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The Impact of Knowledge Management Infrastructure on Promoting Innovation: An Applied Study on Jordanian Communications and Information Technology Companies

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Abstract: In this paper, communication and information technology companies have recently been competing to provide many types of products and services to obtain a larger market share than their competitors – it is essential for them to be prompted to constantly strive to provide an infrastructure for knowledge management to achieve innovation. The study sample consisted of (673) individuals. The study reached several findings, that associated to the most important of which is the provision of the means of information and communication technology by the information and communication technology companies to the personnel to enable them to cooperate with others outside the company. This will allow them to retrieve and use knowledge related to the company's services and administrative operations, search for new knowledge, and cooperate among them – the thing that enhances their innovation. The study recommended the need to strengthen the medium levels of knowledge management infrastructure in the company, consisting of physical structure, general knowledge, organizational structure and organizational culture while maintaining high levels.

Keywords: Technological Knowledge, Structural Knowledge, Cultural Knowledge, Innovative Orientation, Managerial Innovation, Enhancing Innovation Capabilities, Communications, and Information Technology Companies.

1 Introduction

In view of the challenges and rapid environmental changes that business organizations are witnessing, such as the emergence of globalization, intense competition, and technological progress, these organizations have increased their interest in developing and managing their knowledge resources, especially after the decline in the importance of physical and financial assets in building the competitive advantage of the organization and the emergence of what is known as the knowledge economy [1]. The human element, given the nature of the modern business environment and its focus on creativity and innovation, has emerged as an essential resource in enhancing the performance of business organizations and achieving their goals, with the capabilities, skills and competencies it represents. From here, the concept of capital arose to refer to the cognitive capabilities that the organization possesses, which it was able to integrate into its administrative and production processes in order to enhance its competitive position by building competencies that serve as a basis for excellence in performance [2]. In this context, business organizations have sought to adopt the concept of knowledge management, which is one of the latest management concepts, as it is based on a set of processes that help the organization to create and develop the necessary knowledge for its various administrative activities related to its products and services, and to facilitate the process of integrating and sharing that knowledge and making the best use of it in decision-making and solving problems. Problems, strategic planning and development of products and services [3-4]. Moreover, an influential knowledge management approach facilitates the seamless sharing of information, most useful practices, and lessons understood across individuals and departments. When employees can smoothly access and contribute to a wealth of knowledge, it revises idea generation and solves the problems [5].

The reliance of organizations on their new resources of knowledge is important in achieving organizational effectiveness. This knowledge is created through merging and exchanging it among others, as this requires the need to provide an infrastructure represented by organizational structure, organizational culture, and technological requirements [3]. So that it facilitates and encourages the creation, storage, exchange and application of knowledge in order to

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achieve the competitive advantage of the organization [6-7]. From Hamshari's point of view, he believes that it is a set of necessary ingredients for the success of knowledge management activities, as it is represented by working to provide an appropriate environment, developing the technological infrastructure, and working to provide a supportive culture and a networked organizational structure that helps share knowledge, in addition to the need for effective leadership and the provision of an appropriate budget [8].

In light of the tremendous cognitive and technological changes that the world is witnessing in various sectors, communications and information technology companies seek to increase the focus and attention to the knowledge management infrastructure to enhance their innovation [9]. Facing the recent changes brought about by the Corona pandemic, these companies are striving hard to maintain their competitive position and growth rate [10-11]. Therefore, they find that promoting innovation is the only way for them to achieve this. Thus, this study seeks to research the promotion of innovation [10-12], and what information technology companies can achieve through the knowledge management infrastructure represented in its dimensions (technological knowledge, structural knowledge, cultural knowledge).

2 Development of theory and hypothesis

Knowledge management is one of the modern trends in management science, where the interests and development began in the nineties, and included information technology systems, organizational structure, and culture of the organization [13]. It is a systematic, explicit, and clear management of the organization's activities, practices, and programs that are related to knowledge [14]. Therefore, organizations are keen to encourage their personnel to enhance the infrastructure for managing cultural knowledge in the organization because it is the basis on which the management of cultural knowledge, which includes the culture organization, organizational structure, information technology infrastructure, and physical environment. This can be done through creating collaborative links between knowledge and its goals, linking knowledge to innovation, encouraging them to support each other, creating an integrative participatory process of knowledge in their daily work, supporting informal relations between them, and providing the necessary facilities for them while using reward and incentive systems to support the process of sharing knowledge among them [13]. It was found that there is a significant impact of the knowledge management infrastructure on promoting innovation among the personnel in the communications and information technology companies, as the knowledge management infrastructure provides a safe and fertile work environment with ideas, methods, and cooperation between individuals to promote innovation and reach ideas, solutions, and new innovative processes [15].

The concept of infrastructure for knowledge management in most organizations refers to the set of foundations, rules, and resources that are responsible for creating knowledge through organized processes represented in the acquisition, collection, sharing, recombination, and reuse of knowledge to create a new value by improving efficiency and effectiveness in the products, services, and processes [16-17].

[14] Stipulated the importance of the infrastructure for knowledge management in innovation, as the sample of his study consisted of (894) personal in manufacturing companies. The results showed a strong positive relationship between infrastructure and innovation. This study contributed to finding noteworthy conclusions for management by focusing on the knowledge management infrastructure as a key factor at the organizational level for innovative work through knowledge sharing and functional flexibility. Keshavarz et al (2018) emphasized the importance of knowledge management infrastructures (KMI).

Organizational knowledge management affects the economic and social fields of organizations, where the development and progress in information technology contributed to crystallizing this effect [18]. It includes planning, organizing, controlling, coordinating, and synthesizing knowledge, as it is a mixture of concepts, ideas, rules, and procedures that guide decisions and all that is related to knowledge to achieve a positive impact on innovation. It expresses the direct outcome of understanding the content of data and information [13]. It also refers to a set of processes, activities, and tasks that aim to invest knowledge after obtaining, compiling, storing, and distributing it, as well as making it available to users, which leads to the acquisition of capabilities and skills, resulting in behaviors that lead to improving the level of services and products provided by the educational organization [13]. Moreover, it links the basic resources in the organization: the personnel, the operational processes, and the techniques used to invest and share information. This knowledge management also includes the process of diagnosing, planning, publishing, acquiring, storing, distributing, applying, and retrieving knowledge when the need, as well as sharing it with others, following it up, and controlling it to avoid being misused or derailed [16].

2.1 First: The impact of the technological knowledge management infrastructure on promoting innovation

1- H1: There is a statistically significant effect at the level of significance ($\alpha \leq 0.05$) for the infrastructure of technological knowledge management in promoting innovation in communications and information technology

companies.

The infrastructure for managing technological knowledge is represented in the devices, equipment, and electronic tools that the companies use in processing data to acquire knowledge, collecting them in lists or groups according to their nature, type, specialization, and sharing them with users, whether inside or outside the company, re-compiling them, storing them in special databases, and retrieving them when needed to be used to find a new value that distinguishes the organization from its competitors [13].

By improving the efficiency and effectiveness in providing its services and products and conducting their operations in the internal and external environment in private universities, the infrastructure for technological knowledge management in organizations, in the application of the knowledge management system, aims to create an environment that helps the personnel and users exchange and obtain knowledge [19], as well as building it through transforming individual knowledge into organizational knowledge based on the Internet, Extranet and Intranet, which together constitute a technological infrastructure in organizations that use the protocols and rules of the open Internet systems, [20].

The infrastructure of management technological knowledge is an important factor in the process of generating knowledge for universities. and achieving its competitive advantage, through the use of network technology and the Internet to communicate ideas and modern technological solutions to generate and acquire knowledge. To achieve efficiency and effectiveness, special information and communication systems have been designed for knowledge management, such as [14-21].

1. Artificial Intelligence Systems: it refers to computer techniques for carrying out activities that require intelligence when implemented by the personnel in organizations. They process codes and use them to solve problems using computerized software and models.
2. Expert Systems: these are information systems based on the use of knowledge in specific and complex applications and uses.
3. Decision Support Systems: Decision Support Systems are computer systems linked to each other used to assist managers in decision-making and problem-solving processes, by providing the required information from management.

[22] Confirm that innovation results from managing knowledge growth and technological progress based on knowledge and innovation that considers work productivity and encourages personnel to innovate. This study provided strong evidence of the relationship between innovation and knowledge that leads to increased growth for companies. The study used the latest powerful long-memory econometric techniques to identify key determinants of innovation from 1952 to 2018. We measured a seasonal average annual growth rate of 0.93% (using data per hour worked). The productivity compensation difference for each worker follows the average annual growth rate of 1.52%.

[23] The role of knowledge management infrastructure (structural, cultural and technological) in enhancing job satisfaction from the perspective of a developing country. (168) questionnaires were distributed to faculty members at Zarqa University in Jordan, and the study concluded that there is a more positive presence of the two technological environments and cultural in the job satisfaction of faculty members and the lack of a more structural environment management knowledge in the job satisfaction of faculty members at the university the study recommended more studies in this field

[24] Examined the role of knowledge management processes (knowledge generation, knowledge storage, knowledge sharing and knowledge application) and human, structural and relational intellectual capital as a mediating variable between the two variables of knowledge management infrastructure (organizational culture, organizational structure and information technology infrastructure) and organizational performance (financial and non-financial in the food industry companies in Jordan), and the study found the following most prominent results: There is a direct impact of the knowledge management infrastructure on the process of knowledge management and intellectual capital, and there is a more direct presence of knowledge management processes and intellectual capital on organizational performance, while Khalil had a direct effect for knowledge management infrastructure on performance.

[10] Stressed the importance of technological knowledge management in supporting the development of innovation capabilities. The information and communication technology at the strategic level supports dynamic capabilities and knowledge management processes, which aim to enhance the daily performance of activities and link information technology knowledge management with the required functions, giving special attention to issues of collaboration and advanced data analysis, which fosters innovation for all individuals working in the company.

[20] Examined the relationship between knowledge-oriented leadership and open innovation through a mediating variable that is the role of structural, technological and cultural knowledge management capabilities in multinational companies in France. Data was collected from (172) branches of the multinational company in France. And that knowledge management capabilities represented in its cultural, structural and technological structure mediate the relationship between knowledge-

oriented leadership and open innovation, and recommended more studies in this field, and the current study benefited from it in building the study model, especially the first dependent variable, which is innovation.

[25] Pointed out the importance of technological innovation and its importance in promoting innovative activity. This study demonstrated the importance of the innovative intangible performance of a company to examine the effects on the reputation of technological innovation. Using patent data, financial data, and consumer data, the Poisson regression analyzes 65 international companies nominated by 231 consumers. We apply time series as well as cross-section data to our interdisciplinary analysis. The study proved that innovative performance (citation density) is linked to the reputation of technological innovation, and this contributes to attracting technological advances to consumers' attention, increasing their appreciation of costly and uncertain efforts, and appreciating those companies that offer innovation constantly.

[26] Explored the role of knowledge management infrastructure consisting of (organizational culture, organizational structure, human resources, information technology, and the physical environment) in promoting innovation in cellular telecommunications companies in Jordan. (300) questionnaires were distributed to telecommunications companies the three cellular networks concluded that there is an impact of the desalination environment for knowledge management on innovation, and that the largest components of the infrastructure environment affecting innovation are information technology. Among them is the construction of the study model, especially the independent variable, which is the knowledge management infrastructure.

2.2 Second: The impact of the structural knowledge management infrastructure on promoting innovation

2-H1: There is a statistically significant effect at the level of significance ($\alpha \leq 0.05$) for the structural knowledge management infrastructure in promoting innovation in communications and information technology companies.

The structural knowledge management infrastructure is represented by the framework that defines the administrative units and the different departments in the three administrative levels in the organization [18]. It refers to the formal shape of the chain of relations and lines of communication between individuals and groups for the distribution of activities, powers, and responsibilities in the administrative system of private universities. The structural knowledge management infrastructure plays a key role in knowledge management in private universities and reflects the group of functions and activities at the different administrative levels [13-27]. It also defines the administrative units and the way of their connection to other administrative units in the university, showing the formal structure of the university, the division of its activities, and its distribution to its sub-units [28-29]. Through coordination and control of these activities, it represents the link that ensures interaction and coordination between personnel, tasks, and technology of the organization [15].

[19] Noted the relationship between knowledge leadership, knowledge management, innovation, and corporate performance in 283 small and medium-sized enterprises (SMEs) in Thailand, where it emphasized the key role of knowledge management in corporate innovation processes, by providing empirical evidence To support that customer knowledge management mediates the relationship between knowledge leadership and innovation quality, as it has been proven that the quality of innovation mediates the relationship between customer knowledge management and company performance, and there is a strong relationship between knowledge management and innovation quality.

[30] Emphasized the relationship between innovation and managerial knowledge by integrating managerial relationships for knowledge development. This study relied on a cross-sectional sample of 530 companies in France, Malaysia, and the United Arab Emirates. Data was collected from the middle and senior managers working in different industries in these companies. The results showed the mediating effect of perceived absorptive capacity in the relationship of the external managerial links and the open innovation (internal and external). Specifically, managerial relationships affect the internal open innovation in all three countries surveyed, whereas the managerial relationships are positively correlated with the open external innovation in France and the United Arab Emirates. This study contributed to understanding the relationship between administrative linkages and absorptive capacity that may lead to successful innovation processes.

[31] Pointed out the impact of innovation on the company's performance, by increasing the interest in performance that is based on knowledge infrastructure, through his study on European companies listed in the five main European markets in the years 2008-2013. The impact of innovation was studied according to three dimensions: economic performance, measured as a company's turnover; strong financial performance, measured by stock value; and human resources performance, measured by the level of employment. It was found that only internal development is positively and significantly related to the other two dimensions of performance, whereas the effect of internal development of intangible assets affected the economic performance of larger companies only. It was also found that employment increases only for relatively smaller companies, whereas it did not have any impact on the financial side of the performance.

2.3 Third: The impact of the infrastructure of cultural knowledge management on promoting innovation

3-H1: There is a statistically significant effect at the level of significance ($\alpha \leq 0.05$) for the infrastructure of cultural knowledge management in promoting innovation in communications and information technology companies.

The infrastructure of managing cultural knowledge is represented by the cognitive framework that consists of a set of trends, basic values, standards of behavior, assumptions, beliefs, standards, and behaviors shared by individuals working in private universities [25], which affects their decisions, actions and behavior, such as the freedom to present new ideas open compliance and taking risk acceptance [32-29-33]. The infrastructure of cultural knowledge management indicates that organizations differ in the extent of their sensitivity to the needs of the customers and personnel, the extent of encouraging personnel to provide new ideas and solutions, the extent of taking risk acceptance, and the communication alternatives available to their personnel [34-35-36].

[37] Drew attention to the importance of the mediating role of knowledge application in the relationship between knowledge management practices and consistent innovation. Their study emphasized the importance of knowledge management in all its forms in promoting innovation in service companies in developing countries. It also contributed to the development of a conceptual model that assumes the existence of a positive and important relationship between the knowledge infrastructure, which is represented in (knowledge generation, knowledge storage, knowledge dissemination, knowledge application) and the promotion of innovation. The study demonstrated that knowledge generation, storage, and application had a significant and positive impact on a company's innovation and that knowledge management infrastructure practices contribute to innovation as a hierarchy.

[9] Indicated that innovation and regional development are based on the company's core competency, which is represented in knowledge management, by studying some recent evidence from the Northeast of England, to activate them for research, development, and innovation activities. A questionnaire was designed based on the literature for collecting primary data from 330 companies located in the Northeast of England. The study provided a theoretical and empirical framework for enhancing innovation by consolidating the company's core competency of knowledge management regarding the improvement of production qualities and allocating scarce resources to managing innovation and creativity.

3 The importance of the study

The knowledge management infrastructure is one of the important administrative concepts which formed the knowledge economy and human capital. The researcher considers the necessity of researching it, due to its importance in helping the communications and information technology companies keep abreast of knowledge developments and steadfastness in the competitive environment to promote innovation, which is considered one of the modern administrative topics in the field of organizations Business. This helps these companies to survive, continue and develop by obtaining results and recommendations that help them to reconsider their knowledge management infrastructure.

4 Research design, sample size, and procedures

This study followed the descriptive analytical approach using a simple random sampling technique. The sample amounted to (800) items. The participants were (company managers, assistant company managers, department heads, supervisors, or engineers) in the 25 communications and information technology companies. The sample consists of a group of supervisory, executive, and administrative jobs which were represented. The response rate was (88.1%) depending on the data obtained by the Ministry of Industry and Trade, where the significance level ($\alpha \leq 0.05$) was adopted, which corresponds to a confidence level (95%) to interpret the results of the tests. This study was applied to a simple random sample. The sample size was calculated to find the number of its members based on the Steven K. Thompson equation [38] shown below in Table (1):

Table 1: The number of questionnaires distributed and valid for analysis

Construction projects in the Jordanian capital Amman	**Total**
Number of the random sample	800
Number of distributed questionnaires	800
Percentage of recovered questionnaires valid for analysis	673
Number of questionnaires suitable for analysis	88.01%

5 Data analysis and results

A descriptive analytical approach was used. The study model was developed based on the analysis of previous literature related to the subject of the study. The tool of the study represented by the questionnaire was developed based on the opinions of arbitrators and experts. The primary data for the study was collected from the study population that was selected from the communications and information technology companies in Jordan to determine the face validity of the questionnaire by judging the questionnaire questions by a group of university professors, where the questionnaire's arbitration committee consisted of (6) professors specialized in knowledge management and innovation.

To ensure the reliability of the study tool, the value of Cronbach's Alpha Coefficient was calculated to show the extent of

the internal consistency of the study paragraphs, and to show the quality of building the questionnaire items and the strength of their cohesion.

Table 2: values of Cronbach's Stability Coefficient Alpha for study scales

Variable	Number of items	The value of validity and reliability of the questionnaire, Cronbach's Alpha
Knowledge management infrastructure	15	0.801
Dependent variable: Innovation	19	0.793
Total	34	0.802

From Table (2), the values of Cronbach's Alpha Coefficient ranged between (0.801) as the lowest value, and (0.793) as the highest value, and the total value reached (0.802) with a total number of (34) paragraphs, which are high values.

The Pearson's correlation coefficient for the dimensions of the knowledge management infrastructure (the independent variable) was used to ensure that there are no multiple linear correlations between its dimensions as shown in Table (3):

Table 3: Pearson's correlation with the dimensions of knowledge management infrastructure (independent variable)

Knowledge management infrastructure	Technological knowledge	Structural knowledge	Cultural knowledge
Technological knowledge	1		
Structural knowledge	0.388 **	1	
Cultural knowledge	0.397 **	0.618**	1

(**) Significance level at 0.01

Table (3) shows that the highest correlation between the dimensions of the knowledge management infrastructure (the independent variable) (0.618) is between the structural knowledge dimension and the cultural knowledge dimension, while the correlation values between the other dimensions were lower than that, which indicates the absence of a phenomenon The high linear correlation between the dimensions of the knowledge management infrastructure (the independent variable), all of which were significant at (p = 0.01), and this indicates that the dimensions of the independent variable are devoid of the high multiple linear correlation problem.

The Variance Inflation Factor was calculated for the dimensions of the knowledge management infrastructure (the independent variable) to verify that there is no high correlation and linear overlap between its dimensions, and the results are as follows:

Table 4: Test of Variance Inflation Factor and Tolerance

Variable	Tolerance	Variance Inflation Factor
Technological knowledge	0.627	1.301
Structural knowledge	0.347	2.660
Cultural knowledge	0.201	2.587

Table (4) shows that the values of the Variance Inflation Factor VIF are greater than (1) and less than (3). It is also noted from the table that the values of Tolerance are between (0.1), which indicates that there is no linear correlation between the dimensions of the infrastructure for the management knowledge (independent variable)

Pearson's correlation coefficient for the dimensions of innovation (the dependent variable) was used to ensure that there were no linear multiple correlations between its dimensions, as shown in Table (5):

Table 5: Pearson's correlation with innovation dimensions (dependent variable)

Innovation	Innovative orientation	Management innovation	Enhancing innovation capabilities
Innovative orientation	1		
Management innovation	0.374 **	1	
Enhancing innovation capabilities	0.278 **	0.446**	1

(**) Significance level at 0.01

Table (5) shows that the highest correlation between the dimensions of innovation (the dependent variable) (0.446) is between the management innovation dimension and the enhancing innovation capabilities dimension, while the correlation values between the other dimensions were less than that, which indicates the absence of the phenomenon of high linear correlation between the dimensions of innovation (the dependent variable). All of these were significant at (p=0.01), and this indicates that the dimensions of the dependent variable are free from the high multiple linear correlation problem.

The Variance Inflation Factor for the dimensions of innovation (the dependent variable) was also calculated to verify that there was no high correlation and linear overlap between its dimensions. The results were as follows:

Table 6: Test of Variance Inflation Factor and Tolerance

Variable	Tolerance	Variance Inflation Factor
Innovative orientation	0.836	1.203
Management innovation	0.801	1.187
Enhancing innovation capabilities	0.811	1.093

Table (6) shows that the values of the Variance Inflation Factor are greater than (1) and less than (3). It is also noted from the table that the allowable variance values are between (0.1), which indicates that there is no linear relationship between the dimensions of innovation (the dependent variable).

6 Study results

6.1 Results of the characteristics of the study population

Table 7: Distribution of study sample participants by gender

Gender	Number	Percentage
Male	540	80.1
Female	133	17.9
Total	673	100%

It is noted in Table (7) that males constitute the largest percentage of the study sample participants with a percentage of (80.1%) compared to (17.9%) for females.

Table 8: Distribution of study sample participants by age

Gender	Number	Percentage
Under 30	10	1.6
From 30 to 40	300	40.9
From 41 to 50	120	16.9
Over 50	243	35.5
Total	673	100%

It is noted in Table (8) that those aged from 30 to 40 years constitute the largest proportion of the study sample participants with a rate of (40.9%), and the lowest percentage was for those under 30 years of age with a rate of (1.6%).

Table 9: Distribution of study sample participants according to academic qualification

Academic qualification	Number	Percentage
Technical education diploma	11	1.7
Bachelor	381	55.3
Master	201	25.4
PhD	80	10.5
Total	673	100%

It is noted in Table (9) that the holders of a bachelor's degree constitute the largest proportion of the study sample with a percentage of (55.3%), and the lowest percentage was for those holding a diploma with a degree of (1.7%).

Table 10: Distribution of the study sample participants according to years of experience

Years of experience	Number	Percentage
5 years or less	80	10.1
From 6 to 10	60	8.5
From 11 to 14	293	38.2
15 and over	240	36.1
Total	673	100%

It is noted in Table (10) that those with years of experience from 11 to 14 years constitute the largest proportion of the study sample members with a rate of (38.2%), and the lowest percentage was for those with years of experience from 6 to 10 years, at a rate of (8.5%).

Table 11: Distribution of the study sample participants according to job title

Job title	Number	Percentage

Manager	160	20.3
Assistant Manager	150	21.0
Department Head	234	29.9
Supervisor or engineer	129	22.4
Total	673	100%

It is noted in Table (11) that those who have the job title department head constitute the largest percentage of the study sample participants with a percentage of (29.9%), and the lowest percentage was of those whose job titles are a manager and (supervisor or engineer), at a rate of (21.0%).

6.2 Arithmetic means and standard deviation

Table 12: Arithmetic mean and standard deviation

Rank	Dimension	Arithmetic mean	Standard deviation	Relativity
	Technological knowledge	3.20	0.733	High
	Structural knowledge	4.19	0.735	High
	Cultural knowledge	4.15	0.741	High
	Innovative Orientation	4.13	0.733	High
	Management innovation	4.09	0.735	High
	Enhancement of innovation Capabilities	4.39	0.741	High

6.3 Testing the hypotheses of the study

H.1 The first main hypothesis: There is no statistically significant effect at the level of significance (P≤0.05) for the infrastructure of knowledge management in terms of its dimensions (technological knowledge, structural knowledge, cultural knowledge) on innovation in communications and information technology companies.

To test this hypothesis, it was divided into three sub-hypotheses as follows:

H1.1 The first sub-hypothesis: There is a statistically significant effect at the level of significance (P≤0.05) for the knowledge management infrastructure with its combined dimensions on the innovative orientation in the communications and information technology companies.

To test this hypothesis, the Simple Regression test was used to identify the relationship between the knowledge management infrastructure in its combined dimensions and the innovative orientation in communications and information technology companies. Table (13) is illustrative.

Table 13: Results of the simple linear regression test to reveal the impact of the knowledge management infrastructure with its combined dimensions on the innovation orientation in the communications and information technology companies

Dependent variable	Model summary [b]		Variance [b]				Regression coefficients [a]		
	RR R Correlation Coefficient	R^2 Coefficient of determination	Degree of Freedom		Value (F)	Sig F Statistical significance	Value (B)	Value (T)	Sig F Statistical significance.
Independent variable	0.130[a]	0.017	Regress.	1	13.47	0.000[b]	0.222	3.670	0.000[b]
			The rest	672					
			Total	673					

[a] Independent variable of the knowledge management infrastructure in all its dimensions combined

[b] Dependent variable of the invention orientation

The results presented in Table (13) showed that the value of the correlation coefficient (R) between the two variables (the knowledge management infrastructure with its combined dimensions and the innovation orientation) reached (0.130). The relationship between the two variables was direct. This explains that the independent variable, the knowledge management infrastructure with its combined dimensions, positively affects the "innovative orientation" dimension of the dependent variable. The value of the coefficient of determination (R2) reached (0.017), with a percentage (1.7%) of the change in the knowledge management infrastructure with its combined dimensions and innovation. The calculated (F) value reached (13.470) with a statistical significance level (0.000) which is less than (P≤0.05), and this confirms the significance of the regression.

Based on the results, the alternative hypothesis was accepted. That is, there is a statistically significant effect at the level of significance (P≤0.05) for the knowledge management infrastructure in the innovation orientation in the communications

and information technology companies.

H1.2 The second sub-hypothesis: There is a statistically significant effect at the level of significance (P≤0.05) for the knowledge management infrastructure with its combined dimensions on management innovation in communications and information technology companies.

To test this hypothesis, the Simple Regression test was used to identify the relationship between the knowledge management infrastructure in its combined dimensions and the management innovation in communications and information technology companies. Table (14) illustrates this.

Table 14: Results of the simple linear regression test to reveal the impact of the knowledge management infrastructure with its combined dimensions on management innovation in communications and information technology companies

Dependent variable	**Model summary** [b]		**Variance** [b]				**Regression coefficients** [a]		
	RR R Correlation coefficient	R^2 Coefficient of determination	Degree of freedom		Value (F)	Sig F Statistical significance	Value (B)	Value (T)	Sig F Statistical significance
Independent variable	0.228a	0.052	Regress.	1	42.712	0.000[b]	0-.313	-6.535	0.000
			The rest	672					
			Total	673					

[a] Independent variable of the knowledge management infrastructure in all its dimensions combined

[b] Dependent change of management innovation

It is clear from Table (14) that the results showed that the value of the correlation coefficient (R) between the two variables (the infrastructure of knowledge management with its combined dimensions and management innovation) reached (0.228). The relationship between the two variables was direct. This explains that the independent variable, the knowledge management infrastructure with its combined dimensions, positively affects the "management innovation" dimension of the dependent variable, and the value of the coefficient of determination (R2) reached (0.052), with a percentage (5.2%) of the change in the knowledge management infrastructure with its combined dimensions and innovation. The calculated (F) value reached (42.712) with a statistical significance level (0.000) which is less than (P≤0.05). This confirms the significance of the regression.

Based on the results, the alternative hypothesis was accepted. That is, there is a statistically significant effect at the level of significance (P≤0.05) for the knowledge management infrastructure with its combined dimensions on management innovation in communications and information technology companies.

H1.3 The third sub-hypothesis: There is a statistically significant effect at the level of significance (P≤0.05) for the knowledge management infrastructure with its combined dimensions in enhancing the innovation capabilities in the communications and information technology companies

To test this hypothesis, the Simple Regression test was used to identify the relationship between the knowledge management infrastructure in its combined dimensions and the enhancement of innovation capabilities in communications and information technology companies. This is illustrated in Table (15).

Table 15: Results of the simple linear regression test to reveal the impact of the knowledge management infrastructure with its combined dimensions on enhancing innovation capabilities in communications and information technology companies

Dependent variable	**Model summary** [b]		**Variance** [b]				**Regression coefficients** [a]		
	RR R Correlation coefficient	R^2 Coefficient of determination	Degree of freedom		Value (F)	Sig F Statistical significance	Value (B)	Value (T)	Sig F Statistical significance
Independent variable	0.236a	0.056	Regress.	1	46.1	0.000[b]	0.176	6.795	0.000
			The rest	672					

			Total	673					

[a] Independent variable of the knowledge management infrastructure in all its dimensions combined

[b] Dependent variable of enhancing innovation capabilities

A look at Table (15) reveals that the value of the correlation coefficient (R) between the two variables (the infrastructure of knowledge management with its combined dimensions and the enhancement of innovation capabilities) reached (0.236). The relationship between the two variables was direct. This explains that the variable of knowledge management infrastructure with its combined dimensions positively affects the dimension of "enhancing innovation capabilities" of the dependent variable. The value of the coefficient of determination (R2) reached (0.056), with a percentage (5.6%) because of the change in the infrastructure of knowledge management and innovation, while the calculated (F) value reached (46.178) with a statistical significance level (0.000) which is less than ($P \leq 0.05$). This confirms the significance of regression.

Based on the results, the null hypothesis was rejected, and the alternative hypothesis was accepted. That is, there is a statistically significant effect at the level of significance ($P \leq 0.05$) for the knowledge management infrastructure with its combined dimensions in enhancing innovation capabilities in communications and information technology companies.

6.4 Discussion of results

- Technological knowledge: The results of the study showed that communications and information technology companies provide information and communication technology means that help their personnel cooperate with workers in other companies. This helps them to retrieve and use technical knowledge to lead their jobs and search for new knowledge. This can be done through cooperation with their fellow workers. This enables the company to easily collect data and information about its competitors – the thing that contributes to promoting innovation among the personnel due to the availability of the infrastructure for technological knowledge management.
- Structural knowledge: It was found that communications and information technology companies possess a knowledge structure that allows administrative units and departments to share data and information and to grant qualified and competent personnel independence in decision-making. This enhances the sharing of data and information by administrative units and departments without restrictions. This also enhances innovation among personnel because of the availability of the structural infrastructure that allows the cooperation of administrative units and departments without restrictions.
- Cultural knowledge: the results showed that communications and information technology companies encourage their personnel to interact with their colleagues in other units and departments. This enhances the internal trust atmosphere between them and contributes to helping each other because of the confidence in their colleagues' abilities, which contributes to enhancing knowledge sharing. This in turn would enhance innovation due to the exchange of experiences and information and the exchange of assistance between the individuals working in companies.
- Innovative orientation: It was found that communications and information technology companies motivate their personnel financially and morally to present innovative ideas and solutions when practicing innovative planning and providing this innovation with the appropriate innovative environment. This would depend on the integrated infrastructure for knowledge management that enhances the innovative orientation of personnel.
- Management innovation: The results of the study showed that communications and information technology companies adopt new and distinctive ideas and engage their personnel in specialized courses to be able to deal with modern technologies. These companies also prepare their facilities and internal environment to innovate and encourage personnel to benefit from the experiences of other companies in managing challenges and risks. It can be done by employing various modern technologies, and this would enhance management innovation among personnel based on the provision of an integrated infrastructure for a knowledge management intern company.
- Enhancing innovation capabilities: The results showed that communications and information technology companies are interested in the new suggestions, recommendations, and new ideas of customers, and constantly seek to provide products and services that meet their expectations. This can be achieved by relying on innovative ideas, to enhance the quality of services by relying on modern technologies. It enhances the abilities of the personnel to innovate by relying on providing an integrated infrastructure for knowledge management in the company.

7 Findings and recommendations

7.1 Findings

1. Communications and information technology companies provide information and communication technology means that allow personnel to cooperate with others outside the company, it allows them to retrieve and use knowledge related to the company's services and operations, search for new knowledge, and cooperate among them which in turn will enhance their innovation.
2. The structural knowledge management infrastructure in communications and information technology companies allows for the sharing of knowledge. This gives them independence in making decisions related to the tasks of their workers and communicating with internal units each other without restrictions.
3. Communications and information technology companies encourage personnel to interact with others in other units and departments. This creates trust atmosphere that will be reflected in an increase in confidence in their abilities. This attitude will greatly contribute to promoting innovation.
4. Communication and information technology companies motivate the personnel financially and morally when providing them with innovative solutions and ideas as well as an innovative environment.
5. Communications and information technology companies adopted distinguished ideas and encouraged training by using modern technologies to communicate and simulate the benefits from the experience of other companies, which will enhance innovation among personnel.
6. Communications and information technology companies are interested in new customers' suggestions and ideas. The company constantly seeks to innovate new products by enhancing the quality of services, processes, and innovative ideas that in turn will enhance innovation.

7.2 Recommendations

1. The need to strengthen the medium levels of knowledge management infrastructure in the company, consisting of physical structure, general knowledge, organizational structure and organizational culture while maintaining high levels.
2. Enhancing the role of knowledge management infrastructure because of its clear impact on the innovation process in the company.
3. Working to increase knowledge sharing between communications and information technology companies.
4. Increasing the encouragement to provide innovative ideas and solutions.
5. Increasing focus on employing different technologies and activities in innovative perspectives, ways, and techniques, through creating new work programs which will take into consideration the needs of the personnel.

8 Study limitations

The research is confined to a specific scope, and its conclusions may not have more comprehensive relevance in different contexts or industries. As an impact, the results of this research may not be smoothly generalizable to other fields or industries. Other fields and industries may have different or unique characteristics, dynamics, and other variables that can significantly impact outcomes. Thus, readers who are looking for insights beyond the specific field of this research may find another related topic that satisfies their wants, as the findings may not be directly applicable or relevant to their own circumstances.

Conflict of interest

The authors declare that there is no conflict regarding the publication of this paper.

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