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Impact of Information Technology Infrastructure on Innovation Performance: An Empirical Study on private Universities In Iraq

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Abstract

This study investigated the impact of information technology (IT) Infrastructure on Innovation performance as a critical issue in the Iraqi private Universities. The proposed design approach asked participants to respond to a self-reported questionnaire, five information technologies as the independent variable, and subjective measures of Innovation performance as the dependent variable. Factor analysis was performed to identify the banks' IT Infrastructure with Innovation performance to tested. The study population consisted of six private Universities in Iraq. From these, 75 academics of the faculty were chosen. The hypothesis to test variables of the study was absorbed in a questionnaire with Cronbach's alpha coefficient of 75% and was prepared based on a number of measures related to the subject of study. Ranges of methods were used to analysis statistical data, and the results were extracted using SPSS. The regression analysis results indicated a positive and statistically significant association between IT Infrastructure and innovation performance. Based on this, we recommend the academics in the universities to use IT as a strategic tool to enhance innovation performance and expand their empirical knowledge in the context of private universities in Iraq.

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Keywords: Information Technology Infrastructure, Innovation Performance.

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1. Introduction

Information technology (IT) is one of the basic components of innovation performance. Given that technology is one of the strategic factors that can help improve business productivity and performance (Yang et al., 2007), IT can be useful in augmenting the performance of a firm and its human resources. According to O'Brien and Marakas (2008), IT is the development and management of hardware, software, networking, database, and other technologies. Karadag and Dumanogl (2009) Many studies have been conducted to validate the impact of IT on productivity and performance quality. Bharadwaj et al. (1999) information technology refers to a firm's ability to mobilize and deploy IT-based resources and capabilities within a firm. Innovation performance refers is the result of the following business factors: work processes, team, communication, interaction, corporate culture, policies, leadership, climate for innovation and creativity, loyalty, economic and business environment (Lia, et al., 2006). However, (Verma and Seth, 2011) Competitive priorities, including increased customer expectations, intense competition in a world-wide scale, time and quality requirements as well as mass customization, have forced organizations to dramatically change over the years.

This study highlight on identifying important variables and ways to develop and activate the role of the private higher education in Iraq. The private higher education in Iraq emerged in the 1980, in order to merge with the public education and further contribute to the human development process. The importance of investing in higher education, especially, for developing countries, which did not experience the phases of the progressive historical development of the productive as experienced by the industrially advanced countries. Thus, Innovation Performance and IT have become prominent as the fact industry of in developed countries (Taka, 2010). Throughout the last decade, human resource development strategies evolved by a many theoretical features within the development plans' general framework by developing academics, administrative and technical employees which are lead to wider participation in knowledge generation (Ministry of Higher Education and Scientific Research, 2004).

2. Literature Review

2.1 IT infrastructure

Pavic et al. (2007) the importance of IT stems from its role as one of the main tools employed in the service activities of business organizations. Allameh et al. (2011) believed that getting high efficiency and effectiveness in organizations requires investment on IT components, such as the Internet, office automation, and management information system. An IT infrastructure serves as the basis for computer technology, communications and basic data system, within the technical framework that guides organizational work to meet management needs (Melville, 2010). Mitchell et al. (2012) indicated that an IT infrastructure is the foundation upon which a firm can deliver reliable services through an organized and coordinated central information system.

Turban et al. (2008) adopted a method of classifying the support given by IT in enabling the organization to achieve competitive advantage, which include hardware, software, networking and communications, human resources, and databases. O'Brien and Marakas (2008) defined physical components as all the hardware and physical components used in information processing, especially machinery such as Computers, Data Media, and other tangible things that to record the data (p.74). According to Loudon and Loudon (2001), computer software may contain details for the programmed instructions, which control and coordinate the contents of a computer information system. Santhanam and Hartono (2003) mentioned that communications and networking technology link computers and enable them to electronically communicate around the world. A database also refers to an organized collection of facts and information about customers, employees, inventories, competitors, and sales (Sujansky, 2001).

2.2 Innovation Performance

There have been many variations in defining the concept of "Innovation Performance" due using different standards. Often, such variations are due to the multiplicity and diversity of goals and trends being set and examined by researchers, respectively. Despite these differences, some researchers (Archibugi & Pianta, 1996; Damanpour, 1991) innovation performance is the contribution or benefit afforded by product and process innovations to a firm's

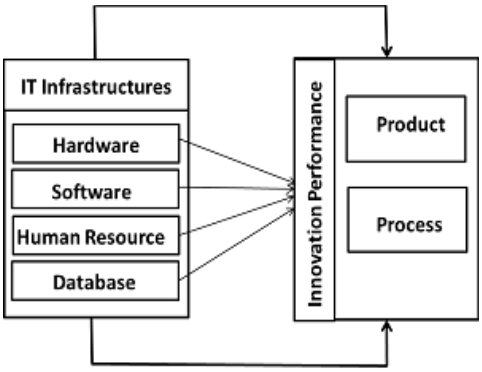
economic performance and as a broader way by viewing it as a new product or service, a new production process technology, a new novelty plan or program pertaining to organizational members. The innovation performance is an opportunity for entrepreneurial firms to gain intellectual capital which is considers continuous innovation activity as the key source of long-term entrepreneurial success (Schumpeter, 1934). Based on, Dan and Yi-Qin (2011) innovation performance is the resource for preserving valuable heritage, learning new techniques, solving problems, creating core competences, and initiating new situations. That the process of innovation consists of an ongoing pursuit of harnessing new and unique knowledge (Subramaniam & Youndt, 2005).

According to Hung, Lien, Fang and McLean (2010), the humanist approach to Knowledge management and innovation performance are importantly and positively related. However, most of the established literature and the corresponding research have focused on the first two areas of innovation, namely: product and process innovations (Inauen & Schenker-Wicki, 2011). Product innovations represent the invention and commercialization of entirely new products or services, whereas process innovations describe changing the production process of products and services through the adoption of new technology and innovations (Inauen & Schenker-Wicki, 2011).

3. Proposed Research Model

Based on the previous literature on IT infrastructure as an independent variable represented via (Hardware, Software, Networking and Communications, Human resources and Databases) will adopt on the ideas of each (O'Brien and ,2008; Turban,et.al,2008). While While the innovation performance, as dependent variable via (Product Innovation and Process Innovation) adopted from (Hung et al., 2011).

The research model is presented as follows:



Fig(1) Proposed Research Model

4. Research methodology

This study is a descriptive-statistical study with a practical goal. The study population consisted of the academics working for the six selected Iraqi universities. Simple non-random sampling was used, in which 75 individuals were chosen for the sample group. A Likert-type questionnaire was used to collect data, with choices ranging from completely disagree (1) to completely agree (5). Experts validated the validity of the study, and the reliability of the questions was approximately calculated as 0.893. Single variable t-test, Friedman, mean, simple regression coefficient, simple linear correlation coefficient, and coefficient variation tests were used for data analysis. SPSS was used to analyse the data.

5. Data Analysis

Results indicated that 44% of the respondents were in the age group of 41 to 50 years, were the education 52% of the sample B.A. degrees, that 76% of the respondents were in the Job title group head of department and 40% accumulated at least 21 to 30 years of personal work experience at a university.

Table 1, Demographic characteristics of the respondents

Variable	N	%	Variable	N	%	Variable	N	%	Variable	N	%
AGE (years)			Years of Service			JOB TITLE			Education Level		
20–30	3	4	5–10	6	8	Executive Director	6	8	Doctorate	12	16
31–40	21	28	11–20	24	32	Director Commissioner	6	8	Master	18	24
41–50	33	44	21–30	30	40	Head of Department	57	76	Bachelor	39	52
51 and above	18	24	31 and above	15	20	Adviser	6	8	Diploma	6	8
Total	75	100		75	100		75	100		75	100

5.1 Description and analysis of the dimensions of IT infrastructure as an independent variable

Table 2 shows the dimensions of IT infrastructure in the surveyed banks. Based on the perceptions of respondents, dimensions of IT infrastructure received a percentage of 76%, in which its Median (3.82) was higher than the Mean of the scale of (3).Variables of IT infrastructure were measured through the following basic dimensions: software, databases, communication and network, hardware, and human resources. Questions were allocated according to the measure (O'Brien and Marakas, 2008; Turban, et.al. 2008).

Table2, Descriptive answers on the dimensions of the study sample (IV.) of information technology infrastructure

Dimensions of information technology	Median	Ratio	Standard Deviation	Coefficient of variation	Sort by important
Hardware	3.80	.76	.353	9.289	First
Software	3.70	.74	.344	9.297	Second
Database	3.92	.78	.365	9.311	Forth
Human resource	3.88	.77	.361	9.304	third
Communication and Network	3.78	75	.352	9.312	Fifth
Total of ITI dimensions	3.82	.76	.353	9.240	

The dimensions were measured of IT infrastructure were Median with software [(3.70)] higher than the Mean to [(0.70)], In spite of this, observed irregularity some software which adds a burden to the academics in order to accomplish the tasks assigned of them. As well as what has caused the imbalance in the flow of the other dimensions. Hardware [(3.80)] higher than the Mean to [(0.80)], this indicates that there is an interest between the surveyed universities in the availability of hardware and equipment to complete the work, where the percentage (76%). Databases [(3.92)] are higher than the Mean [(0.92)]. This means, there is great interest in the importance of databases where the percentage (78%). Human resource [(3.88)] higher than the Mean [(0.88)], this indicates that there is an interest between the surveyed universities in the availability of human resource to complete the work, where the Percentage (77%). Communication was [(3.78)] higher than the Mean [(0.78)]. The standard deviation for the software, hardware, database, communication and human resource were indicates [(0.344), (0.353), (0.365), (0.361), (0.352)] that means the dispersion of a low answers in the study sample, in this area.

5.2. Description and analysis of the dimensions of innovation performance as a dependent variable

Innovation performance was measured through the following dimensions: Product and Process. These activities were measured using 11 questions that were distributed depending on measure (Hung et al., 2011). Table 3 shows the summary of respondents' awareness on the importance and role of each dimension to achieve innovation performance. Data showed that innovation performance received intermediate attention (66%) from the respondents, with a median of 3.34 that was higher than the mean of the scale of (3). This finding indicate the weak innovation performance of the surveyed universities, which were due to the lack of special training programs that guide academics on how to develop and improve performance by maximizing the benefits of IT Infrastructure.

Table 3, Description and analysis of the dimensions of innovation performance (IP) as a dependent variable

Dimensions of IP	median	Ratio	SD.	Coefficient of variation
Process	3.37	.67	.313	9.287
Process	3.61	.71	.335	9.278
Total of IP dimensions	3.49	.69	.324	9.282

Process: this dimension were measured through six questions which its Median (3.61), it was higher than the Mean (0.61).This indicates that there is a desire and a moderate tendency among individuals in the surveyed universities to promoting innovation performance, where the percentage (71%). Product, this dimension were measured through five questions which its Median (3.37), it was higher than the Mean (0.37).This indicates that there is a desire and a moderate tendency among individuals in the surveyed universities to promoting innovation performance. The standard deviation was (0.313). Refers that the dispersion of a low answers in the study sample, in this area.

6. Hypothesis Test

6.1. Analysis of the correlation between dimensions of IT infrastructure and dimensions of innovation performance:

Table 4 shows the correlation between IT infrastructure dimensions and organizational performance dimensions. As can be seen, there was a significant relationship between dimensions of information technology and with dimensions of organizational performance. The value of (t) at 2.537 was the largest of all tabulated values under the 0.5 level of significance. Meanwhile, the value of correlation (0.826) indicated a strong positive correlation among the dimensions, thus proving the validity and providing support for the first main hypothesis, which states that that there is significant correlation between dimensions of IT infrastructure and innovation performance. In all, this finding indicates that IT infrastructure, which includes five basic dimensions, increases the effectiveness and efficiency of innovation performance.

Table 4, Correlation between the total IT infrastructure and innovation performance dimensions

Independent variable	Dependent variable	Correlation of coefficient	t-test	Significance of hypothesis
Hardware X_1		.876	3.oo8	accepted
Software X_2	Dimensions of	.908	3.758	accepted
Database X_3	innovation	.769	2.086	accepted
Human resource X_4	performance	.659	1.517	rejected
Communication X_5		.854	2.846	accepted
Total of IT I dimensions X	Y	.826	2.537	accepted

The value of (t) crosstab below the level of significance (0.05), where the degree of freedom (73) = (1.671)

6.2. Sub-hypotheses based on the first main hypothesis

Results show that dimensions of innovation performance were strongly and significantly correlated with hardware [(t) =3.008)], software [(t) =3.758)], database [(t) = (2.086)], and communication [(t) =2.846)]. The calculated value of (t) for the four dimensions (1.671) showed greater tabular values under the 0.05 level of significance and degree of freedom with a value of 73. The correlation values of the four variables were 0.908, 0.876, 0.769 and 0.854 respectively. These prove the positive correlation and validate the sub-hypotheses (1, 2, 3 and 5), thereby indicating the strong relationship between performance and use of hardware and technological equipment, which can improve innovation performance. The significant relationship also indicates that the surveyed universities use varied software and systems in their daily operations. Results also show that there is no significant correlation between databases and innovation performance dimensions, in which (t) =0.659. The value of (t)=1.517 is the smallest tabulated value under the 0.05 level of significance and degree of freedom value of 73, which amounts to 1.671. That means reject the fourth hypothesis.

6.3. Analysis of the effect of IT infrastructure dimensions on innovation performance

Results of regression analysis showed the significant influence of overall IT infrastructure on innovation performance dimensions. The value of (F) has calculated as 6.44, which was the biggest of its tabulated value under the 0.05 level of significance amounting to 3.96. The value of beta (β) =0.374 also confirmed that the change in a unit one in IT infrastructure is accompanied by a change of 0.374 in innovation performance dimensions. This finding indicates that employing an IT infrastructure is important in enhancing innovation performance. The coefficient of determination (R2) amounted to a high percentage value of 0.68, which represents the total variance in quotient of innovation performance dimensions. Perception of academics involved in the study determined the importance of IT infrastructure how it affects their innovation performance. The value of the constant term of regression curve (α) was also obtained. This means that if the value of independent variable is equal to zero, there is a good relationship between IT infrastructure and innovation performance. This finding has obtained even though the academics of the surveyed universities ignored the importance of an IT infrastructure. The result proves the validity of the second main hypothesis, which states that IT infrastructure dimensions have a significant moral effect on the dimensions of innovation performance.

Table 5, Analysis of the effects of IT infrastructure dimensions on the innovation performance dimensions

independent variable IV	dependent variable DV	R2	regression curve α	β	F	Quality of significance
Software X_1	Dimensions of organizational performance Y	.825	6.741	.550	14.12	Moral
Hardware X_2		.750	7.555	.496	9.05	Moral
Database X_3		.592	9.334	.377	4.35	Moral
Human resource X_4		.434	10.08	.327	2.31	Non-Moral
Communication X_5		.730	7.189	.520	8.11	Moral
Total of ITFI dimensions X	Y	.68	7.996	.374	6.44	Moral

The computed value of (F) was equivalent to 3.96, with 0.05 level of significance and degree of freedom of 73.

6.4. Sub-hypothesises based on the second main hypothesis

Hardware [(F) = 9.05)], software [(F) =14.12)], databases [(F) = 4.35], and communications networks [(F) =8.11] all had a significant moral influence on the dimensions of innovation performance (Table 5). All values were the largest of the respective tabulated values with a 0.05 level of significance and degree of freedom of 73, which amounts to 3.96. Beta (β) amounted to 0.496, which indicated that the change in one unit in hardware was accompanied by change of 0.496 in the dimensions of innovation performance. The value of coefficient of determination (R2) amounted to 0.750.

From observation of beta (β), which amounted to (0.550), the change in one unit in software was accompanied with a change of 0.550 in the dimensions of innovation performance. This demonstrates that the use of software increases the effectiveness of innovation performance. The determination coefficient (R2) amounted to 0.825, which is a high percentage. This finding indicates that 0.751 of the total variance quotient in the dimensions of innovation performance. The beta coefficient (β), which amounted to (0.377), indicated that the change in one unit in database was accompanied by a change of 0.377 in the dimensions of innovation performance. This demonstrates that the use of database increases the effectiveness of innovation performance. Coefficient of determination (R2) amounted to (0.592). This high percentage indicates that the amount of 0.592 of the total variance quotient in the dimensions of innovation performance. Observation of (β), which amounted to (0.520), indicated that the change in one unit in communication was accompanied by change of 0.520 in the dimensions of innovation performance. This demonstrates that communication increases the effectiveness of innovation performance. Coefficient of determination (R2) amounted to 0.730, which is a high percentage. This indicates that the amount of 0.730 of the total variance quotient in the dimensions of innovation performance.

The value of the constant term to curve regression (α) refers to the value of the independent variable if the latter is equal to zero. This means that there is a good relationship between hardware, software, human resource and communication with the dimensions of innovation performance. It also denotes that there is a great interest (7.555) in the dimensions of innovation performance in the surveyed universities. This result confirms the hypothesis and proves the validity of the first sub-hypothesis based on the second main hypothesis (i.e., the use of hardware and equipment has a significant moral influence on the innovation dimensions of innovation performance). It also

suggests that there is a great interest (6.741) in the dimensions of innovation performance in the surveyed universities. This result proves the validity of the second sub-hypothesis based on the second main hypothesis (i.e., the use of software and equipment has a significant moral influence on the dimensions of innovation performance).

It also indicates that there is a great interest (9.334) in the dimensions of innovation performance in the surveyed universities. This result confirms the validity of the third sub-hypothesis (i.e., the use of human resource and equipment has a significant moral influence of on the dimensions of innovation performance).Also, the result proves the validity of the fifth sub-hypothesis based on the second main hypothesis (i.e., communication has a significant moral influence on the dimensions of innovation performance).

Results of the analysis (Table 5) show that there is no significant moral effect between database and innovation performance dimensions, in which (F)=2.303. This value is the smallest of tabulated value at 0.05 level of significance and degree of freedom of 73, which amounts to 3.96. Hence, an estimated value of beta (β) (0.327), which is a weak amount, does not explain the significant moral effect of databases on the dimensions of innovation performance. The determination coefficient (R2) amounting to 0.434 is a low percentage that does not support the assumption that total variance of quotient in the dimensions of innovation performance is determined by databases. Therefore, this result does not prove the validity of the fourth sub-hypothesis based on the second main hypothesis (i.e., databases has a significant moral influence on the dimensions of innovation performance).

7. Conclusions

Nowadays, IT is widely used in organizations to improve their performance and augment customer satisfaction. The purpose of this study is to examine the impact of IT infrastructure on the effectiveness of innovation performance in a number of private universities Iraq, using academics in these universities as the sample. Results indicated that the use of IT was relevant in improving innovation performance. Much previous research that has been conducted reported the same finding. Chen and Tsou (2012) found that there the interaction between the capabilities of information technology and human resources can influence the ability of IT to effectively improve innovation performance. Omare (2015) reported that more research and investigation on banks in Iraq should be done, especially with regards the use of IT components. The findings of the current study also prove that IT helped improve the effectiveness of innovation performance of various universities. The academics of surveyed universities also realized the importance of IT infrastructure dimensions. Finally, the increased use of IT with all its components can increase the quality of the universities' innovation performance.

Appendix A. Demographic

Please answer the following questions by either filling in the spaces provided or ticking the

Age (Years)	□ 20–30 years old	□31–40 years old	□ 41–50 years old	□ 51 and above
Marital Status	□ Marred	□ Single	□ Divorces	□ Widowed
Years of Service	□ 5–10 years	□ 11-20 years	□ 21-30 years	□ 31 years and above
Job title	□Executive Director	□ Director Commission	□ Adviser	□ Head of Department

Appendix B: IT infrastructures Instrument: Component Question

Code	components	Question
ITF1	Hardware	Our bank used of the hardware and modern equipment at work
ITF2		Our bank used of the hardware and equipment sophisticated lets opportunities to adopt new patterns at work.
ITF3		Our bank used of the hardware and equipment sophisticated and stimulate employees to be used.
ITF4	Software	Software application of ready to serve the objectives of the bank and the beneficiary.
ITF5		Software application of ready to ensures reducing time complete the work and the exchange of information.
ITF6		Software application of ready to serve the possibility of adjustments and helps to keep pace with technological developments
ITF7	Communicati	Bank depends on the networks for the flow of information between departments and branches.
ITF8	on & Network	Bank depends of communications systems and networks to handle large numbers of invoices and receipts and resolving of customer problems.

ITF9		Bank depends of modern means of communication to facilitate the exchange of information such as the Internet, intranet, extranet, e-mail, and fax.
ITF10	Human	Our employees have high skills and knowledge in the field of information technology
ITF11	Resource	Our employees have the skills outweigh the skills of our competitors from other banks
ITF12		Our employees have the access to training for the effective to use and application of information technology.
ITF13	Database	Databases of bank are flexible, that helps in constantly updated in accordance to the requirements of the global technology.
ITF14		Databases of bank to help the collect, analyse, store and retrieve data and information easily as needed.
ITF15		Databases of bank are characterized, being a safe to ensure the flow of accurate information between departments and decision-makers

Appendix c: Innovation performance: Component Question

Code	Components	Question
IP16	Product	The speed of R&D of our company is faster than our competitors.
IP17	Innovatin	The speed of production improvement is faster than our competitors.
IP18		R&D has improved production innovation skills
IP19		Compared to our competitors, production in our company is more customized to the customers.
IP20		The speed of innovating a new logistic way is faster than the competitive.
IP21		Compared to our competitors, the production in our company offers more innovative products to the customers
IP22		The latest human resource practices are adopted in this organization.
IP23		The job design innovation is more diverse than our competitors.
IP24	Process innovation	The company has continuously used innovative technology to improve the quality and speed of production and services to our customers.
IP25		The organizational structure innovation is more flexible than the competitors.
IP26		During the last three years, our patent registration has increased significantly.

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