The Investigation of Student's Views and Knowledge about the Implementation of Advanced Technologies in the Design of Buildings

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Abstract :

The revolution in communications and networking computer technology in the second half of the 20th century has paved the way for a number of advanced technologies such as e-business and e-commerce and smart technologies to emerge. These technologies have affected the way that building industry and specifically architectural practices conduct business, communicate and design buildings. E-business and e-commerce tools have helped practices to market their products and to integrate their business systems with their partners-in-business. Smart tools are embedded in building's structure or inside the buildings, not only to aid residents with special needs but also to provide a comfortable and sustainable environment to all types of residents.

The importance of the advanced technologies: smart and e-business and their effect on the work environment and building design are noticeable around us. There is an increasing implementation of these technologies in buildings and they are considered as one of the design factors that would affect the final design product.

However, the author's observation of the design studios at college of architecture, King Faisal University showed that students do not implement these technologies in the design projects. Thus, a survey was launched to explore student's awareness of these technologies and whether they consider them in design projects. The survey showed that architectural students have little awareness about these technologies and how they can be considered in architectural design of buildings.

This paper demonstrates the survey findings and explains why students do not implement the advanced technologies in architectural design. It makes recommendations of how to incorporate these technologies in the educational curriculum.

Keywords:

smart technology, smart homes, the Internet, e-business, e-commerce, design studio, pre-assessment, prior knowledge.

1. Introduction :

A number of technologies emerged in the late 1990's and some have affected the way that people live and erect buildings.

The Internet comprises of a number of technologies that have affected how people trade and conduct business. One of these technologies is the e-commerce (i.e. electronic commerce) which can be defined as buying and selling of goods and services on the Internet, especially the World Wide Web (Goodwin 2001, Grant 1999). The other technology is the E-business (i.e. electronic business) which describes all business activities that involve the sharing of information through electronic networks, i.e. companies are being able to sell or order and pay for goods online, check availability and get further information on products (Thompson 2003). It includes any conduct of business on the Internet, not only buying and selling but also servicing customers and collaborating with business partners.

These electronic technologies have helped people to communicate remotely i.e. to work from home such as tele-workers; they have also helped people to meet and discuss business on line, buy and sell goods and to do banking etc. Buildings became more electronically equipped, networked and more linked to the outside world. Domestic settings become increasingly technologised (Dewsbury 2001). The effect of these technologies on building environment can be seen in streets where the smart electronic city guides are, and in banks that are equipped with electronic cash and deposit machines. Foresighted commercial companies are well aware of these technologies, so they are building warehouses that are replacing their city branches, to provide customers with goods through a direct delivery service from these warehouses to the customer. In the UK, some banks such as Barclays bank have closed hundreds of branches to provide e-banking services on the Internet.

Jackson (2001) suggested that new workplace should accommodate a much wider variety of settings than those provided by traditional design solutions. He pointed out that: "Not all work happens at a desk. Not all meetings take place in meeting rooms. Knowledge workers need a variety of different settings to suit their different needs at different times of the day. They need places for individuals to think and work quietly, places for groups to gather and exchange ideas, places for people to meet—which may be formal or informal, scheduled or impromptu, electronically or face to face—places for teams to set up long-term projects, and places for those just dropping in".

Lizieri, C. (1997, 2003) and Gibson, V.A. and Lizieri, C.M. (2001) pointed out that adoption of computer networking and communications technologies by practices has an impact on a number of building features. In the UK, the impact of ICT-enabled (i.e. electronic Information and Communications Technologies) and new working practices (e.g. hot-desking, home-working and team working) on office space demand was found to be muted and gradual. Gibson (2003) suggested that more firms in the UK demand flexible office space. Gibson and Lizieri (1999) anticipated that these firms adopt a portfolio approach to achieve mobility, flexibility and adaptability in office space. They predicted that amount of office space required by organizations would decrease as organizations continued to reorganize, adopt new working practices and implement more technology.

These networking technologies including e-commerce and e-business have an infrastructure that needs some extra spaces such as horizontal and vertical shafts for networks wiring. These technologies change how businesses conduct work and in some cases, such as in banks, may need spaces for cash machines and deposit machines and in other types of buildings a secure central server's space. These technical and spatial requirements should be taken into account by the architect during the early design phase.

The above-mentioned studies suggested that practices and businesses (e.g. potential clients) who adopt ICT and networking technologies would have the following demands in regards to the building design:

- Mobile, flexible and adaptable space layout;
- Less building size is demanded by ICT practices than practices that do not use these technologies;
- As some business functions can be located remotely or outsourced, less central office or headquarter space is required;
- In some cases, extra spaces would be required to accommodate certain functions.

On the other hand, smart home technologies have been invented to help people including those who have special needs to control the environment that is around them at home. Smart building technology could be defined as the technology used to make all electronic devices in a building act "smart" or more automated.

The smart home technology products and services play an important role in creating benefits for users. In general products and services can be divided into six categories; namely: comfort, energy management,

multimedia and entertainment, healthcare, security, safety and communication (Roe P. R.W. 2007).

The way smart homes are used by occupants is different in some aspects from the use of normal homes. As domestic spaces are created to meet the needs of the individual occupiers, these needs are themselves often related to technological developments. The home computer, for example, along with games machines, televisions, videos etc now acts as a determinant and identifier of these spaces (Crabtree *et al*, 2001).

Technology is not 'added' into the home, it is 'integrated', forming a seamless integration into the fabric of the dwelling when possible. The resulting designs should be aesthetically pleasing, non-invasive, reliable, individualised dependable systems that should assist the person in maintaining a way of life that they wish to maintain. Smart technology should be thought of as an essential part of the design process and not an after-thought. The role of building elements is to be interactive with user daily requirements and changing needs. The technological home of today and tomorrow embraces technology within its structure. The resulting design should be aesthetically pleasing, non-invasive, reliable, individualised dependable systems that should assist the person in maintaining a way of life that they wish to maintain.

The adoption of advanced technologies by the client would have an impact on the building design. Architects should be aware of the special requirements of those clients and the needs of these technologies as well, and how it would impact the design product. Thus, they should be thought of as an essential part of the design of the building elements and not an after-thought.

This paper discusses the student's views regarding the implementation of advanced technologies; namely: smart technology, e-business and e-commerce technology in design projects. At present, these technologies are taught partially and at very limited scale through a tutoring course at college of architecture and planning, King Faisal University (KFU). Observation and chats with few students of Years 3, 4 and 5, were undertaken by the author, and it was found that students were not aware of these technologies and how they can be embedded in the building design and what their likely effect is on the design of buildings. Thus, it was necessary to find out the level of year 4 and 5 student's knowledge about advanced technologies and whether these technologies have been considered in design projects.

2. Research objectives :

The research has a set of objectives and these are:

- To find out the extent of student's awareness of e-business, e-commerce and smart technology and whether these were applied or would be considered in design projects
- To know the reasons of non application of advanced technologies in design
- To set recommendations of how to incorporate advanced technologies in architectural education

3. Research methodology :

In regards to the research objectives, it is argued that a combination of quantitative and qualitative research methods is needed. The use of mixed methods is because the findings that relate to each method will be used to complement one another and at the end of the study to enhance theoretical or substantive completeness (Morse 1991).

To assess the student's knowledge about advanced technologies, a survey questionnaire was suggested as a pre assessment and used to examine the level of knowledge and student awareness about these technologies. The pre-assessment is recommended by researchers as Ausubel (1968) & Meyer (1993) for several purposes such as: to assess student prior knowledge and to provide the basis for the implementation of teaching syllabus into the educational curriculum.

A questionnaire survey was used to target 137 students who are in the fourth and fifth year at college of architecture and planning, departments of architecture and building technology. Fifth and fourth year students were chosen because it was presumed that those students have more advanced knowledge than students who are at lower levels of study. In case that the survey found that they lack of knowledge about the advanced systems, it will make recommendations of how to incorporate it in the curriculum. The recommendations would highlight the likely benefits of teaching advanced technologies to students to their overall architectural education.

A questionnaire was prepared to explore the student's views about the following aspects:

- Their knowledge about each component of e-business and e-commerce
- Whether they think that it can be considered in the architectural design

- Whether they implemented smart building technology in the design studio projects and what were the reasons of non implementation.
- What the level of effect of the application of smart technologies would be on the design of buildings

The original questionnaire was written in English but after careful consultation, it was translated into Arabic as it was found that a large number of students are weak in English. The questionnaire was done using Dream weaver version but there was some difficulty in writing Arabic letters as Dream weaver does not fully support the Arabic language letters. The questionnaire was linked to dynamic database, placed on the internal server of the College of Architecture and Planning and was uploaded onto the web address: http://arch.dammam.kfu.edu.sa/arch/survey. When the student completes the questionnaire and clicks *SUBMIT*, the results will be recorded directly into the database on a designated internal server at the college. An explanation note of where and how to fill the questionnaire was prepared. The author visited all fourth and fifth year design studios of the building technology and architecture departments, explained about the questionnaire to the students, asked for their participation and co-operation, and handed copies of the explanation note to them.

The questionnaire was launched on the Intranet page of the college of architecture in early of June 2007, for around two weeks. At the end, the total number of respondents was 64 that represents an overall return of 47% which is high return percentage of such Internet questionnaire survey.

However, the sample number (i.e. number of respondents) was too small to allow anything but simple statistical tests (Plakett 1974; Everitt 1992), such as Cramers' test of correlation to examine the strength of relationships, and the Chi-square Pearson test to measure their significance. The following tests were applied using SPSS version 13 on the links between the variables:

- The means values calculations where the mean value for each category of the 'implementation' variable is calculated and assigned to a designated category of the explanatory variable. This would show the degree of proposed effect of each of the explanatory variable on the designated category of the usage variable.
- Cramer's test of correlation (i.e. asscoaition): to examine the strength of relations between variables. The strength of correlations that is under 0.2 is considered very weak, 0.2-0.4 to be weak, 0.4-0.6 to be moderate, 0.6-0.8 to be strong, and 0.8 and above to be very strong correlation.

- The Chi-square Pearson or test of significance: It examines the probability of these relations to be held in the population. Any relation between variables that has significant level above 0.05 is rejected, taking into account that level of confidence is 95%. Links that have a significant level between 0.05 to 0.01 are considered to be significant and these between 0.01 and 0.001 are considered to be highly significant and below 0.001 are very highly significant. Only significant links are reported here.

To know the reasons why advanced technologies had been implemented in design projects, a number of interviews were carried out. The target of these interviews was to find out whether there are any constraints on the implementation of advanced technologies in design projects and why students were unwilling to apply them.

4. General results concerning the use of advanced technologies:

4.1 Results concerning e-commerce and e-business:

It was found that most students have little or average knowledge about the e-commerce and e-business. Table 1 (see appendix A) shows that 70% to 75% have little or average knowledge about the following components: electronic shopping cart, electronic catalogue, electronic payment gateway, electronic Inventory tracking, electronic, remote access to office networked computer, electronic banking and transactions, web-based project management sites, electronic, project Tendering services, and electronic customer relations management (*CRM*)

76% to 80% of respondents also have average or little knowledge about the following components: electronic third party payment, electronic processor, electronic visitor tracking. electronic procurement and electronic enterprise management systems. 84% of respondents have little and averaged knowledge about electronic enterprise resource planning (*ERP*). Nearly half of the students have high knowledge about electronic customer accounts (see appendix A, table 1).

Students were asked whether it is possible to consider e-business in the architectural design of commercial, retail, and office buildings. 41% of them said it could be considered and 37% said that it can be considered but they do not know how. The total percentage of whose in favour of considering e-business technology was 78% (see appendix A. Table 2).

4.2 Results concerning smart technology:

Students were asked about the possible implementation of smart building technology in the design studio projects. Nearly more than half of the respondents said that it is possible to consider the electronic medical Devices and medical aids, security and anti-burglary system, and virtual clinic/hospital tools. On the other hand, the same percentage said that it is not possible or it is difficult to implement remote administration tools for monitoring and control of building systems, Voice recognition, movement tracking devices, Electronic equipment's aids for daily life, homecare facilities (see appendix A, table 3).

Around two third of the students said that it is possible to implement the following smart technology components: life safety System, building electronic networking (i.e. Wired, Wireless), Internet appliances: webcams, web phones, video walls etc. 60% said it is difficult to implement an individual wellness monitoring tools and the same percentage of respondents said it is difficult to implement tele-services through the Internet (e-grocery-services, e-banking, Telemedicine etc) (see appendix A, table 3).

To find out whether the students have sound knowledge about the smart technology and its application in buildings, students were asked about the effect of smart technology on a number of building features and building design aspects. In accordance to the building behavior, around two third of respondents said smart technology would positively increase the conservation of energy of the building, the capability of spaces to accommodate new complex activities and ever changing technology. 78% of respondents said it would improve the security of the building (see table 4, appendix A).

53% to 59% said that smart technology increases the following features of a building and building design: the flexibility of spaces, the designer ability to adapt spaces and the complexity of the building services such electricity, drainage, computer networking etc. (see appendix A, table 4). 40% to 50% of students said that smart technology would increase the following features of a building's design: the complexity of designing the building facades, the complexity of designing the elements of the building such as walls, door and windows, and the building spaces in terms of adding up additional spaces such as control rooms (see table 4, appendix A).

Nearly half of students said that smart technology would increase the buildings features listed in points 1, 2, 4, 5 and 9 (see table 4, appendix A).

However, more students were expected to say that smart technology would increase these features i.e. flexibility, adaptability of the building, the complexity of building services and design of intelligent elements of building. More students were expected to say that smart technology has improved the energy conservation of the building. The only satisfactory vote was towards the building security.

Students were asked about the reason of why the smart technologies had not been implemented in design projects: 75% said it was difficult to be implemented and 67% said that it is out of scope of the design project, whereas half of them said that they do not know how to implement it. The explanation of non implementation of smart technology in design projects is mentioned in Section 6.

5. Focused results about the use of advanced technologies:

5.1 Focused results about e-commerce and e-business technologies:

It should be mentioned that only significant links as defined in Section 3 will be reported. Significant links were found between the knowledge about various components of the e-business and e-commerce and the consideration of the use of these components in design projects. However, there was not general agreement among students who have high or above average knowledge of whether to consider a number of e-business and e-commerce components in design projects. In detail, students who have high knowledge about the following components: electronic shopping cart, electronic third Party Payment, electronic processor, electronic inventory tracking, electronic procurement, electronic enterprise management systems,, electronic customer relations management (CRM), electronic enterprise resource planning (ERP), electronic product/data management (EDM, PDM) said they do not think that it should be considered in design of commercial, retail and office buildings, whereas students who have above average knowledge about the above mentioned components said it is possible but with some difficulty to consider them (See appendix A, table 5).

The reasons for these differences in opinion are because students did not imagine that e-business components can be considered in building design and as one student said: *"It was not clear for some students how to consider e-business and, e-commerce technologies in the design projects"*.

5.2 Focused results about smart technologies:

The same tests mentioned in Section 3 were applied here to test the links between the possible implementation of various smart technologies and the knowledge of how to implement them in design projects. The study found that students who do not know how to implement the following smart technology components: energy management system, life safety system and Virtual Clinic are those who said that do not know about it.

6. The interview results:

Students pointed out that there are other reasons of why the advanced technologies had not been implemented. One of them mentioned:

"As a student I am constrained by a number of design factors (e.g. site constraints, environmental and climate factors) so I cannot go beyond the borders so I take only the factors that should be considered in the design projects. This would guarantee success and it is better than taking a risk of implementation of new factors which include the advanced technologies"

A student said there was hardly enough time to do the design project so there was no time to find out how the smart technologies could be implemented. A third student said that he was not aware of these systems as they had not been taught previously at the college of architecture and no one had explained to him how to implement them in design projects. One of the students revealed there was no way to implement these smart technologies because the study term was so short, and the student is usually asked to provide architectural, structural and air conditioning design solutions only. Students have a concern that they would be criticized by the jury if they implemented smart technologies in the design project.

Another student said that some instructors constrained themselves with the old teaching systems and are reluctant to adopt or accept new systems. A student pointed out that design studio instructors usually are not happy about the implementation of smart technologies in the project by students. Thus, if a student submits such implementation ideas, it would be rejected by instructors under the excuse that nobody i.e. the society and people in Saudi Arabia knows about it, so it would be impractical and they would ask the student to abandon it.

Another student pointed out that instructors should teach students about smart technologies and how to apply them in projects, or even giving a hint about them, so the student can do some research about these technologies. Students suggested that college should invite external lecturers who can give lectures about these technologies.

A student explained why smart technology had not been implemented in design of projects by saying: "*I can not implement something which I do not know about it. In architectural design studio, there are no requirements at present to do detailed plans or technical plans apart of A/C and structural plans.*"

Another said: "*if the student feels the impact of the smart technologies on design project or building design thus he would use it. The student should feel the importance of the smart technologies and what it offers to the architect and the positive aspects that it would add to the building and how it would enrich the architectural design*"

Students also said that some of the smart technology components had been taught as a theoretical subject in the second year but not to the required depth that enables students to use it in design projects. They suggested that it should be in the design studio subject as the student would not be able to understand how to apply it in the building design if it was taught as theoretical subject.

7. Discussion and conclusion:

The results showed that so far, most students have little or average knowledge about e-commerce and e-business and smart technologies. These results were expected as these e-business and e-commerce technologies have been previously taught to students, whereas few components of smart technology were taught through theoretical course.

The in-depth analysis of results showed there was an agreement to abandon e–business from the design of buildings between students of high knowledge about e-business with students who have averaged knowledge about e-business. This was explained as it was not clear to many students how to consider these technologies in design and how they would affect the physical and technical layout of the building.

In depth analysis of the results showed that students who did not know about a number of smart technologies are those who did not know how to implement them.

Students highlighted to a number of constraints that would hinder possible implementation or consideration of advanced technologies in design projects, these are:

- Little technical knowledge of student's about these technologies

- Students have no previous awareness about advanced technologies as there are no previous technical courses about the advanced technologies
- The time constraints of the course
- Some instructors ask students to abandon these technologies
- Risk of unsatisfying the design project's juries and subsequently the student's concern of possible failure

To overcome these constraints, it is critical to increase student's knowledge about advanced technologies by incorporating them in the architectural curriculum as technical course and also in design studio as well. E-business and e-commerce can be taught to students in a way that it demonstrates their effect on the working environment and buildings. The components of smart technology can be considered in design studio among the other design factors and subsequently students can learn how to be implemented them in design projects.

However, this can not be achieved without the support of the teaching staff and their willingness to consider advanced technologies in the design studio. There is also a need to increase student's awareness about the advanced technologies. As students suggested, this is can be done by inviting specialists in the application of advanced technologies in project design to deliver lectures.

E-business technologies require certain technical settings and they affect the traditional business processes by replacing some or most of it with virtual processes. Therefore would affect the design of the retail, commercial and office building in terms of the flexibility, number and size of spaces and organization of the space, technical aspects of the space etc. Further research is needed to find out how e-business and e-commerce would impact work environment and building design.

Acknowledgement :
The author would like to thank all students who took part in this survey. My specials thanks to engineer Badran Zunifer who set the on-line survey questionnaire on the KFU intranet pages.

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Appendix A

Table (1)

Level of student's knowledge about e-business and e-commerce

E-commerce components	Very little	little	Average	high	Very high	Total average or little	Total high
Electronic shopping cart	38%	17%	20%	19%	6%	75%	25%
Electronic Catalogue	23%	27%	20%	20%	9%	70%	29%
Electronic Payment gateway	27%	22%	22%	20%	9%	71%	29%
Electronic Third party payment	44%	19%	13%	16%	9%	76%	25%
Electronic processor	44%	19%	17%	11%	9%	80%	20%
Electronic Customer accounts	14%	17%	27%	20%	22%	58%	42%
Electronic Inventory tracking	36%	22%	13%	20%	9%	71%	29%
Electronic Visitor tracking	33%	23%	20%	13%	11%	76%	24%
Remote access to office networked computer	31%	19%	22%	19%	9%	72%	28%
Electronic banking and transactions	30%	19%	23%	16%	13%	72%	29%
Web-based Project management sites	31%	22%	17%	20%	9%	70%	29%
Electronic Project Tendering services	38%	23%	14%	22%	3%	75%	25%
Electronic Procurement	38%	25%	16%	14%	8%	79%	22%
Electronic Enterprise management systems	33%	30%	17%	13%	8%	80%	21%
Electronic Customer Relations Management (CRM))	39%	20%	14%	17%	9%	73%	26%
Electronic Enterprise Resource Planning (ERP)	42%	22%	20%	11%	5%	84%	16%
Electronic/Product Data Management (EDM/PDM)	34%	28%	17%	13%	8%	79%	21%

Sample size of 64, **Bold font**: The percentages of students above 50%

Question 1: The level of student's knowledge about e-commerce and e-business

Table (2)

Student's views about the consideration of e-commerce and e-business in design of buildings

	I don't think it should be considered	I think it is difficult to consider it	It could be considered	It could be considered but I don't know how
Possible consideration of e-commerce and e-business in architectural design of	14%	8%	41%	37%

Sample size of 64, **Bold font**: The percentages of students above 50%

Question 2: Possible consideration of e-commerce and e-business in the architectural design of commercial, retail and office buildings

Table (3)
Possible implementation of smart technologies in project design

Smart building technology components	I Do not know about it	It was not considered	It is taken into account but it had not applied	It was applied	Total it should not/difficult to consider	Total it is possible to considered
Electronic medical Devices and medical aids	20%	27%	28%	25%	47%	53%
Energy management system (EMS)	6%	25%	36%	33%	31%	69%
Life safety System	14%	22%	25%	39%	36%	64%
Building electronic networking (i.e. Wired, Wireless)	6%	28%	31%	34%	34%	65%
Internet appliances: *Webcams, web phones, video walls* etc	11%	28%	39%	22%	39%	61%
Virtual clinic/hospital tools	23%	23%	36%	17%	46%	53%
Remote administration tools for monitoring and control of building systems	17%	36%	27%	20%	53%	47%
Voice recognition, movement tracking devices	31%	23%	28%	17%	54%	45%
Environmental Control Systems	20%	30%	23%	27%	50%	50%
Security and anti-burglary system	11%	31%	34%	23%	42%	57%
An individual wellness monitoring tools	28%	39%	22%	11%	67%	33%
Electronic equipment's aids for daily life	19%	36%	28%	17%	55%	45%
Tele-services through the Internet (e-grocery-services, e-banking, Telemedicine)	22%	38%	25%	16%	60%	41%
Homecare facilities	25%	34%	22%	19%	59%	41%

Sample size of 64, Bold font: The percentages of students above 50% who voted for the chosen option

Question 3: The possible implementation of smart building technologies in design projects

Table (4)
The effect of smart technologies on building design

Effect of the smart technologies on building's design	Increase	Neutral	Decrease	Total
1. Flexibility of spaces in terms of the possibility of changing the use of internal spaces	**59%**	31%	10%	100%
2. The designer ability to adapt spaces in terms of joining spaces or separation of spaces	**53%**	44%	3%	100%
3. Complexity of designing the building facades	47%	42%	11%	100%
4. The complexity of designing the elements of the building such as walls, door and windows	50%	30%	20%	100%
5. The complexity of the building services such electricity, drainage, computer networking etc	**58%**	30%	12%	100%
6. The building spaces in terms of adding up additional spaces such as control rooms	42%	39%	19%	100%
7. Positively the conservation of energy of the building	**69%**	27%	4%	100%
8. The improvement of the building security	**78%**	20%	2%	100%
9. The possibility of incorporating adaptable fixings such as bedrooms, WC, Bath and kitchen	**52%**	45%	3%	100%
10. The capability of spaces to accommodate new complex activities and ever changing technologies	**61%**	39%	0%	100%

Sample size of 64, **Bold font**: The percentages of students above 50% who voted for the chosen option

Question 4: Student's views about the effect of the smart technologies on design of buildings

Table (5)
The links between student's knowledge about various e-business and e-commerce components and consideration of e-business& e-commerce in design of buildings

Variables tested	Correlation value	Level of significance	Result
Knowledge about electronic shopping cart * Consideration of use of e-commerce& e-business technologies in design of commercial, retail and office buildings	0.38	0.01	students who have high knowledge said they do not think that it should be considered or difficult to consider whereas students who have knowledge above average said it can be considered but it might be difficult to consider
Knowledge about electronic third Party Payment * Consideration of use of e-commerce& e-business technologies in design of commercial, retail and office buildings	0.38	0.01	
Knowledge about electronic processor * Consideration of use of e-commerce& e-business technologies in design of commercial, retail and office buildings	0.40	0.00	
Knowledge about electronic inventory tracking * Consideration of use of e-commerce& e-business technologies in design of commercial, retail and office buildings	0.44	0.00	
Knowledge about electronic procurement * Consideration of use of e-commerce& e-business technologies in design of commercial, retail and office buildings	0.38	0.01	
Knowledge about electronic enterprise management systems * Consideration of use of e-commerce& e-business technologies in design of commercial, retail and office buildings	0.45	0.00	
Knowledge about Electronic Customer Relations Management CRM * Consideration of use of e-commerce& e-business technologies in design of commercial, retail and office buildings	0.33	0.05	
Knowledge about electronic enterprise resource planning (ERP) * Consideration of use of e-commerce& e-business technologies in design of commercial, retail and office buildings	0.45	0.00	
Knowledge about electronic product/data management (EDM, PDM) * Consideration of use of e-commerce& e-business technologies in design of commercial, retail and office buildings	0.38	0.01	

Table (6)
The links between student's views about the possible implementation of smart technologies and their knowledge of how to implement it

Variables tested	Correlation value	Level of significance	Result
Possible implementation of energy management system * do not know how to implement it	0.35	0.05	students who said they who do not know about it are those who do not know how to implement it
Possible implementation of life safety system * do not know how to implement smart technologies	0.44	0.01	students who said they who do not know about it are those who do not know how to implement it
Possible implementation of Virtual Clinic * do not know how to implement smart technologies	0.37	0.03	students who said they who do not know about it or not considered are those who do not know how to implement it
Possible implementation of voice recognition movement tracking * do not know how to implement smart technologies	0.36	0.04	Students who said they who do not know about it, or who said not considered, or who said considered but not applied are those who do not know how to implement it

استطلاع وجهات نظر الطلاب و مدى معرفتهم بكيفية تطبيق التقنيات المتقدمة في تصميم المباني

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الملخص :

إن ثورة شبكات الكومبيوتر و الاتصالات الالكترونية والتي قامت في النصف الثاني من القرن العشرين قد مهدت الطريق لظهور عدد من التقنيات الالكترونية مثل التجارة الالكترونية، الأعمال الالكترونية و التكنولوجيا الذكية. أثرت هذه التقنيات على طرق الاتصال و مزاولة الأعمال و تصميم و إنشاء الأبنية في قطاع البناء عامة ومن قبل المكاتب المعمارية خاصة. في الوقت الحاضر ساعدت أدوات التجارة الالكترونية والأعمال الالكترونية الشركات على الوصول بفعالية إلى الزبائن البعيدين، تسويق منتجاتهم، وربط أنظمتهم مع أنظمة شركائهم في الأعمال. إن وظيفة التكنولوجيا الذكية الموضوعة داخل البناء أو المغروسة في هيكل البناء ليس فقط مساعدة الساكنين من ذوي الاحتياجات الخاصة بل تامين بيئة مريحة و مستدامة لكل أنواع الساكنين. إن أهمية التقنيات الالكترونية و تأثيرها على بيئة العمل وتصميم الأبنية ظاهر بشكل جلي من حولنا. إن هناك تطبيقا متزايدا لهذه التقنيات في المباني وهي تعد الآن أحد العوامل التي يمكن أن تؤثر على تصميم الأبنية. أجرى المؤلف مراقبة لقاعات التصميم المعماري في كلية العمارة جامعة الملك فيصل ووجد أن الطلاب لا يأخذون هذه التقنيات بالاعتبار في عملية التصميم. أجريت فيما بعد عملية مسح على الطلاب و مقابلات معهم لتحري مدى معرفة الطلاب بهذه التقنيات .أظهرت عملية المسح أن الطلاب لديهم معرفة قليلة بهذه التقنيات وكيف يمكن اعتبارها في عملية التصميم. تعرض هذه الورقة نتائج عملية المسح وتبين أسباب عدم أخذ الطلاب التقنيات الالكترونية بالاعتبار .تتضمن الورقة أيضا بعض الاقتراحات حول كيفية إدراج هذه التقنيات في المنهاج التعليمي.

الكلمات الرئيسية :

التكنولوجيا الذكية، والمنازل الذكية، شبكة الانترنت، الأعمال الالكترونية،والتجارة الالكترونية، أستوديو التصميم، التقييم الأولي المسبق، المعرفة المسبقة.