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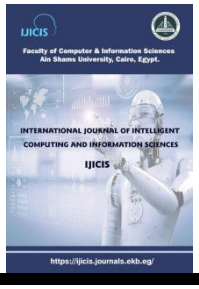

INNOVATION INITIATIVE OF EGYPTIAN E-GOVERNMENT SYSTEM USING BIG DATA

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Abstract: *The Electronic government system in Egypt faces great challenges during its current phase of development and implementation. These challenges are due to the emergence of new technologies and applications in the field of government electronic services. New technologies such as Near-Field Communications NFC, Smart Cities, and Green Information Technology for preserving the environment have contributed to new principles and procedures for the E-Government system in Egypt.*
This Research aims at developing an initiative for the Egyptian Government System through developing an integrated and systematic plan for defining priorities of engaging above-mentioned modern technologies to be applied in the next phase of development and implementation. The government body responsible for this work is the Ministry of Administrative Development.

Keywords: *E.GOV – GIT – NFC – E. CITIES- GIS- AHP – QFD - TRIZ.*

1. Introduction

There are so many projects of application of the Electronic Government systems in many countries of the world. Those technological projects provide high speed and accuracy among the governmental institutions and business companies. They also provide citizens with required services anytime anywhere. Egypt, as an advanced country in the African and Arabic regions, has started applying the electronic government system since 2001 and has assigned the establishment and introduction of e-government system to the Ministry of Administrative Development.
The research study addresses the issue of requirements traceability by assessing the degrees of impact with the help of quality function deployment (QFD), House of Quality (HoQ). HoQ from (QFD) is used to map the voice of customers into multiple phases of Product/Service development life cycle. The advantage of using HoQ (from QFD) is that it traces customer requirements from the very beginning to Product/Service design [1].

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The methodology uses the **Analytic Hierarchy Process** AHP in order to prioritize citizen requirement, and TRIZ technique - (TRIZ is a word of Russian origin and is the acronym of Teoria Resheniya Izobretatelskikh Zadatch) in English: (Theory of Inventive Problem Solving) - to solve for the contradicting requirements [2].

2. Research Problem

The Ministry of Administrative Development faces many challenges in the course of development of E-Government system; these challenges will be even harder during the following years because of the enormous rise in scientific and technological advances and increasing demand for them as a result of increasing population besides; the anticipation of citizens for better handling methods. Accordingly; the research problem can be stated as follows: "The recent approach of applying the Electronic Government System in Egypt is limited to three main dimensions, but it ignored the ability of adding modern information technology applications into its components during execution." [3].

3. Research targets:

The research aims at accomplishing the following:

- Setting up a completed plan to maximize the performance of the Electronic Government in Egypt during its final phase of application through adding and applying new Information technology applications at lower cost and higher quality
- Identifying the priorities of applying this technology in the final phase.
- Improving the Egyptian environment and making it clean environment.
- Integrating he Egyptian Electronic Government with the global system [4].

4. The Electronic Government in Egypt [5]

Electronic Government System targets:

- Providing special services to people, foreigners, business men, companies and investors. Thus; lowering effort through suitable interactive responsive methods
- Saving time either for asking for the service or for the responsible person for serving it
- Developing the governmental business organization, and increasing the performance quality in the ministries or the establishments through using information and communication technologies
- Minimizing the governmental expenditures by using new mechanisms for the Government Procurement strategy, managing the Inventory and using the optimum available resources
- Providing accurate information for the decision maker and evaluating the performance of the ministries' organizations.
- Habilitation of the governmental body to integrate into the global system [6].

Figure 1 shows contents of the E.Gov system in Egypt.

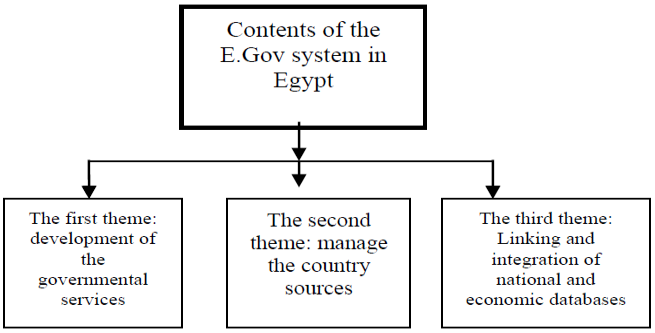


Figure 1: Three main themes of the E-government system in Egypt

4.1 The first theme: the development of the governmental services

This program aims at providing the government services via many channels in an easy way. Besides, it ensures satisfaction of Egyptian people. Of course, accuracy, efficiency, security and insurance in exchanging information and documents between the various government agencies can be achieved.

4.2 The second theme: Enterprise Resource Planning and Back Office Automation Program

This program aims at establishing a working system for Egyptian E-Government, in order to reduce the governmental expenditure and mechanization cycles of working systems in governmental agencies through using technology and scientific applications which provides the highest degree of performance

4.3 The third theme : Linking and Integrating National and Economic Databases Program

This program aims at developing a main repository that links and harmonizes all databases of E-Government System.

5. The Green Information Technology

All countries should adopt a policy of making the life cycle of information technology Eco-friendly by tackling environmental stability on four complementary paths, which are as follows:

First path: Green use
Second path: Green Disposal
Third path: Green Design
Fourth path: Green Manufacturing

Figure 2 show devices which are compatible with the above-mentioned technology.

Figure 2: shows that the outer frame of the device is made of bamboo wood section that efficiently contributes to the waste disposal usefully and more environmentally in friendly manner where it can be fully recycled.

6. Electronic Cities (Digital Cities)

The growing development of information and communication technologies has led to the emergence of the concept of Electronic Cities (digital cities); Electronic Cities is a new era with new thinking for cities that generally wasn't known before. All information about city's activities are collected in one Website address to be as the Electronic entity for that city. This website contains several services and electronic activities, combined with different electronic links covering all city's services, as it is shown in Figure 3**.**

- (Info): deeply involved In Communication and Information technology among the commercial and social fields.
- (Bio): transforming to Biotechnology and information technology.
- (Nano): marketing and commercial usage of Nano technology

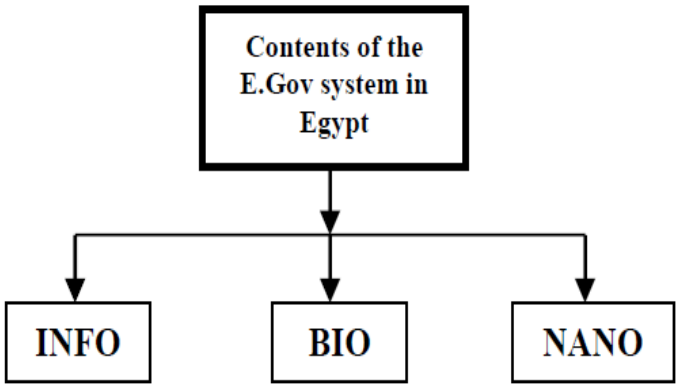


Figure 3: Three main Elements of the future of E-cities

7. Geographic Information System (GIS)

The Technical development of applying the E-Gov system is always followed with the ability of applying the GIS in consideration with the governmental institutions that are related to urban Development. Organizations that are responsible for maintaining and saving fertile agricultural lands benefit from providing necessary Procedures for facing creeping projects on the agricultural lands**.** They all need Geographic Information System which is able to develop complete data base, thus E-Gov System is dependent on GIS as one of its important contents**.**

8. NFC Technology

NFC means near –field communications. This technology can transfer data between two smart cell phones in tide narrow space which doesn't extend more than 4 Cm with data rate reaching 474 kilobyte/second, this technology is being used now in some developed countries instead of the governmental plastic cards like (IDs – License – Entry IDs. etc)**.**

9. New QFD Integrated Methodology for Design of E-Government System in Egypt

The research study addresses the issue of requirements traceability by assessing the degrees of impact with the help of quality function deployment (QFD), House of Quality (HoQ). HoQ from (QFD) is used to map the voice of customers into multiple phases of Product/Service development life cycle. The advantage of using HoQ (from QFD) is that it traces customer requirements from the very beginning to Product/Service design. As a result, it is easier for both customers and developers to visualize which design item reflects which set of requirements and to what extent these requirements are implemented. Based on the assessment result, limited resources can be allocated to more important design items and the resultant product/service will achieve a higher level of customer satisfaction. Thus, a priority assessment framework, different from the traditional linkage-based traceability methods, is provided to help find the important design items phase by phase. An integrated framework for the application of QFD of E-Government System is developed [7].

The methodology uses the Analytical Hierarchy Process AHP in order to prioritize citizen requirement, the automated House of Quality HoQ to trace the citizen requirement in multiple phases of design process and Theory of Inventive Problem Solving TRIZ technique to solve for the contradicting requirements. The HoQ correlates both the Functional requirements and Quality (non-functional) requirements with citizen requirements [8].

In this new integrated methodology, a new integrated framework that improves the quality of both the software development process and the product and assures that customers receive high quality products is established. It is integrated in the sense that it improves the limitations of previous methodologies. It ensures the following**:**

- Overcome the vagueness and inconsistencies of customer requirements and elaborate the importance index of those requirements.
- Utilizing a number of design phases of software development life cycle.
- Overcome the Limitations due to the difficulty of manual construction and calculations of the huge number of Quality Function Deployment QFD matrices which are time consuming and liable to inaccuracies.
- Using theory of inventive problem solving (TRIZ) to solve contradictions between technical requirements.

The process of operation of TRIZ for software matrix is as follows: first find what you wish to improve, then identify what is preventing or worsening that improvement. After that translate previous pair into a matching pair from the matrix parameter list, then the matrix will show the inventive principles to solve that contradiction. The forty principles of classical TRIZ are also applied to TRIZ for software with minor changes in terminology. The parameter list of the new software matrix is shown in Figure 4.

Size (Static)
Size (Dynamic)
Amount of Data
Interface
Speed
Accuracy
Stability
Ability to Detect/Measure
Loss of Time
Loss of Data
Harmful Effects Generated By System
Adaptability/Versatility
Compatibility/Connectability
Ease Of Use
Reliability/Robustness
Security
Aesthetics/Appearance
Harmful Effects On System
System Complexity
Control Complexity
Automation

Figure 4: Twenty-one Parameters of the New Software Matrix

10. Implementing the New QFD Integrated Methodology for Design of E-Government System in Egypt

As an example, to demonstrate the methodology, we will implement phase 1 of the E-Government system design process. The matrices R1 of (F-HoQ), R2 of (Q-HoQ), and R3 (Design Point Analysis Matrix) will be completed. The customer requirements serve as an input into R1 (F-HoQ) and R2 (Q-HoQ) requirement elicitation matrices. The results of these two requirements elicitation matrices serve as inputs for the R3 matrix. Results of the R3 matrix are used to combine the product functions and quality factors into one set of second phase (subsystem-level requirements) [9].

After conducting some preliminary investigation about the G2C sector, the elicited customer requirements (CRs) are as follows**:**

CR1-Fast Response
CR2-Accurate and Efficient Service
CR3-Service around the clock
CR4-Service anywhere
CR5-Save Time, Effort and Money
CR6-Easy and Understandable GUI
CR7-Sharing Decision Making Process

AHP Process for customer requirements prioritization

To prioritize citizen requirements, a questionnaire was conducted on 200 people from different sectors of the society.

The resultant filled questionnaire form after data collection and analysis appears in table 1. The AHP Matrix is illustrated in table 2.

It appears from the AHP Matrix that the priorities of Customer Requirements Priorities are as shown in table 3.

Table 1: Filled AHP Questionnaire form

		Absolute	Intermediate	Very Strong	Intermediate	Strong	Intermediate	Weak	Intermediate	Equal	Intermediate	Weak	Intermediate	Strong	Intermediate	Very Strong	Intermediate	Absolute		
		9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9		
CR1	Fast Response													X					Accurate and Efficient Service	CR2
CR1	Fast Response												X						Service around the clock	CR3
CR1	Fast Response										X								Service anywhere	CR4
CR1	Fast Response						X												Save Time, Effort and Money	CR5
CR1	Fast Response							X											Easy and Understandable GUI	CR6
CR1	Fast Response					X													Sharing Decision Making Process	CR7
CR2	Accurate and Efficient Service								X										Service around the clock	CR3
CR2	Accurate and Efficient Service						X												Service anywhere	CR4
CR2	Accurate and Efficient Service		X																Save Time, Effort and Money	CR5
CR2	Accurate and Efficient Service				X														Easy and Understandable GUI	CR6
CR2	Accurate and Efficient Service	X																	Sharing Decision Making Process	CR7
CR3	Service around the clock							X											Service anywhere	CR4
CR3	Service around the clock			X															Save Time, Effort and Money	CR5
CR3	Service around the clock					X													Easy and Understandable GUI	CR6
CR3	Service around the clock		X																Sharing Decision Making Process	CR7
CR4	Service anywhere					X													Save Time, Effort and Money	CR5
CR4	Service anywhere						X												Easy and Understandable GUI	CR6
CR4	Service anywhere			X															Sharing Decision Making Process	CR7
CR5	Save Time, Effort and Money										X								Easy and Understandable GUI	CR6
CR5	Save Time, Effort and Money								X										Sharing Decision Making Process	CR7
CR6	Easy and Understandable GUI							X											Sharing Decision Making Process	CR7

Table 2: AHP Matrix

AHP-Case Study (E-Gov)

	CR1	CR2	CR3	CR4	CR5	CR6	CR7
CR1	1	1/5	1/4	1/2	4	3	5
CR2	5	1	2	4	8	6	9
CR3	4	1/2	1	3	7	5	8
CR4	2	1/4	1/3	1	5	4	7
CR5	1/4	1/8	1/7	1/5	1	1/2	2
CR6	1/3	1/6	1/5	1/4	2	1	3
CR7	1/5	1/9	1/8	1/7	1/2	1/3	1

Weights if Inconsistent Matrices - Eigenvalue / Eigenvector Method

	CR1	CR2	CR3	CR4	CR5	CR6	CR7	CR1	CR2	CR3	CR4	CR5	CR6	CR7	Score	Product	Ratio
CR1	1.00	0.20	0.25	0.50	4.00	3.00	5.00	0.078226858	0.085005903	0.061710256	0.054988217	0.145454545	0.151260504	0.142857143	0.10279	0.7465	7.2629
CR2	5.00	1.00	2.00	4.00	8.00	6.00	9.00	0.391134289	0.425029516	0.493682045	0.439905734	0.290909091	0.302521008	0.257142857	0.37147	2.8384	7.6408
CR3	4.00	0.50	1.00	3.00	7.00	5.00	8.00	0.312907432	0.212514758	0.246841023	0.329929301	0.254545455	0.25210084	0.228571429	0.26249	2.0241	7.7113
CR4	2.00	0.25	0.33	1.00	5.00	4.00	7.00	0.156453716	0.106257379	0.082280341	0.109976434	0.181818182	0.201680672	0.2	0.14835	1.1036	7.4387
CR5	0.25	0.13	0.14	0.20	1.00	0.50	2.00	0.019556714	0.053128689	0.035263003	0.021995287	0.036363636	0.025210084	0.057142857	0.03552	0.2516	7.0822
CR6	0.33	0.17	0.20	0.25	2.00	1.00	3.00	0.026075619	0.070838253	0.049368205	0.027494108	0.072727273	0.050420168	0.085714286	0.05466	0.3856	7.0544
CR7	0.2	0.11	0.13	0.14	0.5	0.33	1.00	0.015645372	0.047225502	0.030855128	0.015710919	0.018181818	0.016806723	0.028571429	0.02471	0.1765	7.1431
								1	1	1	1	1	1	1	1	CI	0.055557
																CI/RI	0.041153

Table 3. Customer Requirements Priorities

Requirement #	Priority Index
CR2	0.371
CR3	0.262
CR4	0.148
CR1	0.103
CR6	0.055
CR5	0.036
CR7	0.025
Sum	1

Design Process: Phase 1 (Requirements Elicitation Phase)

F-HoQ: Matrix R1

The System Requirements - Functional Requirements (SRs) developed in phase 1 to satisfy the abovementioned Customer requirements are:

SR1-Qualified and Trained employees
SR2-Real time On-Line Service
SR3-Integrated Centralized service
SR4-Encouraging Citizens Participation
SR5-Multi-Language GUI
SR6-Easy and Clear Forms
SR7-Multichannel Citizen Interaction [10]

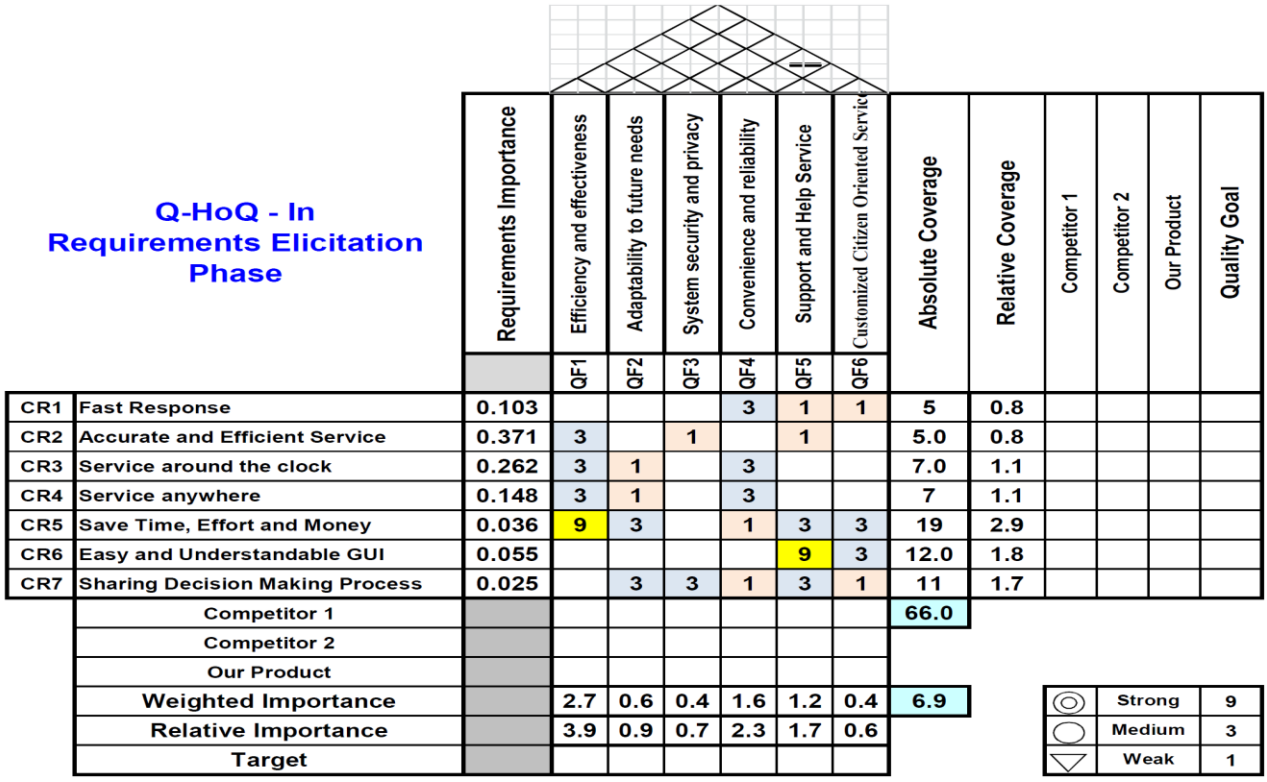
And the F-HoQ Matrix (R1) is shown in Figure 5.

Q-HoQ: Matrix R2

The Quality Factors – Non-Functional Requirements (QFs) developed in phase 1 to satisfy the abovementioned Customer requirements are:

QF1-Efficiency and effectiveness
QF2-Adaptability to future needs
QF3-System security and privacy
QF4-Convenience and reliability
QF5-Support and Help Service
QF6-Customized Citizen Oriented Service.

And the Q-HoQ Matrix (R2) is shown in Figure 6

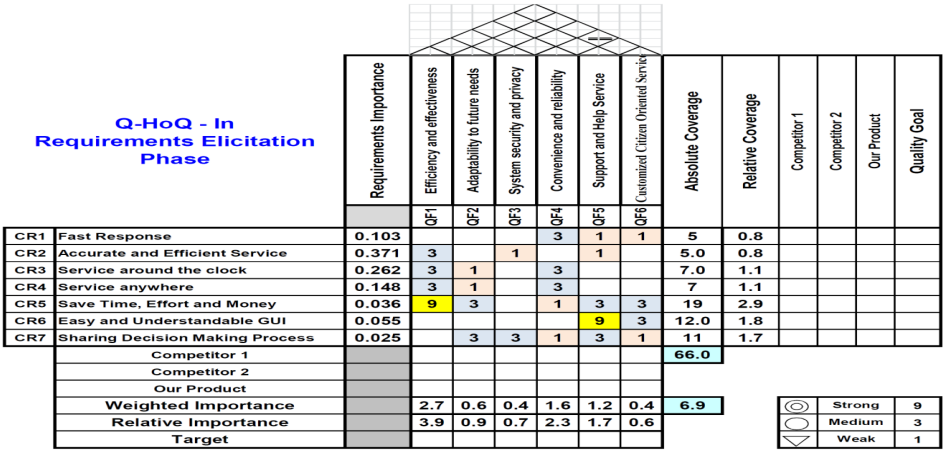


Q-HoQ - In Requirements Elicitation Phase

		Requirements Importance	Efficiency and effectiveness QF1	Adaptability to future needs QF2	System security and privacy QF3	Convenience and reliability QF4	Support and Help Service QF5	Customized Citizen Oriented Service QF6	Absolute Coverage	Relative Coverage	Competitor 1	Competitor 2	Our Product	Quality Goal
CR1	Fast Response	0.103				3	1	1	5	0.8				
CR2	Accurate and Efficient Service	0.371	3		1		1		5.0	0.8				
CR3	Service around the clock	0.262	3	1		3			7.0	1.1				
CR4	Service anywhere	0.148	3	1		3			7	1.1				
CR5	Save Time, Effort and Money	0.036	9	3		1	3	3	19	2.9				
CR6	Easy and Understandable GUI	0.055					9	3	12.0	1.8				
CR7	Sharing Decision Making Process	0.025		3	3	1	3	1	11	1.7				
	Competitor 1								66.0					
	Competitor 2													
	Our Product													
	Weighted Importance		2.7	0.6	0.4	1.6	1.2	0.4	6.9					
	Relative Importance		3.9	0.9	0.7	2.3	1.7	0.6						
	Target													

◎	Strong	9
○	Medium	3
△	Weak	1

Figure 5: F-HoQ Matrix (R1)



Q-HoQ - In Requirements Elicitation Phase

		Requirements Importance	Efficiency and effectiveness QF1	Adaptability to future needs QF2	System security and privacy QF3	Convenience and reliability QF4	Support and Help Service QF5	Customized Citizen Oriented Service QF6	Absolute Coverage	Relative Coverage	Competitor 1	Competitor 2	Our Product	Quality Goal
CR1	Fast Response	0.103				3	1	1	5	0.8				
CR2	Accurate and Efficient Service	0.371	3		1		1		5.0	0.8				
CR3	Service around the clock	0.262	3	1		3			7.0	1.1				
CR4	Service anywhere	0.148	3	1		3			7	1.1				
CR5	Save Time, Effort and Money	0.036	9	3		1	3	3	19	2.9				
CR6	Easy and Understandable GUI	0.055					9	3	12.0	1.8				
CR7	Sharing Decision Making Process	0.025		3	3	1	3	1	11	1.7				
	Competitor 1								66.0					
	Competitor 2													
	Our Product													
	Weighted Importance		2.7	0.6	0.4	1.6	1.2	0.4	6.9					
	Relative Importance		3.9	0.9	0.7	2.3	1.7	0.6						
	Target													

◎	Strong	9
○	Medium	3
△	Weak	1

Figure 6: Q-HoQ Matrix (R2)

Design Point Analysis Matrix (R3)

The Design Point Analysis Matrix (Matrix R3) which correlates the Functional Requirements with the Quality Factors is shown in Figure 7.

Design Point Analysis Matrix In Requirements Elicitation Phase	Initial Priorities	Qualified and Trained employees	Real time On-Line Service	Integrated Centralized service	Encouraging Citizens Participation	Multi-Language GUI	Easy and Clear Forms	Multichannel Citizen Interaction	Weighted Priorities	Final Priorities	Priority Index (Quality Factors)
Initial Priorities		1.2	3.1	2.1	0.4	0.4	1.9	1.0			
Efficiency and effectiveness	3.9		1	3			3	3	70.6	2.9	2
Adaptability to future needs	0.9	3	3	3		1			17.6	0.7	4
System security and privacy	0.7	3		3	9			1	10.2	0.4	5
Convenience and reliability	2.3	9		9	3		3	1	86.5	3.6	1
Support and Help Service	1.7	3	3		9	9	3	3	49.0	2.0	3
Customized Citizen Oriented Service	0.6	3			9	9		1	7.1	0.3	6
									240.9		

◎	Strong	9
○	Medium	3
▽	Weak	1

Weighted Priorities		38.9	36.3	78.1	13.6	8.6	45.0	20.4	240.9
Final Priorities		1.6	1.5	3.2	0.6	0.4	1.9	0.8	
Priority Index (Functional Requirements)		3	4	1	6	7	2	5	

Figure 7: Design Point Analysis Matrix (R3)

Results of the R3 matrix are used to combine the product functions and quality factors into one set of second phase (subsystem-level requirements), and so on [11].

11. Results

The phases of quality Function Deployment design process are: Requirements Elicitation, Sub-System Design, Module Design and Component Design phases.
The output of Design Point Analysis Matrix of the last phase of design which is component design phase traces and reflects the priorities of the above-mentioned customer requirements.
The traceability of organized needed priorities among citizens translates to the implementation of the following Information technology applications:

1- Geographic Information system
2- Electronic Cities
3- Green Information Technology
4- NFC technology

A proposal to add the above-mentioned Information technology applications to the previous phases of design of the Electronic Government system in Egypt enhances the functionality and performance of that system.
Due to the arrangement mentioned above, the excepted results of the mentioned proposal are:

1- Maximizing the performance of the Electronic Government System in Egypt.
2- Keeping pace with technological advances in the field of Information Technology as the technologically advanced countries.
3- Contributing to providing clean and green environment in Egypt
4- Integration with the world system.

12. Contributions Of This Research

This paper includes three integrated tools for the improvement of Egyptian E-Government System. These tools are; the Analytical Hierarchy process (Alternative choices Prioritization tool), Quality Function Deployment (design traceability tool) and Theory of Inventive Problem Solving (for resolving contradictions among requirements). These tools when integrated together produce high performance system design.

13. Conclusion

The issue of requirements traceability by assessing the degrees of impact with the help of quality function deployment (QFD), House of Quality (HoQ) is used to map the voice of customers into multiple phases of Product/Service development life cycle. The advantage of using HoQ (from QFD) is that it traces customer requirements from the very beginning to Product/Service design. As a result, it is easier for both customers and developers to visualize which design item reflects which set of requirements and to what extent these requirements are implemented. Based on the assessment result, limited resources can be allocated to more important design items and the resultant product/service will achieve a higher level of customer satisfaction. This research implements Quality Function Deployment approach to enhance the Egyptian E-Government System by using the Analytical Hierarchical Process for the purpose of ranking citizen requirements and the House of Quality for tracing Functional and Non-Functional (Quality) requirements. This method uses also Theory of Inventive Problem Solving (especially the contradiction matrix for software and the forty inventive principles) in order to achieve consistent and improved requirements. All these techniques are implemented during all phases of design and development [10].

14. FUTURE WORK

The future work to be done is adding more quality tools to this integrated model for E-Government System to further improve the performance of the Product/Service design process. The new quality tools to be added are: Tagushi method for design of experiments (Robust design), Design for Six-Sigma (DFSS), Lean design, and Future TRIZ research and innovations. Also, the crisp numbers used in correlations will be replaced with Fuzzy membership functions.

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