124	0.000

From Table (5), which shows the values of the path coefficients for the second sub-hypothesis of the main hypothesis, it is clear that the results showed that the value of beta regression coefficient (0.316) for devices and equipment is positive, which means that devices and equipment have a positive impact on the integration of supply chains in the Yemeni pharmaceutical manufacturing companies. Assuming that any other variables are neutral, that are not subject to the study, will lead to an increase in the level of device and equipment practice in the companies under study by one degree (31.6%) in the integration of supply chains for these companies.

The value of (T) was an additional significant value, reaching (5.124), which is more than 2 and it is the value that allows the hypothesis to be accepted and enhances the beta value in terms of accepting the hypothesis, and thus we accept the second sub-hypothesis of the main hypothesis.

Third: Testing the third sub-hypothesis of the main hypothesis:

Which states: “There is a statistically significant impact of software on the integration of supply chains in the Yemeni pharmaceutical manufacturing companies”.

Table 6: Path coefficients for the third sub-hypothesis of the main hypothesis

Path	Beta	Standard deviation	T	Significance
Software -> Supply Chain Integration	0.039	0.074	0.533	0.297

From Table (6), which shows the values of the path coefficients for the third sub-hypothesis of the main hypothesis, it is clear that the value of the beta coefficient was (0.039), which indicates that there is no statistically significant impact of software on the integration of supply chains in the Yemeni pharmaceutical manufacturing companies, which means that a single value increase for software reduces the impact of supply chain integration by (0.39%).

The value of (T) was not statistically significant at a significance level less than (0.05); as it reached (0.533), and therefore, we reject the third sub-hypothesis of the second main hypothesis, means that the software variable does not have a significant and direct impact on supply chain integration.

Fourth: Testing the fourth sub-hypothesis of the main hypothesis:

Which states: “There is a statistically significant impact of databases on the integration of supply chains in the Yemeni pharmaceutical manufacturing companies”.

Table 7: Path coefficients for the fourth sub-hypothesis of the main hypothesis

Path	Beta	Standard deviation	T	Significance
Databases -> Supply Chain Integration	0.343	0.068	5.011	0.000

From Table (7), which shows the values of the path coefficients for the fourth sub-hypothesis of the main hypothesis, it is clear that:

The results showed that the value of beta regression coefficient (0.343) for databases is positive, which means that databases have a positive impact on the integration of supply chains in the Yemeni pharmaceutical manufacturing companies, assuming neutralizing the effect of any other variables that were not subject to study, will lead to an increase in the level of database practice in The companies under study by one degree (34.3%) on the integration of supply chains for these companies.

The value of T was an additional significant value, reaching (5.011), which is a value greater than(2), and it is the value that allows the hypothesis to be accepted and enhances the beta value in terms of accepting the hypothesis, and thus we accept the fourth sub-hypothesis of the second main hypothesis.

Fifth: Testing the fifth sub-hypothesis of the main hypothesis:

Which states: “There is a statistically significant impact of communication networks in the integration of Supply chains in the Yemeni pharmaceutical companies”.

Table 8: Path coefficients for the second sub-hypothesis of the main hypothesis

Path	Beta	Standard deviation	T	Significance
Communication networks -> supply chain integration	0.065	0.06	1.077	0.141

From Table (8), which shows the values of the path coefficients for the fifth sub-hypothesis of the main hypothesis, it is clear that the value of the beta coefficient was (0.065), which indicates that there is no statistically significant impact of communication networks on the integration of supply chains in the Yemeni pharmaceutical manufacturing companies, which means an increase of one value for communication networks reduces the impact of supply chain integration by (0.65%).

The value of (T) was not statistically significant at a significance level less than (0.05); as it reached (1.077), and therefore, we reject the fifth sub-hypothesis of the main hypothesis, means that the communication networks variable does not have a significant and direct impact on the integration of supply chains.

Sixth: Testing the sixth sub-hypothesis of the main hypothesis:

Which states: “There is a statistically significant impact of information security on the integration of supply chains in the Yemeni pharmaceutical manufacturing companies”.

Table 9: Path coefficients for the second sub-hypothesis of the main hypothesis

Path	Beta	Standard deviation	T	Significance
Information Security -> Supply Chain Integration	0.262	0.057	4.569	0.000

From Table (9), which shows the values of the path coefficients for the sixth sub-hypothesis of the main hypothesis, the results showed that the value of beta regression coefficient (0.262) for information security is positive, which means that

information security has a positive impact on supply chain integration. The t-value (4.569) was statistically significant at a significance level of less than (0.05), which means that the impact is significantly positive. Therefore, we accept the hypothesis.

The results indicate that all three variables: devices and equipment, databases, and IT information security, have a positive impact on supply chain integration.

In contrast, the results showed that software, communication networks, and human resources do not have a statistically significant impact on supply chain integration, and therefore, we reject the three sub-hypotheses.

Overall, the results of this study suggest that information technology can play an important role in improving supply chain integration in Yemeni pharmaceutical companies. Specifically, companies should focus on investing in equipment and devices, databases, and information security.

CONCLUSIONS

The pharmaceutical manufacturing companies under study reveal great interest in providing information technology in all its dimensions: (human resources, devices and equipment, software, databases, communication networks, information security), but their major interest in achieving the information security dimension was greater than their interest in providing the rest of the dimensions: (resources Human resources, devices and equipment, software, databases, communication networks).

The pharmaceutical manufacturing companies under study practice supply chain integration in all its dimensions: (integration with customers, integration with suppliers, internal integration), but their interest in practicing integration with internal integration was greater than their interest in integration with suppliers and integration with customers. The impact of information technology on the integration of supply chains in the Yemeni pharmaceutical manufacturing companies under study varies according to the dimension. The most influential factor was the database dimension, the devices and equipment dimension, the information security dimension, the communication networks dimension, the software dimension, and the human resources dimension was less dimension that have an impact on the integration of supply chains.

Recommendations

The researcher provides a number of recommendations including paying attention to attract qualified personnel who have the ability to deal with modern systems and technology, and to carry out to periodic maintenance of computer devices to improve their performance and the effectiveness of their software and increase the life span of these devices, paying attention to the acquisition of modern computers with specifications that fit the business of the companies , paying attention to developing and updating software that saves time and effort and facilitates the process of exchanging information between all administrative and functional levels in companies.

The researcher also recommends to pay attention to provide software that improves the performance and speed of computers in pharmaceutical manufacturing companies, promoting the presence of clear and accurate databases about suppliers to facilitate the process of searching and accessing data in companies, providing a strong Internet network available to everyone throughout the company, as it is a fast communication technology to communicate with customers, suppliers, and other competing companies, developing communication networks in companies to enhance

coordination and cooperation between departments and divisions and disseminate information and data in companies. Furthermore, enhancing the provision of strong systems to protect all digital, proprietary, intellectual and paper information, and to protect devices in companies from hacking .Also, paying attention to information security in pharmaceutical manufacturing companies due to its impact on improving product quality and that such companies must strive to rehabilitate production lines to improve productivity and provide products that conform to international specifications. In addition, these companies must share market information and product development processes with their customers and suppliers and to increase companies' interest in feedback from their customers to improve companies' products and to strengthen the strategic partnership with suppliers.

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