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Research on the application of information technology in the Pharmaceutical sector

Balaguer Llantada
University of Illinois at Chicago, United States
Pedro Perez
University of Illinois at Chicago, United States

ABSTRACT

The basic purpose of this research study determines the research on the application of information technology in the pharmaceutical sectors. This research study was conducted in the Chinese pharmaceutical sectors. The research study is based on primary data analysis; these data were collected from different pharmaceutical sectors. Information technology is an independent variable, and pharmaceutical sectors, including organization performance, industrial innovation and production, and supply chain management, are all considered dependent variables. The research study used smart PLS software and presented different results, including composite reliability, the validity analysis, R square values, indicators correlations, significant analysis, and the smart PLS Algorithm model. Overall results found that information technology plays a vital role in the pharmaceutical sector and presents that significant analysis with each other. In addition, the organization's performance shows a positive and significant relationship. Supply chain management also directly relates to industrial innovation, and production significantly affects pharmaceutical sectors.

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INTRODUCTION

The world of today is known as the era of information and technology. In today's world, the advancement in science and technology is at its peak. Society is the major part that is mostly affected by the advancement in technology, both positively and negatively. This advancement of technology has resulted in the development of various computing programs like internet-based programs, sensors, microphones, social media apps, etc. [1]. All these technology-based programs benefit humans in one or either way. Almost all the world's fields, whether related to the industry or management, or any other field working, are based on technology. Any field functioning without technology is far behind in this modern world. Nowadays, People around the globe prefer to use technology to seek solutions to their problems. Technology has proved itself to be the ultimate solution to problems that humans could not solve. The modern form of technology is information technology. Information technology uses various computer programs to process and store data. In all management and industry-related fields, information technology is mostly used to make better plans to run an industry. The use of information technology has turned the world into a better place [2].

Information technology is mainly used in the industry because it has resulted in the fourth industrial revolution. The fourth industrial revolution is also termed as 4.0 industry. This pharmaceutical revolution is due to the advancement of information technology. This revolutionized industry works mainly by improving the data quality, interconnecting and linking the data, enabling the use of machine

learning, and improving the quality of real-time data. Improving data quality in the 4.0 industry using information technology benefits the industry by increasing the flexibility and the efficiency of the working system. Customers' experience with the industry improves when its data quality is improved. [1] One more benefit of the application of information technology in the industry is that it is used to enhance product quality, resulting in decreased product prices [3]. Using information technology in the manufacturing industry allows goods and cheaper products to be obtained in bulk amounts. Nowadays, traditional manufacturing techniques are replaced by technology-based manufacturing techniques to avoid environmental problems. Almost all the industries of the world, especially the 4.0 industries, use only information technology for the management and working of their industries.

As we know that with the rapid development of science and technology, the applications of information technology have been utilized in every pharmaceutical sector, including the manufacturing sector, business sector, agriculture industries, etc.; due to rapid industrialization, many organizations have been considering the use of various applications of IT as an essential need of the organization to enhance the operational performance and to improve the economy of the country. Computing, telecommunication, software, and networking are all elements of information systems. Moreover, information technology has remarkable applications in the pharmaceutical sector [2] Managing and processing data and information, including textual, image, voice, audio, or video, is indeed a part of information technology. Today every person has access to the internet, which, in turn, has great potential to increase the business of industries. Information can be created, stored, or modified using information technology. It was very difficult to store, manage, or process information in the past. People store data and information manually, giving organizations less accurate results. But nowadays, due to technological advancements, everything has changed [3]. The technological revolution has changed the living standards of the people. With time, the needs and demands of the people have also increased, and to meet the individuals' demands and requirements, it is essential to improve the pharmaceutical sector in the country. For this purpose, information technology has put great effort. Now industries can be made replicas of various products, which can help people in case of a shortage of resources.

Information technology also plays its role in the development and progress of economic development with the help of 4.0 industries. These industries produce great material that is not only used in the country where the product is manufactured, but also the product is being exported to various countries around the globe. Exporting products manufactured based on modern technology helps earn foreign exchange. The foreign exchange results in the betterment of the economic state of a country [4]. The most common example of economic development due to information technology was seen during the period of Covid-19. during the covid-19, all the health programs, educational systems, and other household's things were based on information technology. The use of information technologies in all these fields during the covid-19 time has saved the world from massive economic destruction. Now post the covid-19, the use of information technology in various industries is at its peak. Many scientific types of research in the past have also declared the use of information technology in the industry as one of the most important factors responsible for economic progress and stability [5].

Information technology has applications in other fields as well, besides industry. Most of the modern world's telephones and radio system works on information technology. Information technology also helps in improving the performance of various software management programs for setting developmental goals. The spreadsheet-making process also improves by using information technology. The most recent and new usage of information technology is in management software for blogging. Cloud computing technology is also the application of information technology [6]. This technology is used by many industries as it causes organizational growth and progress daily. The main feature of cloud computing is that it provides the client with a SAAS application for business management. The SAAS application is best known for managing business data by browsing the data with the help of the internet. All these applications of information technology help many industries around the globe to make progress by leaps and bounds.

As the world is rapidly changing, people's demands for a better living have increased. The only solution to fulfill the ever-increasing demands of the people of the modern age is to use information technology in various fields. Only by opting for the new technological programs can we make our industries and economic progress [7]. One more important factor that influences people around the world to use

information technology in their work is because this technology is built while keeping in view the needs of the modern age. People can get the solution to their queries in no time by using modern technology. The educational system also focuses on providing useful information to the students by using innovative technology. Many types of research have shown that students who learn and acquire knowledge using technology learn more than those students who learn by old and traditional teaching methods. As thorough information about technology helps students in the same way, incomplete information can misguide them. Hence, our new generation must have complete knowledge of information technology trends [8]. Furthermore, all countries' governments should ensure that their industries are working based on information technology to maintain the world's overall economic stability.

Research objectives:

The main objectives of the research paper include the concept of information technology, application of information technology in the industry, economic development due to new pharmaceutical technologies, and the role of information technology in the functioning of various computer programs.

This research study describes into five selective portion which explain overall research study the first section describe that introduction elated to the application of information technology in pharmaceutical sectors. The second part describe that literature review about previous research also review the variable wise research study of previous author. The third portion describes the methodology of research this part also presents that tools and techniques and represent the theoretical framework. The fourth section describe the results and its descriptions related to the overall variables this part present the reliability test, validity test analysis also describe that smart PLS Algorithm model. The last segment describes conclusion and discussion about research study.

Literature review:

Information technology and SCM:

As with the rapidly growing world, information technology has gained popularity in almost every field of life. [9] researched the applications of IT in pharmaceutical sectors, and it was investigated that information technology has a significant positive impact on the dexterity of supply Chain management systems. Furthermore, [10] claimed that apart from information technology, information technology knowledge and skills, system integration based on information technology, design of GPS and GIS, and information technology infrastructure also greatly influence the dexterity of the supply chain management system. [10] highlighted that nowadays, many advanced industries are required to respond to the changes happening in the market to obtain business success and competitive advantages. The industries can only be able to respond to these unexpected changes of the market through the SC market. These changes in the market can also be utilized as business opportunities. So, it was examined that the dexterity of SCM can be achieved by utilizing information technology, which in turn acts as the most significant factor in assisting the organizations. Moreover, [11] investigated that the applications and effective implementation of Information technology can enhance the cooperation between agility of the supply chain through accurate information distribution, rapid transfer, and the accurate utilization of information. In addition, [12] explored that information technology has the greatest impact on SCM. It was studied that information is a significant factor in the better performance of the Supply chain, and by utilizing IT, information can be collected more precisely and accurately. It also provides the base on which managers can make decisions, and the SC process executes. Furthermore, [13] investigated that IT greatly influences the coordination of the supply chain because it eliminates information errors and inefficiencies, lowers trading costs, and, eventually, enables e-collaboration.

Information technology and organization performance:

The researcher investigated the research on the application of IT to enhance organization performance. In this research study, knowledge-based views and technology, Organization and Environment theory have been utilized and based on sample data collected from 428 [14] presents an interdisciplinary research model that evaluates the network of relations using correlation SEM. The findings revealed that environmental dynamics, KM capability, and IT capability positively related to innovation. Environmental dynamics appear to amplify the positive impact of innovation ambidexterity on the organization's performance. Apart from this, [14] studied that industries have widely used information technology to gain a competitive advantage and make

informed decisions. But, according to [14], simply having technology wouldn't be enough to enhance organizational performance and gain a competitive advantage. The long-term information needed to fulfill the requirements of IT (resource-based view) as a competitive advantage necessitates organizational learning. It was also investigated that organizational learning and performance are directly associated with information technology. [15] claimed that evaluation of the role of IT on an organization's performance seems challenging because organizations' performance cannot be transformed solely by the applications of information technology [24]. Therefore, other variables, including organizational culture, and business strategies, would also be considered while examining the influence of information technology on the overall organizational performance. Whereas [15] highlighted that information technology has a stronger impact on organizational performance. Information system sectors monitor IT in multiple ways to effectively utilize technology and install applications that minimize operational costs. Many respondents in Chinese industries have admitted that information technology enables them to show effective organizational performance. [16] described that in today's modern dynamic, global, and complex business world, IT seems to be a significant engine that has been changing almost all elements of online business. In contrast, human and knowledge resources have been seen increasingly as important drivers of competitiveness. It also shows a positive impact on organizational performance. Whereas [25] suggests that entrepreneurs should improve innovative strategies to achieve organizational performance.

Information technology, industrial innovation, and productivity:

Researchers investigated pharmaceutical innovation with the utilization of information technology. It was studied that to compete effectively in today's age of globalization, industries must need to innovate. To investigate the association between pharmaceutical innovation and information technology, [16] utilized SEM using sample data from two hundred manufacturing industries. The results of this research revealed that SCC and information technology have a positive influence on pharmaceutical innovation. In addition, it was examined that information technology can directly improve both kinds of product innovation (radical and incremental) and indirectly through SCC. Furthermore, [17] highlighted that information technology (IT) and innovation are important elements affecting KM. This article explores the influences of IT and innovation on medium and small-scale industries' internationalization and the moderating and direct impacts of knowledge and information circulation examined during information technology adaptation. Apart from this, [17] investigated the positive association between international growth and innovation. The importance of important stakeholders as vital information sources for innovation that drives international competitiveness has also been demonstrated. According to [18], innovation activities positively correlate with export activities. Whereas small-medium enterprises' export activities have been encouraged by industries' product innovation. [18] explain that an increase in information technology investments positively affects productivity. Various previous studies examined that productivity has no significant link with the investment in information technology. While many other shows that IT and productivity have some association between them. Thus, the association between productivity and information technology needs more research in the future [19].

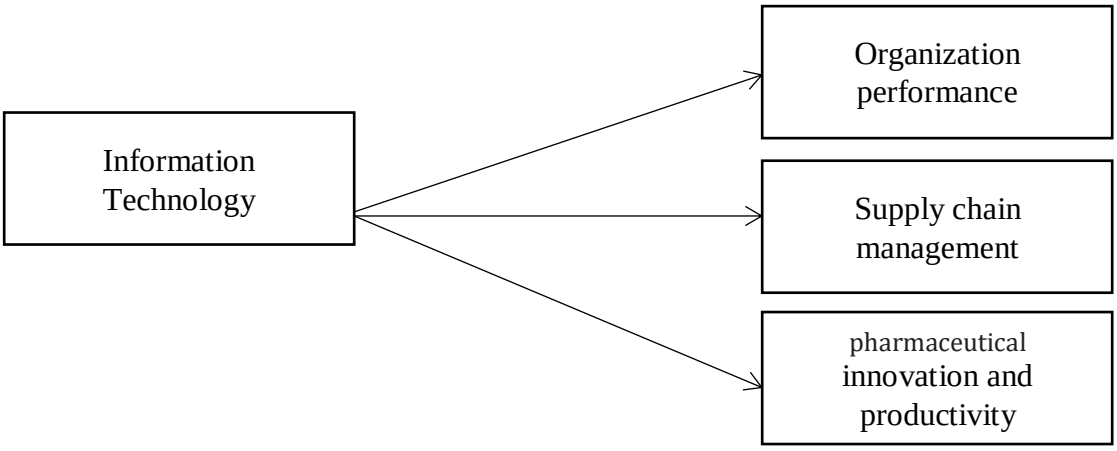
Research methodology:

This study describes the research on the application of information technology in the pharmaceutical sector. Research studies present information technology, including industrial innovation, production, and supply chain management; these are all considered indicators for measuring the organization's performance. Therefore, this research study depends upon primary data analysis to determine and develop questions related to the variables.

Research techniques and tools:

This research study depends upon primary data analysis for measuring the study using smart PLS software and running results between information technologies in pharmaceutical sectors. The value of R square, f square, reliability, discriminant validity analysis, model fitness analysis, and model selection criteria all represent the application of information technology in pharmaceutical sectors as numerical analysis.

Theoretical Framework:



Information Technology:

Applying skills, methods, and procedures in pharmaceutical production and scientific research results in technology. Technology is incorporated into the functioning of all machinery, with or without a thorough understanding of its function, for an organization's stated purpose. A technical system comprises several related parts to produce a certain task without further human design input [20]. Technological systems change, store, transmit, or control materials, energy, and/or information for a particular purpose. Automation refers to technical applications in which human influence is limited. BPA, IT automation, personal applications like home automation, and other technologies are all included in it. Technological design is a distinct process with several distinctive traits, including clearness, attention to particular requirements, repetition, innovation, and approach. The information technology is main independent variable for measuring the research related to the application of information technology in pharmaceutical sectors.

Organization performance:

In business, organizational performance refers to how successfully a firm fulfills its vision, purpose, and goals. Therefore, organizational performance evaluation is necessary for strategic management. Four categories are used to categorize organizational performance measurements: human resource results, organizational outcomes, financial accounting outcomes, and capital market outcomes [21]. The organizational performance analysis involves comparing a company's performance to its goals and objectives. Put another way, organizational performance is the contrast between actual and anticipated results. The organization performance mostly related with information technology its shows that direct link with each other.

Supply chain management:

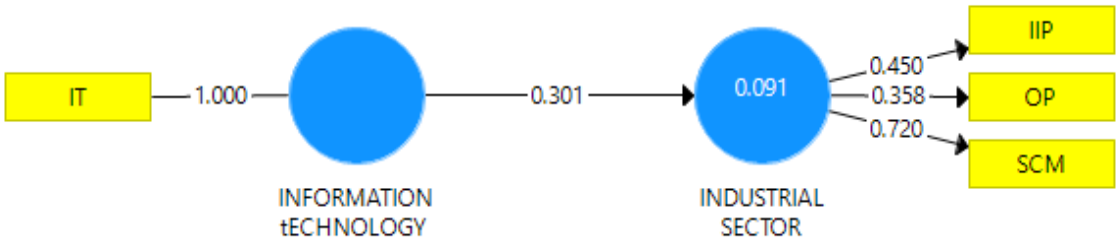
The management of a product's or service's whole manufacturing flow, starting with raw materials and finishing with delivery to the customer, is known as supply chain management. This models top-level contains five separate processes that are sometimes referred to as components of the supply chain management system: plan, source, make, deliver, and return. Let's examine each element in more detail: Plan: Planning is necessary to keep production and inventory under control [22]. Supply chain management is a method for managing the numerous tasks necessary to produce and deliver customer goods and services. Examples of supply chain activities include designing, farming, manufacturing, packing, and transportation. The supply chain management is dependent variable for measuring the application of information technology in pharmaceutical sectors.

Industrial innovation and production:

pharmaceutical technology innovation aims to create fundamental changes in the technology system by reorganizing diverse production technologies in various areas. Production Innovation is a notion that

describes ongoing re-engineering processes as well as a core-organizational culture. It seeks to shift product and production engineering from the dominant tendency of "continuous improvement" toward "continuous innovation." Because it helps producers to be more flexible and adaptive to market changes, innovation is also a forerunner to increased productivity and lower costs [23]. If you innovate effectively, you may increase your company's value and earnings; if you don't, your organization will develop [24]. In addition, innovation makes staying one step ahead of the competition simpler. Increasingly competitive businesses result from globalization and a market that is affecting development. The industrial innovation and production is also a part of pharmaceutical sectors the innovation play a vital role in organization performance also that production activities present the significant relation with information technology.

Results and descriptions:



The above model represents the smart PLS algorithm model in between information technology and pharmaceutical sectors. The organization performance, supply chain management, and industrial innovation and production are all sub part of pharmaceutical sectors. The algorithm model shows that 0.450, 0.358, and 0.720 all show 45%, 35%, and 72% positive values of each variable. The information technology shows that 30% positive and significant relationship.

The above research study describes the discriminant validity analysis between dependent and independent variables. For example, industrial innovation and production show that 0.450 means a 45% validity rate in pharmaceutical sectors. On the other hand, the organization's performance shows that 35% discriminant validity rate with pharmaceutical sectors. Supply chain management is another independent variable; its validity rate is 0.720, which means a 72% validity rate in pharmaceutical sectors.

Discriminant Validity:

Variables	INDUSTRIAL SECTOR	INFORMATION TECHNOLOGY
Industrial innovation and production	0.450	
Information Technology		1.000
Organization performance	0.358	
Supply chain management	0.720	

Table-1

R-square:

	R Square	R Square Adjusted
INDUSTRIAL SECTOR	0.91	0.81

Table-2

The above table describes the R square analysis; it represents the R square values and adjusted R square. According to the results, its R square value is 0.91, and its adjusted R square value is 0.81 means 81%, respectively.

Composite Reliability analysis:

	Cronbach's Alpha	Rho_A	Composite Reliability	Average Variance Extracted (AVE)
INDUSTRIAL SECTOR	-0.333	-0.325	0.520	0.283
INFORMATION TECHNOLOGY	1.000	1.000	1.000	1.000

Table-3

Cronbach's Alpha values, Rho-A values, composite reliability, and average variance extracted values of dependent and independent variables are all shown in the results of the composite reliability study in the results section above. The pharmaceutical sector's Cronbach's alpha is -0.333, and its rho-A value is -0.325. Its composite reliability rating is 0.520, which indicates that 52% of the research is reliable for analysis. The average variance extracted value is 0.283, which indicates that the test is 28 percent reliable, whereas the information technology industry's overall values are 1.000.

Co-linearity statistic analysis:

Variables	VIF
Inustrial innovation and production	1.018
Information Technology	1.000
Organization performance	1.042
Supply chain management	1.024

Table-4

The above table represents that co-linearity statistic analysis results present the VIF values of results. For example, according to the above table, its VIF values are 1.018, 1.000, 1.042, and 1.024, respectively, showing positive co-linearity statistic analysis of each variable.

Model fitness:

	Saturated Model	Estimated Model
SRMR	0.188	0.188
D_ULS	0.353	0.353
D_G	0.069	0.69
Chi-Square	34.415	34.415
NFI	-1.554	-1.554

Table-5

The above results indicate that the model fitness analysis shows the estimated and saturated models. The outcome demonstrates that each model's chi-square value, which includes estimated and saturated values, SRMR value, D-ULS value, and D-G value, is present. These are the numbers: 0.188, 0.353, 0.069, 34.415, and -1.554. As a consequence, the model is appropriate for research analysis.

Model selction criteria:

	AIC (Akaike's I…	AICu (Unbiase…	ALCc (Correcte…	BIC (Bayesian….	HQ (Hannan…	HQc (Correct….
INDUSTRIAL SE…	-6.400	-4.379	94.853	-1.209	-4.300	-4.043

Table-6

The above model describes that model selection criteria result shows that each variable has AIC, AICu, ALC, BIC, HQ, and HQc values. According to the result, its values are -6.400, -4.379, 94.853, -1.209, -4.300, and -4.043, respectively these all show negative model selection criteria.

Significant analysis:

Matrix	Original Sample	Sample Mean (…	Standard Devia….	T Statistic (|O/….	P-Value
IIP<- INDUSTRIAL SECTOR	0.450	0.360	0.319	1.409	0.159
IT<- INFORMATION TECHNOLOGY	1.000	1.000	0.000		
OP<- INDUSTRIAL SECTOR	0.358	0.325	0.379	0.943	0.346
SCM<- INDUSTRIAL SECTOR	0.720	0.602	0.309	2.331	0.020

Table-7

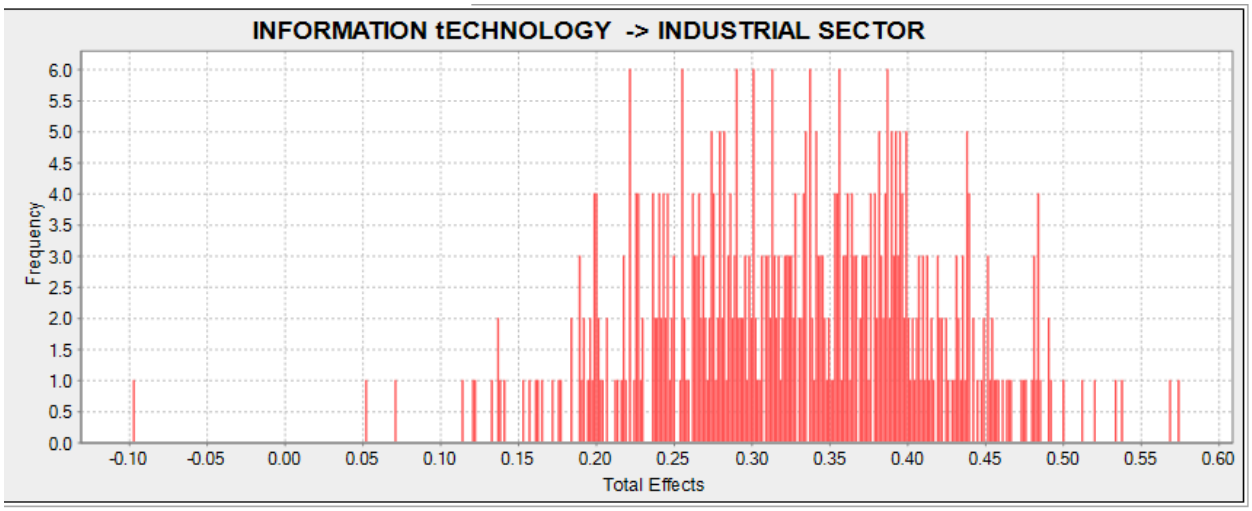
The above table represents the significant analysis of each matrix; the result presents original sample values, the sample mean values, standard deviation values, and the T statistic rate and P values of each matrix, including dependent and independent variables. Industrial innovation and production are dependent variables; its original sample value is 0.450, its sample mean value is 0.360 the standard deviation rate is 0.319. According to the result, its T statistic values show that positive relationship between variables. The probability value of IIP and the industrial sector is 0.15, which means that 15% significant analysis. Performance of the organization - pharmaceutical sector This indicates that the sample mean value is 0.325, and the original sample value is 0.358. Its standard deviation value deviates from the mean by 37%. The outcome indicates that the probability value for the T statistic is 34 percent, and its value is 0.943. The final matrix between supply chain management and the industrial sector has a 0.720 original sample value. 0.602 is its sample mean value. The study between supply chain management and pharmaceutical sectors is 2 percent significant, according to the standard deviation value of 0.309, T statistic value of 2.331, and probability value of 0.020.

Indicator Correlation:

Variables	No.	Missi…	Mean	Median	Min	Max	Standard Deviation	Excess kurtosis	Skewness
Information technology	1	0	2.030	2.000	1.000	5.000	0.858	0.134	0.525
Organization performance	2	0	2.051	2.000	1.000	3.000	0.757	-1.254	-0.085
Supply chain management	3	0	2.505	2.000	1.000	5.000	1.086	-0.381	0.467
Industrial innovation and production	4	0	2.848	3.000	1.000	5.000	1.140	-0.948	0.137

Table-8

The above table describes that indicators correlation of each variable result shows that missing values, mean values, median values, minimum values, and maximum values also present the standard deviation values of each variable. The result shows that excess kurtosis rate also the skewness values of each indicator. Technology in the knowledge economy is an independent variable. Its excess kurtosis rate is 0.134, its skewness value is 0.525, and its standard deviation is 0.858. The minimum value is 1.000, and the maximum value is 5.00; the total missing value is 0. the organization performance is a dependent variable; its mean value is 2.051; its standard deviation rate is 0.757; its excess kurtosis value is -1.254. the industrial innovation and production shows that 1.140 the skewness rate is 0.137, which shows that a 13% skewness rate



The above graph represents the total effect of information technology in industrial sectors. The horizontal side describes the total effect; this value starts from -0.10 and ends at 0.69. The red bar line describes the total effect between both variables; the vertical side shows the frequency level, which starts from 0.0 and ends at 6.0, respectively.

Discussion:

Information technology applications in many industries facilitate communication between staff members, clients, and business partners. Every industry uses IT in its own way according to the demand of the business. In this research, we discuss some of them. First, information technology has wider applications in manufacturing industries, including IT aids the pharmaceutical sector in automating and streamlining the production process. Second, the applications of information technology tremendously facilitate just-in-time analytics and development [21] Third, every pharmaceutical sector relies on its management system, and information technology significantly improves the organization's management system. Fourth, while consumer expenditure seems to rise in developed markets, industrial innovations and efficiency are currently receiving much attention. Finally, information technology may link the industrial sector with its clients, vendors, and service providers [22] Apart from this, the manufacturing industry faces a similar difficulty in benefiting from all Technological expenditures, but things are moving quickly now. With the necessary capacity to develop various business structures, IT manufacturing can now provide the business with tailored methods to help it advance.

Moreover, along with manufacturing industries, information technology has a great role in business sector, education sector, etc., the emergence of information technology offers great applications in communication which is an important element of any business. The more effective the communication system will be, the more business will grow. In addition, nowadays many companies have been providing various communications apps including skype, twitter, videos, email, SNSs, chat rooms etc., which plays a significant role in the development of the business, and it also assist to maintain the association between customer, suppliers, and employees. Apart from this, inventory management, consumer relationship management all are based on the information technology in industrial sector [23]. In this study, we examine the various applications of information technology in industrial sectors and examines that industrial sector holds great importance in the country's economy growth. Thus, in order to maintain the sustainable development of the county's economy, it is essential to maintain the development of industrial sector in an effective way. IT has a competitive advantage in the finance industry. Additionally, it enables businesses to make quick decisions and to enhance production. People look for strategies to complete a huge amount of work in a short time period in the industrial world. And that should only be possible due to advancement of modern technologies (information technology) [24] Furthermore, nowadays in the market various kinds of smart gadgets are available which enables the user to convey key information and data to managers, who then utilize it to make important decisions for the improvements of the management system in the organization.

Conclusion:

In conclusion, it is examined that today with the emerging trends in science and technology, information technology has gain popularity in every field of life. It has its vast application in almost every field including industrial field, educational sectors, sport sectors etc., in this research paper we have discuss the applications of information technology in pharmaceutical sectors of China. we study the applications of information technology and its association with organizational performance, innovation, productivity, supply chain management, knowledge management etc. and it was investigated that organizational performance, supply chain management, and innovation have direct positive association with information technology while information technology has no significant influence on productivity.

This research study determines the application related to the information technology in pharmaceutical sectors. This research study represents the primary data analysis for measuring the research study used smart PLS software and run different results. The indicator correlation, also present that reliability and validity analysis related to the dependent and independent variables. The concept of the association between industrial productivity and information technology was not clear from previous research. Research study concluded that there are positive and significant relationship in between information technology and pharmaceutical sectors. So, there is need to do more research in order to understand the association between them. Furthermore, we can say that information technology is the modern form of technology which has been utilized in various industrial processes to process and store data from recent many years. In many industries information technology used for management process, to making better decisions and plans in order to run business effectively. In this research paper, we collected sample data from different companies in China and investigated through SEM and it is examined that information have positive influences on business effectiveness and have many applications in pharmaceutical sector in order to enhance business activities and to achieve competitive advantages. The major focus of this research article is to evaluate the impact of information technology on industrial innovation and on the performance of firm. In order to compete in competitive environment in which we run business, there is need to develop effective innovative strategies by utilizing information technology in order to meet the requirement of customers which in turn guarantee an efficient business performance. The results of this research show that information technologies have great influence on industrial innovation which in turn has ability to enhance SME performance. Apart from this, it is also examined that entrepreneur also have great role in the association between firm performance and IT innovation. Therefore, small, and medium sized industries can gain a competitive advantage by using information technology innovation through the capability and energy of the entrepreneur at all levels of organization development. Furthermore, we also examine the link of IT and HRM and it is highlighted that information technology capability improve human resource management capability which in turn improves knowledge management capability. Thus, knowledge management capability along with information technology capability improves business performance of organization. Moreover, we also examine strategies to improve organizational performance by utilizing information technology in industrial sector from different perspectives. It is investigated that information technology in various industrial sector have ability to enhance organization performance by improving business performance, brand equity, overall satisfaction of customers, improving satisfaction of customer-supplier relationship, risk management and innovation performance.

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