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The impact of knowledge management infrastructure on the innovation process and products: The mediating role of knowledge management technologies and mechanisms

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A B S T R A C T

The study aims at measuring the availability of knowledge management (KM) infrastructure and its impact on the innovation process and products of Munir Sukhtian Trading Group Company (MSTGC), through the intermediary role of KM mechanisms and technologies. The study tool, which took the form of a questionnaire, was designed to collect the required data from the company under research. The validity and stability of the research tool were both tested. The study community is made up of the MSTGC, and the study sample consisted of the senior and middle management. A group of 101 managers were randomly selected from the sampling unit which consisted of (140) managers, heads and deputy heads of departments, sales supervisors and team leaders at the Head Office of the company in Amman. The study used the descriptive-analytical research method, and found the following most notable findings: high level of information technology (IT) infrastructure and intermediate levels of the rest of the components of KM infrastructure (physical environment, common knowledge, organizational culture, and organizational structure). The innovation process is of a medium level and the same is for KM mechanisms and technologies. As for MSTGC's commercial products, the results show a high level represented by two things: first, value-added products and knowledge-based products. Furthermore, a statistically significant effect was found ($\alpha \leq 0.05$) for the KM infrastructure with its components (IT infrastructure, physical environment, common knowledge and organizational structure) on the MSTGC's products. On the other hand, the effect was outwardly in relation to the component of organizational culture. The findings also show that the KM infrastructure had a statistically significant impact on the innovation process and the products through KM mechanisms and technologies. The study presented a set of recommendations, most notably: the need for enhancing and elevating the intermediate levels of KM (physical environment, common knowledge, organizational structure, organizational culture), while maintaining the high levels of IT infrastructure. Also, among the recommendations is the need for maintaining the high levels of value-added and knowledge-based products of MSTGC's in order to remain in competition with the market and enhance the reputation of the company's products among customers. Also recommended is paying more attention to KM infrastructure because of its impact on the innovation process and the company's products.

1. Introduction

Munir Sukhtian Trading Group Company (MSTGC) was established in 1933 as a family business. The company started as the Munir Sakhtian Pharmacy in Tulkarem, Palestine, and then expanded to various countries to establish a strong regional company operating in various fields including trade, marketing, distribution, services, information and communication technology, and manufacturing. They manufactured cosmetics, medicines, hygiene tools and chemicals. It is the first company to

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receive the good manufacturing practice (GMB) European Pharmaceuticals certification in the Middle East, and it is the first greenhouse manufacturer in the Arab world, the first company to export locally manufactured medicines to Europe, and the first to introduce command, control, communications, and intelligence (C3I) systems in the Arab region. This study seeks to achieve the main objective of measuring the impact of the KM infrastructure on the innovation process and the products of MSTGC through the intermediate variable of KM mechanisms and technologies. Out of the main objective, a set of sub-objectives emerges for measuring the levels and impact combined and individually in the study´s variables. Theoretically, the importance of the study is highlighted by the KM literature and its integrated infrastructure in institutions and companies. In practice, on the other hand, the importance is seen in the availability of the KM infrastructure in MSTGC in particular and in the impact of this infrastructure on the innovation process and the company's products through the mediator variable of KM mechanisms and technologies.

2. Theoretical Framework

2.1 Previous Studies

Al-Omari's study (2008) tested the impact of KM mechanisms and technologies on the development of intellectual capital in Jordanian industrial companies. Data from 64 public industrial joint-stock companies were collected by questionnaires, and the study produced the following highlights: Above-average levels of mechanisms and technologies were the most used mechanisms, with a high computational average, and the most highly used technology being databases. The Kushwaha Pooja and Rao (2015) study examined the role of integrating KM infrastructure and its components: (collaboration, trust, learning, formal, central, IT support skill-problem technology) with KM strategy (i.e. personalization and blogging) to enhance individual competence (knowledge, skill, and ability) within the perception of enabling the knowledge process. It concluded that the provision of KM infrastructure and KM strategy facilitated an environment conducive to the development of individual and organizational efficiency in the organization. Hajir et al. (2015) explored the role of KM infrastructure (organizational culture, organizational structure, human resources, information technology, and physical environment) in fostering innovation in cellular telecommunications companies in Jordan on the three cellular carriers. She concluded that there is an impact on innovation, and that the biggest component of the infrastructure that influence the innovation is information technology, and companies recommended to invest more in infrastructure, especially information technology, because of their role in innovation and achieving advantage. Naqshbandi and Jasimuddin, S. (2018) study examined the relationship between cognitive-oriented leadership and open innovation through an intermediate variable which is the role of KM capabilities (structural, technological and cultural) in multinational companies in France. Results included that high-level knowledge-oriented leadership enhances KM capabilities and improves open innovation outcomes. The KM capabilities represented in its cultural, structural and technological structure mediate the relationship between cognitive-oriented leadership and open innovation. The research recommends further studies in this field. Abualoush Shadi et al. (2018) examined the role of KM processes (knowledge discovery, knowledge storage, knowledge sharing, knowledge application) and intellectual capital (human, structural, and relationships) as an intermediate variable between the variables of KM infrastructure (organizational culture, organizational structure, IT infrastructure) and organizational performance (financial and non-financial) in companies like food industry in Jordan. The study concluded the following highlights: a direct impact of KM infrastructure on KM and intellectual capital, and a direct impact of KM processes and intellectual capital on organizational performance, while the KM infrastructure had little direct impact on organizational performance. It recommended further studies in this regard to enhance the role of information technology in the sharing of knowledge in companies. Masa'deh et al. (2019) explored the role of KM infrastructure (structural, cultural and technological) in promoting job satisfaction from the developing country perspective. The study found that there was a positive impact of the technological and cultural environments on the job satisfaction of faculty members and the absence of an impact on the structural environment of KM in the job satisfaction of the university's faculty. The study recommended further studies in this area.

2.2 KM infrastructure

The KM infrastructure is the foundation of KM and includes five main components: (organizational culture, organizational structure, IT infrastructure, common knowledge and physical environment) (Fernandez & Sabherwal, 2015). The main components of the KM infrastructure can be narrated as follows:

Organizational Culture: Culture is a set of core values, assumptions, beliefs, understandings and standards shared by members of the organization. Organizational culture refers to a meaningful system maintained by members of the organization and distinguishes the organization from other organizations, which are characteristics of the values, traditions and behaviours shared by employees of the company (Dessler, 2017: 496). There are seven basic characteristics of organizational culture: (innovation and risk tolerance, attention to detail, results orientation, individual orientation, team orientation, competitiveness and collaboration, and stability). Culture is transmitted to the employees of the organization in a number of ways that contribute to building a strong organizational culture, including stories, rituals, physical symbols and language (Judge & Robbins, 2017: 565-581).

Organizational Structure: The formal form of task and authority relationships that control how people coordinate their actions and use resources to achieve organizational goals (Jones, 2000:8). The organizational structure defines how the tasks of a function are formally divided, grouped, and coordinated (Robbins & Judge, 2017: 531). KM is highly dependent on the organizational structure, and there are several aspects of the relevant organizational structure: hierarchical structure, specialized structures and roles that specifically support KM, and the communities of practice. A community of practice is defined as a self-organized membership group of individuals who are geographically or organizationally distributed but regularly discuss issues of common interest. Communities of practice provide access to a wider range of individuals, than is possible within the boundaries of traditional management (Fernandez, et al., 2004:42-43).

IT Infrastructure: It includes the development of data processing and storage technology systems, communication technologies and systems, databases and data repositories, as it allows systematic methods of measuring the organization's capabilities in four areas: 1) Reach: which is the ability to effectively communicate and reach the largest number of geographical areas possible and creating links between partners, 2) Depth: which is the level of effectively communicating information and details widely to customers according to their requests and listening to the customer and customizing their needs; 3)Richness: refers to the momentum of communication which allows the information to reach the user in different ways; such as body language, facial expressions, tone of sound and a quick feedback; and 4) Aggregation: due to advanced information technology, it is now possible to access data warehouses and repositories which include a great deal of knowledge that is linked for the purpose of benefiting the organization. This can be summed up by noting that the four aspects of IT infrastructure enable enhancing KM by means of facilitating KM´s four processes: discovery, capture, sharing and application (Fernandez et al., 2004: 44-45).

Common Knowledge: it is the shared knowledge among the members of the organization and represents the accumulated pool of experiences and a common understanding of knowledge, principles and activities that support communication and coordination in the organization. It consists of a common language, areas of individual knowledge, common knowledge scheme, and common standards. Elements of specialized knowledge are common among individuals who share knowledge. Common public knowledge relates to the two important concepts: capacity and knowledge of the common area in which specialists work within the organization, such as sharing financial information with the IT for the purposes of generating an innovative value and advantage for the organization, making it difficult to imitate by external competitors (Fernandez & Sabherwal 2015:48-49).

Physical Environment: The main aspects of the physical environment include the design and separation of buildings, so that meeting rooms, offices and corridors are separate and of different sizes and numbers, and have dedicated spaces to facilitate knowledge sharing and learning among employees such as (cafeteria, coffee rooms, water-coolers and hallways where employees learn from) (Fernandez & Sabherwal, 2015:50).

2.3 KM Mechanisms and Technologies

KM mechanisms are organizational or structural tools used by the organization to enhance KM, such as learning by doing, learning by observation, on-the-job training, and face-to-face meetings, including the appointment of a senior knowledge officer and collaborative projects across organizational departments and policies (Fernandez & Sabherwal (2015:49). Al Omari (2008:26) explained that there are more than 27 mechanisms used by the organizations to support KM processes, including meetings, metaphors, debates, learning through observation, learning through work, brainstorming, memos, lessons learned, standards, organizational policies, apprenticeships, storming, mental memoirs, standards, regulatory policies, modelling, etc.

KM technology is an information technology used to facilitate KM work. It is not fundamentally different from information technology, but it focuses on KM rather than information processing. It supports KM systems and benefits from KM infrastructure, especially infrastructure. IT includes AI technology, case-based thinking systems, electronic discussion groups, databases of best practices and lessons learned, computer-based simulations, decision support systems, enterprise resource planning systems, and expert systems, (Fernandez and Sabherwal, (2015:51-52). Al-Omari (2008:44) explained that there are 24 KM technologies including computer-based communications, internet, group software, neural networks, artificial intelligence systems, data warehouses, etc. Hajric (2108: 113) added aggregate systems, internet, extranet, document management systems, simulation systems, content management systems and semantic networks.

2.4 Innovation Process and Products

Innovation Process: Creation is the first step of innovation, while innovation is meant to transform capabilities into new products, services, and processes, which are of two types in each organization: product or service renewal, and the innovation of the various skills and activities needed to supply them. Innovation may stem from the needs of the market or customers' needs. Innovation may also come from the development of the skills and knowledge learned by individuals in the enterprise. Innovation as a function means providing better economic goods and services with benefit (Ali, et al., 2020: 68). Innovation is meant to improve brainstorming between employees to improve innovation and better explore new ideas in the company (Fernandez et al., 2004: 58).

Products: In the highly competitive market, the company's products are influenced by KM and accumulative knowledge, and this is reflected in its outputs and products in general, in value-added products and knowledge-based products in particular. Value-added products are new products that are improved by KM and best practices. This is evident by the innovation and added value that distinguishes them from older products, (Fernandez & Sabherwal, 2015: 19) such as Ford's new Hybrid cars, which are different from their predecessors in saving fuel costs through the joint use of electric car battery and gasoline fuel, as well as modern electricity cars that charge electricity while eliminating gasoline fuel. Knowledge-based products refer to the products created as a result of the accumulated knowledge of expert programmers and mechanics working at automobile industries. Another example is when some companies use programs and social media to involve customers in solving issues they face, by means of providing them with the tools that help them be part of this process.

3. Research Problem

The study problem is the presence of a knowledge gap between the KM infrastructure, innovation process, products, mechanisms, and technologies in different institutions and companies, and what should be researched and examined in other institutions and companies, such as the MSTGC in Jordan. This conforms to recommendations mentioned in a number of previous studies such as Hajir et al. (2015) and Abualoush Shadi, et al., (2018), and others. Therefore, the purpose of this study is to measure the impact of KM infrastructures on the innovation process and products of The MSTGC through the mediating role of KM mechanisms and technologies.

The proposed study of this paper considers the following hypotheses:

H_{01}: The KM infrastructure has no impact at the level of significance ($\alpha \leq 0.05$) on the innovation process and the products of MSTGC in Jordan.

H_{02}: The KM infrastructure at the level of significance ($\alpha \leq 0.05$) has no impact on the mechanisms and technologies of KM in MSTGC in Jordan.

H_{03}: The mechanisms and technologies of KM at the level of ($\alpha \leq 0.05$) have no impact on the innovation process and products of MSTGC in Jordan.

H_{04}: The KM infrastructure has no impact at the level of ($\alpha \leq 0.05$) on the innovation process and products of MSTGC in Jordan through the mediating role of KM mechanisms and technologies.

The independent variable in this study is the KM infrastructure consisting of (the organizational culture, organizational structure, IT infrastructure, common knowledge, and physical environment). The two dependent variables are the innovation process and the company´s products (value-added products and knowledge-based products). The mediator variable is the KM mechanisms and technologies at the MSTGC. A number of studies were adopted in the preparation of the model, including Fernandez and Sabherwal (2015), Hajir, A. Jinan et al., (2015), Masa'deh, R., et al., (2019) and others. Fig. 1 shows the virtual study model.

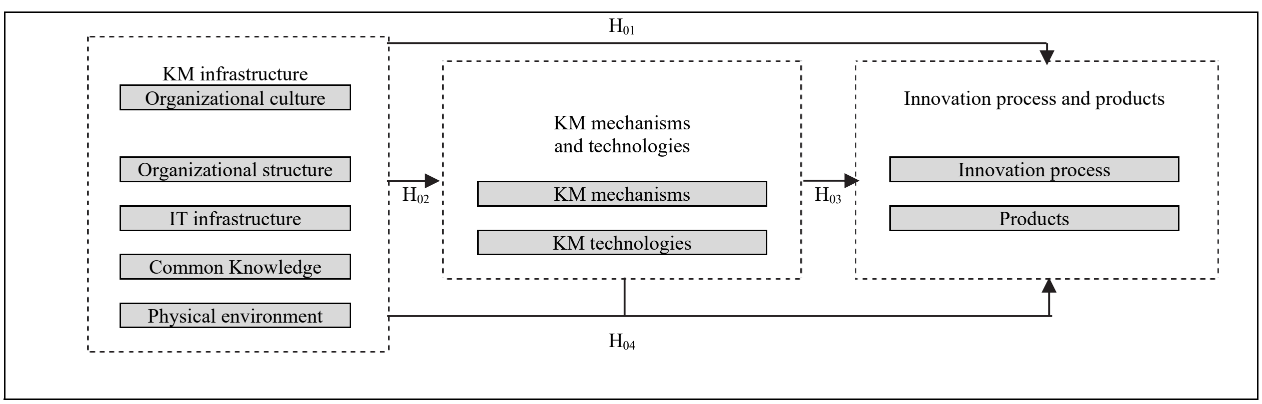

Fig. 1. The Study Model prepared by the researchers

4. Study Methodology

The study used the descriptive-analytical research method as it was found to be the appropriate method to conduct the research. This method facilitates illustrating the study community and its variables, and helps analyse those variables in a robust scientific way.

4.1 Study Population, Sample, and Sampling Unit

Study population: The study population consisted of the Munir Sukhtian Trading Group Company MSTGC in Jordan.
Study Sample: The study sample consisted of senior and middle management in managerial positions (directors, assistants, heads of departments, heads of divisions and team managers) in MSTGC.

Sampling Unit: The sampling unit was drawn from a simple random sample consisting of (103) out of (140) workers in the company, and it was based on the statistical tables for determining the sample size. Two were found to be invalid and the analysis was conducted on (101) questionnaire (72%), which is statistically acceptable as per Sekaran, U. and Bougie, R. (2013).

4.2 Study Tool

A questionnaire was developed by the researchers based on a number of previous studies. The questionnaire consisted of four parts. The first part contains the demographic data of the respondents. The second includes 24 items related to the KM infrastructure which is the groundwork for KM at MSTGC and it includes five key components: organizational culture, organizational structure, IT infrastructure, common knowledge and physical environment, measured by the paragraphs (1-24) in the questionnaire. As for the questionnaire's third part, it includes items related to KM mechanisms and technologies. KM mechanisms are organizational tools used by the company to enhance KM, such as learning by doing, by observing, on-the-job training, face-to-face meetings measured by the paragraphs (25-29) in the questionnaire. KM technology is an information technology that supports KM and includes artificial intelligence technology, case-based thinking systems, electronic discussion groups, databases of the best practices and lessons learned, computer-based simulations, decision support systems, ERP systems, and expert systems measured by the paragraphs (30-35) in the questionnaire. The last part includes items related to the innovation process and products. The innovation process is a process that intends to transform capabilities into new products, services, and processes. This happens in two ways: renewing and upgrading products as well as the various skills and activities needed to supply them in the MSTGC, and this was measured by the paragraphs (36-40) in the questionnaire.
Products: MSTGC's products include value-added products and knowledge-based products measured by the paragraphs (41-50) in the questionnaire.

4.3 Study Tool Reliability

The reliability of the study was measured by using the Cronbach Alpha coefficient as shown in Table 1.

Table 1
Values of coherence coefficient (Cronbach Alpha) for the paragraphs of the study tool

Paragraph Numbers	Cronbach Alpha	Variables	Paragraph Numbers	(Cronbach Alpha)	Variables
5	.786	Innovation process	5	.667	Organizational culture
5	.823	Value-added products	4	.603	Organizational structure
5	.773	Knowledge-based	5	.887	IT infrastructure
5	.735	KM mechanisms	5	.887	Common knowledge
6	.664	KM technologies	5	.818	Physical environment
			24	.846	KM infrastructure
			50	.908	All Paragraphs

Based on the data in Table 1, the result of Cronbach Alpha ranged from (.603-.887). The value of Cronbach alpha for all paragraphs was .908), so the study tool can be described as stable, and the data obtained through it is suitable for measuring variables, and are subject to for a good and appropriate degree of reliability. The value of Cronbach alpha is higher than (60), and therefore it is acceptable, (Sekaran & Bougie, 2013).

4.4 Statistical Processing

The statistical package (SPSS.18 and AMOS) was adopted to analyse the study data, using the following statistical methods:
1. The descriptive statistics measure was used to describe the characteristics of the study sample in percentages, and to answer the study questions and measurement phrases through the arithmetic averages and standard deviations.
2. The multiple regression analysis was used to test the validity of the study models and the impact of the independent variables and their dimensions on the dependent and mediator variable.
3. The simple linear regression analysis was used to measure the effect of the intermediate variable on the dependent variable.
4. The path analysis was conducted using AMOS.

5. Data Analysis, Hypotheses Testing and Statistical Analysis Results

We first present personal characteristics of the participants in our survey.

Gender: The analysis of gender results show that the percentage of males is 67.3% while the percentage of females is 32.7%. The reason behind these percentages may be attributed to the work nature of Munir Sukhtian Trading Group.

Age: Age analysis shows that the fourth and fifth age categories (35-40 years) and (more than 40 years) make up-to 63.4% of the sample. 9.9% of the sample belongs to the age group of between 24 - 29 years, and the remaining 26.7% belongs to the age group of 30 – 40 years. This means that most of the workers at the company are among the youth category.

Experience: The results also indicate that most of the sample members have over 10 years of experience (44.6%) and the lowest percentage (1%) are of those with less than one year of experience. This displays that the company fosters job stability and that it has accumulated employee experience, which plays a role in boosting the company´s products and reputation in their market.

Job Title: The results reveal that 41.6% of the company workers hold the title of ´Director´ or ´Head of Section´. 25.7% of employees have the title ´Deputy Head of Section´, 16.8% are ´Sales Supervisors´, and 15.8% are ´Team Leaders´. This is an indication of the level of hierarchy distributed in the company based on its nature of work.

A five-point Likert Scale was used to build the questionnaire with the following measurements: (Totally Disagree (1), Disagree (2), Neutral (3), Agree (4), Totally Agree (5). In order to have three levels that measure the importance of the study´s variables we used 5-1/3 = 1.33 (1 - 2.33) is low, (2.34 – 3.67) is medium and (3.68 – 5) is high.

Table 2
KM Infrastructure Arithmetic Means and Standard Deviations

	N	Mean	Std. Deviation	Level
Organizational culture	101	2.97	.598	Medium
IT infrastructure	101	3.85	.606	High
Common knowledge	101	3.23	.657	Medium
Physical environment	101	3.44	.461	Medium
Organizational structure	101	3.19	.605	Medium
Valid N (list wise)	101			

Results in Table 2 illustrate the arithmetic means and standard deviations of KM infrastructure. It is shown that the highest level is that of IT infrastructure, where the arithmetic mean is equal to (3.85) and the standard deviation is (0.606). The lowest level was of the organizational culture, where the arithmetic mean is (2.97) and standard deviation is (0.598). The remaining elements have a medium level and were ranked in the following sequence: physical environment, common knowledge and organizational structure.

Table 3
KM Mechanisms and Technologies´ Arithmetic Means and Standard Deviations

	N	**Mean**	**Std. Deviation**	**Level**
KM mechanisms	101	2.79	.722	Medium
KM technologies	101	3.45	.520	Medium
Valid N (list wise)	101			

Table 4
Arithmetic Means and Standard Deviations of Innovation Process and Products

	N	**Mean**	**Std. Deviation**	**Level**
Innovation process	101	3.29	.656	Medium
Value-added products	101	3.88	.591	High
Knowledge-base products	101	3.66	.578	Medium
MSTGC products	101	3.77	.522	High
Valid N (list wise)	101			

Table 3 shows that KM technologies have a higher level over KM mechanisms. KM technologies have an arithmetic mean of (3.45) and standard deviation of (0.520), and KM mechanisms have an arithmetic mean of (2.79) and a standard deviation of (0.722). Both have medium levels. Results in Table 4 display high levels for MSTGC products with arithmetic means of (3.77) and standard deviation of (0.522). This is a result of the value-added products which has a high level of (3.88) whereas the knowledge-based products has a medium level with (3.66). Least in the list with a medium level is the element of innovation process with an arithmetic mean of (3.29) and a standard deviation of (0.656). The normal distribution for the two dependent variables (innovation process and products) was tested using the One-Sample Kolmogorov-Smirnov Test. The results of this test show in table (5) the values of (z) as follows (1.286, 1.359) and they are less than 5. Whereas values of (sig) are as follows (0.51, 0.73), and they are higher than the significance value (0.05). This indicates the normal distribution of the dependent variable data.

Table 5
Normal Distribution Test

One-Sample Kolmogorov-Smirnov Test		innovation	products
N		101	101
Normal Parameters[a,b]	Mean	3.29	3.77
	Std. Deviation	.656	.522
Most Extreme Differences	Absolute	.128	.135
	Positive	.100	.135
	Negative	-.128	-.130
Kolmogorov-Smirnov Z		1.286	1.359
Asymp. Sig. (2-tailed)		.073	.051

a. Test distribution is Normal.
b. Calculated from data.

Table 6
Co-linearity Statistics

	Tolerance	VIF
Organizational culture	0.815	1.226
IT infrastructure	0.839	1.191
Common knowledge	0.694	1.440
Physical environment	0.789	1.267
Organizational structure	0.833	1.199

Data in the Table 6 show that the inflation coefficient (VIF) of the company´s KM infrastructure sub-variables is between (1.191 – 1.440) and they all are below (5). Whereas the values of (Tolerance) is between (0.694 – 0.839) and this is higher than the significance value of (0.05).

5.1 Study Hypotheses: Testing and Discussion

First main hypothesis: There is no statistical significance at the level of (α≤0.05) for KM infrastructure in the innovation process and products at MSTGC.

The hypothesis was tested using the multiple regression method as follows:

Table 7
Results of the Multiple Regression Analysis for KM Infrastructure in the Company´s Innovation Process and Products

	Un-Standardized Coefficients		Standardized Coefficients	T	Sig	
	B	Std. Error	Beta			
(Constant)	.355	.375		.948	.345	R=674a
Organizational culture	.006	.073	.007	.089	.929	RS=0.454
IT infrastructure	.295	.071	.344	4.157	.000	F=15.823
Common knowledge	.164	.072	.208	2.282	.025	Sig=.000a
Physical environment	.291	.096	.258	3.023	.003	Df 5
Organizational structure	.155	.071	.180	2.168	.033	

a. Predictors: (Constant), Organizational culture, IT infrastructure, physical environment, common knowledge, Organizational structure.
b. Dependent Variable: KMINNOPRODUCTS

Table 7 shows the results of the regression summary with the correlation coefficient value: the correlation value reached (67.4%), which reflects the strength of the positive relationship at a moderate degree between the KM infrastructure with its five components (organizational culture, IT infrastructure, common knowledge, physical environment and organizational structure) and the innovation process and products at MSTGC. As for the determination coefficient (value = 454), it explains that 45.4% of the change in the company´s innovation process and products, is connected to the change in the KM infrastructure. The rest of the results are attributed to other variables. The analysis of the multiple regression variance shown in Table 7 indicates the value of F (15.823) and the significance value of sig = .000. This shows the ability to rely on the multiple regression models to explain the changes that occur due to changes in the company´s innovation process and products in terms of KM infrastructure. As a result of the above, we reject the null hypothesis and accept the alternative hypothesis which states that the KM infrastructure has a statistically significant effect at the level of significance (α≤0.05) on the innovation process and products at MSTGC. Furthermore, the multiple regression analysis also indicates the value of (t) for IT infrastructure= (4.157), and that its significance value equals (.000), (t) for the physical environment = (3.023) with significance value at (.003), (t) for common knowledge = (2.282) with significance value at (0.025), and (t) for organizational structure = (2.168) and significance value at (.033). All of the mentioned significance values are less than (0.05), which means that there is a statistically significant effect of the previous KM infrastructure components on the results of the innovation process and products in the company. Whereas, the organizational culture in the group has no statistically significant effect as the significance value is equal to (0.929) and that is higher than (0.05).

Second main hypothesis: KM infrastructure does not have an impact at the significance level of (α≤0.05) of the KM mechanisms and technologies in MSTGC in Jordan.

Table 8
Results of the Multiple Regression Analysis of KM Infrastructure for KM Mechanisms and Technologies

	Un-Standardized Coefficients		Standardized Coefficients	T	Sig	
	B	Std. Error	Beta			
(Constant)	1.469	.399		3.683	.000	R=.478a
Organizational culture	.062	.078	.080	.800	.426	RS=.228
IT infrastructure	-.032	.075	-.042	-.429	.669	F=5.616
Common knowledge	.203	.076	.288	2.658	.009	Sig=.000a
Physical environment	.262	.102	.260	2.560	.012	Df 5
Organizational structure	.011	.076	.014	.144	.886	

a. Predictors: (Constant), Organizational culture, IT infrastructure, physical environment, common knowledge, Organizational structure
b. Dependent Variable: KMMT

Table 8 shows the results of the regression summary with the correlation coefficient value: the value of correlation is 47.8%, and this shows the strength of the positive relationship at a medium level between KM infrastructure components (organizational culture, IT infrastructure, common knowledge, physical environment, organizational structure) and the innovation process and products at the MSTGC. The coefficient of determination, on the other hand, whose value is 0.228, explains that 22.8% of the change in KM mechanisms and technologies at the trading group is attributed to the change in KM infrastructure, while other results are related to other variables. In addition, the analysis in table (8) presents the value of (F) which is equal to (5.616) with significance value sig = .000. This indicates the ability to depend on the multiple regression models to clarify the change occurring due to changes in the group´s innovation process and products in the light of KM infrastructure. The aforementioned information concludes refusing the null hypothesis and accepting the alternative hypothesis which states that there is a statistically significant impact at the level (α≤0.05) by the KM infrastructure on KM mechanisms and technologies in the trading group. The multiple regression analysis further deducts the value of (t) for common knowledge (2.658) with significance value at (.009) and (t) for physical environment (2.560) with significance value (.012). Both of these values are less than (0.05), which indicates that common knowledge and the physical environment have a statistically significant impact on KM mechanisms and technologies in MSTGC. As for the other elements (IT infrastructure, organizational structure, and culture), they do not have a statistically significant impact as their value is higher than (0.05).

Third main hypothesis: KM mechanisms and technologies have not impact at the significance level of (α≤0.05) on the innovation process and products of MSTGC in Jordan.

The hypothesis was tested using the multiple regression method as follows:

Table 9
Results of the Multiple Regression Analysis of KM Mechanisms and Technologies in the Company´s Innovation Process and Products

	Un-Standardized Coefficients		Standardized Coefficients	T	Sig
	B	Std. Error	Beta		
(Constant)	1.950	.316		6.171	.000
KMMT	.506	.100	.453	5.054	.000

R=..453a, RS=.205, F=25.545, Sig=.000a, Df 1
a. Predictors: (Constant), KMMT
b. Dependent Variable: KMINNOPRODUCTS

Table 9 shows the results of the regression summary with the correlation coefficient value: the correlation value reached (45.3%), which reflects the strength of the positive relationship at a moderate degree between the KM mechanisms and technologies and the innovation process and products at MSGTC. As for the determination coefficient (value = 0.205) explains that 20.5% of the change in the company´s innovation process and products is connected to the change in the KM mechanisms and technologies. As for the rest of the results, they are attributed to other variables. Moreover, the analysis of the multiple regression variance shown in Table (9) indicates the value of F (25.545) and the significance value of sig = .000. This shows the ability to rely on the multiple regression models to explain the changes that occur due to changes in the company´s innovation process and products in relation to KM mechanisms and technologies. Consequently, the null hypothesis is rejected and the alternative hypothesis is accepted which states that KM mechanisms and technologies have a statistically significant impact at the level of significance (α≤0.05) on the innovation process and products at the trading group. The multiple regression analysis also indicates the value of (t) for KM mechanisms and technologies = (5.054), and that its significance value equalling (.000), which is less than (0.05). This means that there is a statistically significant effect of KM mechanisms and technologies on the innovation process and products of the trading company.

Fourth main hypothesis: KM infrastructure, through the mediating role of KM mechanisms and technologies, has no impact at the significance level of (α≤0.05) on the innovation process and products of MSTGC in Jordan.

Table 10
Results of Testing the Fourth Hypothesis Based on Path Analysis in AMOS

Overall Impact	Indirect Impact	Impact	Variables	P	RMSEA	CFI	GFI	CMIN/DF	CMIN
0.350	---	0.350	Med ← Ind	0.073	0.078	0.943	0.947	1.615	20.997
0.276	---	0.276	Dep ← Med						
0.734	0.097	0.637	Dep ← Med ← Ind						

0.350*0.276= 0.097+0.637= 0.734
***Significant at (P≤0.05).

As shown in Table 10, the results of the statistical analysis and Fig. 2, that the Chi-squared test (Chi²) has a statistically significant impact by (independent variable: KM infrastructure) on the (dependent variable: innovation process and products) with the mediator variable (KM mechanisms and technologies). The value of the calculated Chi² is equal to 20.997. The CMIN test also shows that CMIN=1.615. This data reveals a level of significance where (P = 0.073) which is higher than (0.05). The results also show that the Goodness of Fit Index (GFI) is equal to 0.947 and it nearly approaches (1). This indicates a good enough quality in the model (Good-Enough Fit), and the Comparative Fit Index (CFI) is equal to 0.943, which is also approaching (1). Furthermore, the Root Mean Square Error of Approximation (RMSEA =0.078) is approaching zero, which supports the good compatibility of the model. This indicates that the (Lack of Model Fit) was low, and this further supports the good compatibility of the model. As for the standard direct impact of the independent variable (KM infrastructure) toward the mediator variable (KM mechanisms and technologies), it has reached (0.350) with a significant level (α≤0.05). Similarly, the standard direct impact of the mediator variable (KM mechanisms and technologies) toward the (innovation process and products) has reached (0.276). The standard direct impact for (KM infrastructure) toward the (innovation process and products) reached (0.637). On the other hand, the standard indirect impact (of the KM infrastructure) on the (innovation process and products) in the presence of (KM mechanisms and technologies) has reached (0.097). Accordingly, the KM infrastructure is able to have a 10% indirect impact on (the innovation process and products) through (KM mechanisms and technologies) (Fig. 2).

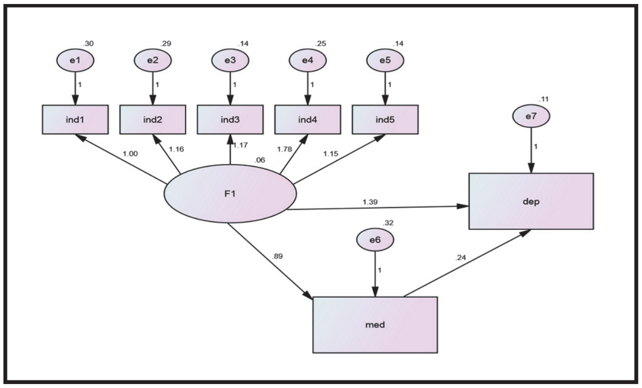

Fig. 2. Results of Testing the Fourth Hypothesis

6. Results Review

The results of this study can be presented as follows:

1. High-level IT infrastructure is installed: The group provides advanced information technology and communication tools with a network connecting all its branches and customers, which helps the company store its knowledge. The other KM infrastructure components can be described as having a medium level. For the ´physical environment´, the trading group has suitable work premises that include meeting rooms to share knowledge, leisure rooms, and offices. In terms of the ´common knowledge´ component, workers at the company share a common specialized knowledge language, common work standards, and a shared level of awareness towards common and accumulated knowledge, on which they base their work. Concerning the ´organizational structure´ component, the company focuses on decentralization and uses a matrix organizational structure. Leading roles are given more weight than administrative ones as the company emphasizes work teams and fosters the adoption of best practices. Similarly, with regards to the ´organizational culture´ at the trading group, the company encourages innovative teamwork. It is worth noticing that the results on the IT infrastructure component agree with those of the Al-Omari study (2008), which examined Jordanian industrial companies

2. KM technologies are of medium level: The trading group uses decision support and artificial intelligence systems, and store its best practices using modern electronic tools. The group also uses web-based discussion groups, provides high-level webpages to display its products and extracts data from its data inventories. In addition, the company has medium level KM mechanisms and emphasizes the use of brainstorming methods among workers. It also provides training, job rotation, vocational rehabilitation as well as a focus on direct-observation learning. This result concerning medium-level KM mechanisms and technologies did not agree with the ones in Al-Omari study (2008) conducted on Jordanian industrial companies.

3. High-level products at MSTGC: This finding was based on two elements: the first is the added value that the company seeks to create when offering new products and improving current ones. The value-added products benefit from the innovation in the group and customer feedback. The company also redesigns its products in a smart way using its knowledge base. The second element relates to knowledge-based products. This is seen in the group´s cooperation with software-specialized companies and how it utilizes its electronically stored data and knowledge to save time and effort while involving customers in solving product-related issues. The group further ensures communication with its customers online to illustrate the usage of its products. Furthermore, there is a medium level innovation process. MSTGC encourages its employees to continuously brainstorm ideas and it establishes best practices, implements innovative ideas, supports research and the development efforts and uses new innovative ideas in work.

4. There is a statistically significant impact at ($\alpha \leq 0.05$) for KM infrastructure components (IT infrastructure, physical environment, common knowledge, organizational structure) on the innovation process and products at the trading group. As for the organizational culture component, the impact was superficial. This outcome conforms to the Hajir, A. Jinan et al. (2015) study, which revealed that IT infrastructure is the most impactful component of innovation.

5. There is a statistically significant impact at ($\alpha \leq 0.05$) for the ´physical environment´ and ´common knowledge´ on KM mechanisms and technologies at the trading group. The impact was, conversely, superficial in relation to the other KM infrastructure components. This outcome conforms to the Hajir, A. Jinan et al. (2015) study, which revealed that IT infrastructure is the most impactful component for innovation in Jordan. It also conforms to the Naqshbandi, M. & Jasimuddin, S (2018) study in terms of IT. However, it disagrees with this study in France in terms of the organizational culture. This means that more effort is needed to enhance the role of organizational culture that supports the innovation process.

6. There is a statistically significant impact at (α≤0.05) for KM mechanisms and technologies on the innovation process and products in MSTGC. The results are consistent with findings of Naqshbandi and Jasimuddin (2018) in France which states that KM´s cultural, structural and technological abilities in organizations play a role between knowledge-oriented leadership and open innovation.

7. There is a statistically significant impact at (α≤0.05) for KM infrastructure on the innovation process and products through KM mechanisms and technologies. This outcome does not agree to the Abualoush Shadi et al., (2018), which shows the weakness of KM infrastructure components in the organizational performance in food industry companies in Jordan.

7. Recommendations

Based on the outcomes reached by this study, a number of recommendations are suggested. Firstly, there is a need to strengthen the medium levels of KM infrastructure in the company (i.e., the physical environment, common knowledge, organizational structure and organizational culture) while maintaining high levels of IT infrastructure. It is also recommended that the company enhance the intermediate levels of KM mechanisms and technologies it uses. Secondly, MSTGC is advised to maintain the high level of the value-added and knowledge-based products at the company. This will ensure that the company continues to compete in the market and it will enhance the reputation of the company's products among customers. Another recommendation is to promote the medium level innovation in the company by focusing on research, development, brainstorming and encouraging creative ideas among workers that eventually reflect on the company's products. It is also recommended that the company enhance the components of IT infrastructure and the physical environment because of their clear impact on the innovation process and products in the company. Thirdly, there is a need to enhance the shared common knowledge and the physical environment as they both have a clear impact on KM mechanisms and technologies at the company. Lastly, the company is advised to strengthen KM mechanisms and technologies for their clear impact on the innovation process and the products of Munir Sukhtian Trading Group Company.

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