Identification and Analysis of Hindering Factors of ICT Adoption in Project Management in Iraq

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Abstract

Information and communication technology is very important in projects management. The objective of this research is to identify and analysis the factors hindering the adoption of Information and Communication Technology (ICT) in projects management. In this research, 23 effective factors were collected from interview with engineers and experts in project managers and designers in consultant bureaus and construction companies. These factors are grouped into seven categories "Financial Factors, Human Factors, Technical Factors, Legal Factors, Administrative Factors, Cultural Factors, Security Factors ". A survey questionnaire of 75 respondents was distribute among different companies and consultant bureaus. A statistical analysis was done using SPSS and Excel packages. The relative important index was used to find out the most significant factors that hindering the adoption of ICT in projects management. The results accomplished from survey revealed that major factors hindering ICT adoption in projects management (ranked from the worst factors with Relative Important Index values, respectively) namely, Lack of training on ICT content of construction process (86.4%), Satisfaction with traditional working methods and tools (84.8%), Problem of ICT integration/compatibility with the work (82.9%), Poor interoperability between different applications/organizations (81.3%), poor quality and/or quantity of telecommunication infrastructure (81%).

Keywords- Information and communication technology, Hindering factors, Projects Management, Important index.

1. Introduction

Project management is the continuity and integration of a large amount of information and controls the reception and distribution of this information is the main thing to avoid the construction problems of any delay in the completion of activities and reduce claims. computer and software used are plays a key role in controlling the transfer and documentation of information through use to control the various events in projects.

Effective control over the movement of information in construction projects is a critical activities that extends throughout the lifetime of the project. This information includes the works to be performed, information required to support decision making, analysis of progress work, communicate in the passing of information to project participants and registration and install the sources of the claims and supporting estimation processes in similar projects through ongoing documentation processes[1]. Today, ICT is responsible for the entire construction process from information that is generated, converted, interpreted, maintained, reused and eventually recycled to establish construction projects. The daily life of individuals is increasingly relevant to the information and communications technology, where it become widely used among individuals and organizations.

Information technology creates new opportunities for the construction industry by providing information in all its sources. As a result, benefiting from this field creates new opportunities for construction institutions that are doing design and implement works. Information technology cannot be seen as an aid to traditional construction steps, but as an innovative element that gives the ability to find new options for designing and operating construction projects, as well as the expansion of development and competition area between construction firms [2].

2. Research Objective

The study aim to:

1. To identify the factors affect the use and adoption of ICT in construction projects in Iraq.
2. To evaluate and class the most important factors that affect the use of adoption of ICT in construction projects in Iraq.

3. Information and Communication Technology

Information technology can be described as devices, electronic means, and software used to transmit and disseminate information. While information systems refer to the interdependence of the performance of persons involved in the processes of transferring, documenting the information and disseminating it's within specific functional structures, in which the information technology is a part of it[3]. ICT in construction can be divided into different sectors for better understanding and its role in construction. The word ICT can be understood from different perspectives to reach a new point of view of information technology and communications. Adriaanse and Voordijk [4] gives an explanation from the functional perspective "scientific" "ICT is a neutral provider of inputs to make decisions". ICT can be adopted by specific groups of users within the organization. For example, the use of computer-aided design (CAD) by architects or software used by estimated engineers or project managers. Amit and Krosi [5] considered the communications between participants in the construction industry and buildings and organizations are concerned to information exchange, dealing with graphics, specifications and cost data, as well as other design programs and information management.

4. The relationship between engineering project management and ICT

In order to achieve the objectives pursued by the consulting organizations or the executive companies in the projects, the activities, and tasks necessary for the completion of the work should be confined to an integrated format and then consolidated in a balanced and coordinated manner to prevent duplication in works during implementation. It is obvious that no administrator can be president of an unlimited number of individuals, especially at senior management levels[6]. A study conducted on more than 1000 American companies has proved that to maintain the extent of control of the manager to his staff efficiently, the number of employees in the general situation of no more than 10 people taking into account the wide uses of computers and technical information and communications, and the advantages of using technology Information and Communications[7] Stay away from ambiguity and complexity of the parameters of responsibility and authority. Speed in making administrative decisions and transferring information between levels. Easy to accomplish the required tasks and increase follow-up and control of the implementation of the work.The success of managers in making the right decisions due to the presence of experts. Through Information and communication technology (ICT) can be addressed problems quickly in the emergency states.

5. Factors affecting of ICT use and adoption in construction

Factors affecting ICT use and adoption in the construction industry were the topic of investigation by many researchers. In order to increase the use and adoption, a survey of the factors affecting it, whether positively or negatively, is needful.

The set of previous studies concerning factors affecting on ICT use in the construction industry, in the countries surrounding Iraq and some countries, the Arab world will be and reviewed the factors that affect ICT use in the construction industry are shown the Table (1).

Table 1: Factors hindering the use of ICT in construction in the Countries Surrounding Iraq and the Arab world

No	Author's	Year	Country
1	**Al-Shammary and Ali [8]**	**2017**	**Jordan**
	1. Limitations of ICT application in construction projects. 2. Specific contract's conditions to use ICT in projects and government policy. 3. Strategic planning to inject ICT in project management. 4. Experience years of the project managers and work team. 5. Training to use ICT and its tools. 6. The effect of community culture of using ICT as engineering practices. 7.Cost of ICT and its components		
2	**Kivrak et al[9]**	**2010**	**Turkey**
	1. Cost of technology 2. Lack of IT strategy. 3. Organizational culture. 4. Inadequate advice 5. Lack of trust.		
3	**Owolabi And Olufemi [10]**	**2018**	**Nigeria**
	1.High cost of implementation. 2. Uncertain return of investment. 3. Technical know-how. 4. Fear of virus attack. 5. Lack of job security.		
4	**Akinbile and Oni [11]**	**2016**	**Nigeria**
	1.High cost of employing computer professionals. 2. Inadequate power supply. 3. Inadequate training on ICT content of construction process. 4. High cost of hardware and software. 5. Lack of sufficient jobs. 6. Low return on investment. 7. Fear of virus attacks. 8. Privacy/security fear. 9. Fear of professional redundancy. 10. Fear of mass job loses in the industry.		
5	**Naik and Bobade[12]**	**2018**	**China**
	1.Inadequate knowledge about return on ICT investment. 2. Lack of staff with appropriate skill and knowledge in ICT. 3. Highly dispersed nature of the industry/projects &participants. 4. Fear of job losses /making professionals redundant.		

	5. Satisfaction with existing method of working.
	6. Rapid changes in ICT technologies.
	7. Software and hardware reliability problems.
	8. High rate of obsolescence ICT products in the market.
	9. Lack of legal support for use of ICT.
	10. Access to relatively cheap work force.
	11. Majority of client not interested in firms ICT base.
	12. Problem of ICT integration/compatibility in the organization.
	13. Resistance/Mistrustin ICT technology .
	14. Inadequate ICT content of construction education.
	15. Cost of implementing ICT.
	16. High cost of employing ICT professionals.
	17. limited benefits/Low return on investment in ICT.
	18. Lack of training and technical support for professionals in ICT.
	19. Lack of commitment by firms management towards ICT.
	20. Budget Constraints for ICT investment.
	21. Security implications of ICT transactions

6. Research Methodology

This research is based on personal interview aimed at collected all necessary information in an effective manner. This study offers (23) influencing factors that hindering ICT adoption in projects management, which have been collected from previous relevant research. These factors were classified into 23 factors surveyed in seven main groups, namely: 1. financial group, 2. Technical group, 3. Human group, 4. Administrative group, 5. Legal group, 6. Cultural Factors, 7. Security Factors.

7. Design the questionnaire The questionnaire consist of 4 sections as shown **table** (**2**):

No	sections	description
1	the first section	includes general information about respondents
2	The second Section	explain the status of ICT infrastructure in construction organizations
3	The third section	includes the level of ICT use
4	The four section	which is the focus of the study contain seven tables, which represent the seven groups of factors hindering the ICT adoption and the scale dish Likert quintet is used in the design of the questionnaire [13]. So the scale extends from (2 very weak) to (5 very strong). To confirm the consolidated, the results of the questionnaire, a second assessment has been conducted after reviewing and auditing to ensure its effectiveness and suitability for the construction projects management in Iraq. The original questionnaire consists of 23 factors affecting ICT adoption in construction projects in Iraq. Before distributing the questionnaire, a pilot test (pilot study) has been conducted to ensure that the questionnaire was designed gradually and appropriately simpler

8. Sample Size

The appropriate study sample size (N) is depending on the required level of confidence and the type of distribution according to "Standard recommended the practice for the choice of a sample size to estimate the average quality of a lot of processes" of (ASTM E122, 1979) [14], as shown in table (3).

Table (3): Sample size for required confidence level of (ASTM E122, 1979)

Required Confidence Level	Confidence Factors	Sample Size (N)	
		Normal Distribution	Triangular Distribution
95%	1.96	11	16
99%	2.58	19	28
99.7%	3.00	25	38

According to this table, the required sample size (N) for (95%) confidence level equal to (11) in the normal distribution, that's mean any sample size equal or more than (11) will achieve this requirement.

The researcher distributed a (126) questionnaire form in different construction companies and consultant bureaus, but only (75) forms had been received. So the number of received questionnaire forms is greater than (11) and that will achieve a confidence level equal to (95%).

9. Measuring the Consistency of the Questionnaire

Stability is defined as the stability of the scale and lack of contradiction with itself, meaning that the measure would re-applied to the same sample after a period of time will give the same results, lies the value of consistency between the two values (zero) and (one), where the closer the value of one indicates that the high stability of the questionnaire and vice versa. In order to measure the stability of the questionnaire stability coefficient is used (Cronbach's alpha) for equestion (1) [15] to ensure the stability of the search tool, and using equation (2) to a validity value (α) [15].

$$\alpha = \frac{n}{n-1}\left(1 - \frac{\sum_i V_i}{V_t}\right) \qquad \text{.....(1)}$$

Where:

n: is the number of items.
Vi: is the variance of associated with item (i).
Vt : is the variance of associated with the sum of all (n) item score.

$$r = \sqrt[2]{\alpha} \qquad \text{.....(2)}$$

Table (4) illustrates the values of trust and credibility, according to Cranach's alpha for each worker in the questionnaire. Chronbach's shows that the alpha values are in the range of (0.758 to 0.984). This is a high-scale (Excellent), ensures the reliability and validity of each group in the questionnaire.

Table (4): Reliability and validity coefficient

Factors Group	No. of Factors	Reliability	Validity
Financial factors	7	0.9	0.948
Human factors	2	0.758	0.87
Technical factors	5	0.966	0.982
Legal factors	2	0.896	0.946
Organizational / administrative factors	2	0.925	0.961
Cultural factors	3	0.984	0.991
Security factors	2	0.963	0.981

***(Cranach's Alpha)**

10. Methods of study

1. Relative Importance Index (RII)

To analyze the data using the relative Importance Index according to the following equation (3) [16, 17, 18], who used the relative importance index (RII %) method to identify and rank of the variety of factors affecting the use and adoption of ICT in the different project stages. The five-point Likert scale ranged from (1 to 5) is adopted and transformed to relative importance indices for each factor in the questionnaire.

$$\boldsymbol{RII}\ \% = \frac{\mathbf{5} * (\boldsymbol{n5}) + \mathbf{4} * (\boldsymbol{n4}) + \mathbf{3} * (\boldsymbol{n3}) + \mathbf{2} * (\boldsymbol{n2}) + \mathbf{1} * (\boldsymbol{n1})}{\mathbf{5} * (\boldsymbol{n1} + \boldsymbol{n2} + \boldsymbol{n3} + \boldsymbol{n4} + \boldsymbol{n5})} \ldots (\mathbf{3})$$

Where: n1, n2, n3, n4 and n5 = the number of respondents who selected:
n1= number of respondents who selected little effect.
n2= number of respondents who selected some effect.
n3= number of respondents who selected average effect.
n4= number of respondents who selected high effect.
n5=number of respondents who selected very high effect.
In contrast, these five expressions are defined by the equal intervals, as the following,
$10.0 \leq$ little effect (LE) ≤ 20.0
$20.0 \leq$ some effect (SE) ≤ 40.0
$40.0 \leq$ average effect (AE) ≤ 60.0
$60.0 \leq$ high effect (HE) ≤ 80.0
$80.0 \leq$ very high effect (VHE) ≤ 100

11. Results and discussion

In this study, 23 factors that hindering the ICT adoption in the construction projects management in Iraq have been identified and ranked according to the Relative Importance Index. These factors have been categorized into seven groups.

To find the results of this research, the following software has been used:

1. (SPSS) version 21 is employed to find the Relative Importance Index and Chronbach's Alpha of the impact strength (1 to 5) for each factor individually according to participants, replies to the questionnaire, and to find frequencies that are used in the calculation of importance coefficient.

2.Excel program (MS Excel 2016) for the application of the formula for the calculation importance coefficient.

1. Financial Reasons

The Relative Importance Index and ranks of the seven factors are classified under the "Financial Group" as shown in Table (5).

Table 5. Ranking Financial factors

First Group Financial Factors	RII %	Rank	Degree of Effect
High cost of employing professionals	**73.3**	**1**	**HE**
The speed of damage to modern techniques when misuse	**60.5**	**2**	**SE**
High cost of ICT and its components	**58.6**	**3**	**SE**
High rate of obsolescence ICT devices	**57.3**	**4**	**SE**
High maintenance costs of devices	**56**	**5**	**SE**
Limited benefits/ Low return on ICT investment	**51.7**	**6**	**SE**
Budget constraint for ICT investment	**49.8**	**7**	**SE**
Result of Financial Group	**RII %**	**Rank**	**Degree of Effect**
	50.74	**6**	**SE**

Table (4) illustrates that the surveyed participants ranked "High cost of employing professionals" as the most important factor that hindering ICT adoption in this group, with a RII of 73.3%. This top ranked factors influence is further ranked as the sixth in its effect among all factors explored. In contrast, the factor "Budget constraint for ICT investment" is the least important factor that hindering ICT adoption in this group, with a RII of 49.8%. This group scored the sixth rank.

2. Human Reasons

The Relative Importance Index and ranks of the two factors are classified under the "Human Group" as shown in Table (6).

Table 6. Ranking Human factors

First Group Human Factors	RII %	Rank	Degree of Effect
Satisfaction with traditional working methods and tools	**84.8**	**1**	**VHE**
Fear of job losses	**53.8**	**2**	**SE**
Result of Human Group	**RII %**	**Rank**	**Degree of Effect**
	69.3	**3**	**HE**

Table (5) shows that the surveyed participants ranked 'Satisfaction with traditional working methods and tools" as the most important factor that influences ICT adoption in this group, with a RII of 84.8%. This top ranked factors influence is further ranked as the second in its effect among all factors explored, contrariwise, the factor "Fear of job losses" is the least important factor that influence ICT adoption in this group, with a RII of 53.8%. This group scored the third rank.

3. Technical Reasons

The Relative Importance Index and ranks of the fifth factors are classified under the "Technical Group" as shown in Table (7).

Table 7. Ranking Technical factors

First Group Financial Factors	RII %	Rank	Degree of Effect
Lack of training on ICT content of construction process	**86.4**	**1**	**VHE**
Problem of ICT integration/compatibility with the work	**82.9**	**2**	**VHE**
Poor quality and/or quantity of telecommunication infrastructure	**81**	**3**	**VHE**
The weakness of the periodic maintenance of the technologies used	**64**	**4**	**HE**
Rapid changes in ICT technologies	**63.7**	**5**	**HE**
Result of Technical Group	**RII %**	**Rank**	**Degree of Effect**
	75.6	**1**	**HE**

Table (6) illustrates that the surveyed participants ranked "Lack of training on ICT content of construction process" as the most important factor influencing ICT adoption in this group, with a RII of 86.4%. This top ranked factors influence is further ranked as (One) in its effect among all factors explored, contrastively, the factor "Rapid changes in ICT technologies" as the least important factor that influence ICT adoption in this group, with a RII of 63.7%. This group scored the one rank.

4. Legal Reasons

The Relative Importance Index and ranks of the two factors are classified under the "Legal Group" as shown in Table (8).

Table 8. Ranking Legal factors

First Group Financial Factors	RII %	Rank	Degree of Effect
Lack of legal support for use of ICT	**65.3**	**1**	**HE**
The property rights of some programs	**48**	**2**	**SE**
Result of Financial Group	**RII %**	**Rank**	**Degree of Effect**
	56.65	**5**	**SE**

Table (7) illustrates that the surveyed participants ranked "Lack of legal support for use of ICT" as the most important factor that influence ICT adoption in this group, with a RII of 65.3%. This top ranked factors influence is further ranked as the (Ten) in its effect among all factors explored. Contrariwise, the factor "The property rights of some programs" is the least important factor that influences ICT adoption in this group, with a RII of 48%. This group scored the fifth rank.

5. Organizational Reasons (administrative)

The Relative Importance Index and ranks of the two factors are classified under the "Organizational Group" as shown in Table (9).

Table 9. Ranking Organizational factors

First Group Financial Factors	RII %	Rank	Degree of Effect
Poor interoperability between different applications/organizations	**81.3**	**1**	**VHE**
Lack of common standard for adoption of technologies between construction organizations	**67.2**	**2**	**HE**
Result of Financial Group	**RII %**	**Rank**	**Degree of Effect**
	74..25	**2**	**HE**

Table (8) illustrates that the surveyed participants ranked "Poor interoperability between different applications/organizations" as the most important factor that influence ICT adoption in this group, with a RII of 81.3%. This top ranked factors influence is further ranked as the (Fourth) in its effect among all factors explored. Contrariwise, the factor "Lack of common standard for adoption of technologies between construction organizations" is the least important factor that influences labor productivity in this group, with a RII of 67.2%. This group scored the second rank.

6. Cultural Reasons

The Relative Importance Index and ranks of the three factors are classified under the "Cultural Group" as shown in Table (10).

Table 10. Ranking Cultural factors

First Group Financial Factors	RII %	Rank	Degree of Effect
Weak effective communication between the work teams	**71.7**	**1**	**HE**
Weak resistance to change by staff	**70.4**	**2**	**HE**
Lack of continuous research on new technology and dependence on available technologies	**61.8**	**3**	**HE**
Result of Financial Group	**RII %**	**Rank**	**Degree of Effect**
	67.96	**4**	**HE**

Table (9) illustrates that the surveyed participants ranked "Weak effective communication between the work teams" as the most important factor that influence ICT adoption in this group, with a RII of 71.7%. This top ranked factors influence is further ranked (seveth) in its effect among all factors explored. Contrastively, the factor "Lack of continuous research on new technology and dependence on available technologies" is the least important factor that influences ICT adoption in this group, with a RII of 61.8%. This group scored the fourth rank.

7. Security Reasons

The Relative Importance Index and ranks of the two factors are classified under the "Security Group" as shown in Table (11).

Table 11. Ranking Cultural factors

First Group Financial Factors	RII %	Rank	Degree of Effect
Problems of reliability / damage accompanying devices	**51.4**	**1**	**SE**
The difficulty of controlling the security and confidentiality of information	**46.4**	**2**	**SE**
Result of Financial Group	**RII %**	**Rank**	**Degree of Effect**
	48.9	**7**	**SE**

Table (10) illustrates that the surveyed participants ranked "Problems of reliability / damage accompanying devices" as the most important factor that influences ICT adoption in this group, with a RII of 51.4%. This top ranked factors influence is further ranked (Nineteen) in its effect among all factors explored, while, the factor "The difficulty of controlling the security and confidentiality of information" as the least important factor influencing ICT adoption in this group, with a RII of 46.4%. This group scored the seven rank.

12. The Most Influential Factors on ICT adoption

By categorizing the factors into 7 groups, it has been considered that any factor at which its RII falls within the interval of (0.8-1) is very sensitive and would have a significant impact on ICT adoption. Table (12) show the results of the most influential factor through the results of the survey. It is found that the highest factor affecting is the "Lack of training on ICT content of construction process" and the value of the relative importance of his index is (86.4%), while the factor that occupies the fifth position in the ranking is the "poor quality and/or quantity of telecommunication infrastructure" and the value of the relative importance index (81.0%).

Table (12): Most of the effective factors affecting the ICT adoption

Rank	Factor	Degree of effect	RII %	Category Belong
1	Lack of training on ICT content of construction process	VHE	86.4	Technical
2	Satisfaction with traditional working methods and tools	VHE	84.8	Human
3	Problem of ICT integration/compatibility with the work	VHE	82.9	Technical
4	Poor interoperability between different applications/organizations	VHE	81.3	Administrative/ Organization
5	poor quality and/or quantity of telecommunication infrastructure	VHE	81.0	Technical

13. Group's Ranking

The 23 identified factors are grouped into seven groups.

X-axis represented the top important group affecting ICT adoption in projects management is Financial, Human, Technical, Legal, Organizational, Cultural, and Security.

Y-axis represented the ranking of these groups is associated with importance as assessed by respondents who work in the construction sector in Iraq.

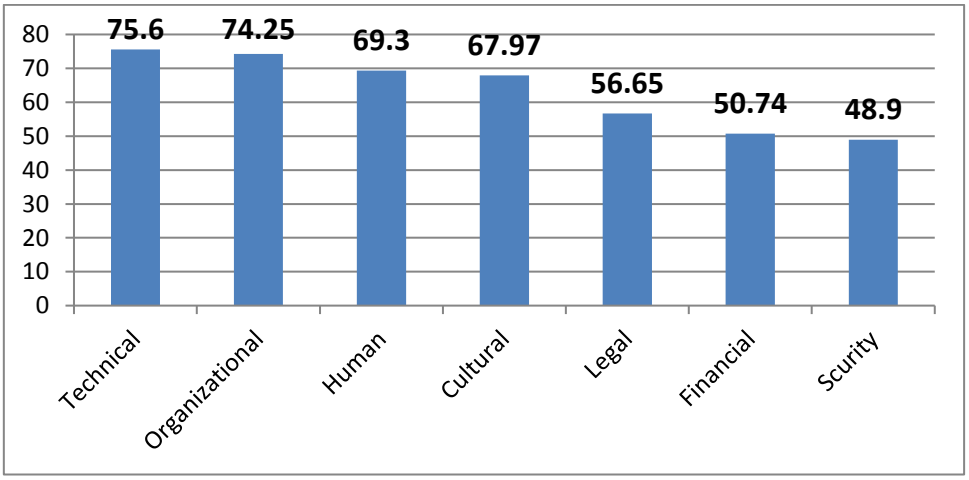

Fig 1. Main groups ranking

14 Conclusions

The objective of this study was to identify the factors that hindering ICT adoption in construction projects management in Iraq. In this study, it was found that twenty three factors affect ICT adoption.

The most important, namely:

1. Lack of training on ICT content of construction process.
2. Satisfaction with traditional working methods and tools.
3. Problem of ICT integration/compatibility with the work
4. Poor interoperability between different applications/organizations
5. Poor quality and/or quantity of telecommunication infrastructure

Moreover, 23 factors considered in the study were divided into seven groups, which were ranked according to their Relative Importance Index:

1. Financial Reasons group.
2. Human Reasons group.
3. Technical Reasons group.
4. Legal Reasons group.
5. Organizational Reasons group.
6. Cultural Reasons group.
7. Security Reasons group.

Conflicts of Interest

The author declares that they have no conflicts of interest.

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تحديد وتحليل العوامل المعيقة لاعتماد تكنولوجيا المعلومات والاتصالات في إدارة المشاريع في العراق

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الخلاصة

تكنولوجيا المعلومات والاتصالات مهمة جدا في إدارة المشاريع. الهدف من هذا البحث هو تحديد وتحليل العوامل التي تعيق تبني تكنولوجيا المعلومات والاتصالات في إدارة المشاريع. في هذا البحث، تم جمع 23 عاملا فعالا من مقابلة مع المهندسين والخبراء ومديري المشاريع والمصممين في المكاتب الاستشارية وشركات البناء. تم تجميع هذه العوامل في سبع فئات "العوامل المالية، العوامل البشرية، العوامل الفنية، العوامل القانونية، العوامل الإدارية، العوامل الثقافية، العوامل الأمنية". تم توزيع استبيان استقصائي شمل 75 من المستجيبين على مختلف الشركات ومكاتب الاستشارات. تم إجراء تحليل إحصائي باستخدام حزم SPSS و Excel .تم استخدام مؤشر الاهمية النسبية لمعرفة أهم العوامل التي تعيق تبني تكنولوجيا المعلومات والاتصالات في إدارة المشروعات. كشفت النتائج التي تم الحصول عليها من الاستطلاع أن العوامل الرئيسية التي تحول دون اعتماد تكنولوجيا المعلومات والاتصالات في إدارة المشاريع (مرتبة من أسوأ العوامل ذات القيم النسبية للمؤشر الهام، على التوالي) وهي نقص التدريب على محتوى تكنولوجيا المعلومات والاتصالات في عملية البناء (86.4 ٪)، الرضا عن أساليب وداوت العمل التقليدية (84.8 ٪)، مشكلة تكامل / توافق تكنولوجيا المعلومات والاتصالات مع العمل (82.9 ٪)، وضعف التشغيل البيني بين التطبيقات / المنظمات المختلفة (81.3 ٪)، وضعف جودة و / أو كمية البنية التحتية للاتصالات (81 ٪).

الكلمات الدالة: تكنولوجيا المعلومات والاتصالات – العوامل المعيقة – ادارة المشاريع – مؤشر الاهمية.