Quality Management in Software Companies- A Jordanian Field Study

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DOI: 10.4697/2020.26.1.1
Volume 26, Number 1
March 2020, pp. 65-78

This research aims at studying and understanding the extent of the commitment of the software industry in Jordan to apply the quality assurance standards in the software industry. This research concluded that the implementation of the overall quality assurance standards for the software industry is applied to a medium degree. And this research concluded with a set of conclusions and recommendations aimed at increasing attention to the quality assurance of the software products.

Keywords: Software Quality Management, Quality Assurance, Software Quality Requirements, Software Product Quality

1. Introduction

The commercial value of the software product increases as the quality of the software product increases. Therefore, the process of focusing on the quality of the software is one of the main features of the software. Any disregard for the quality of the software results in financial losses, in addition to the user's dissatisfaction with the product provided to them, especially in dangerous systems. Users are exposed to high risks (Leveson & Turner, 1993). Furthermore quality assurance process is the basis of the concrete quality of the software product and it is achieved through several things, the most important of which is the process of checking the software product and ensuring that the quality evaluation process goes along with the end of the software product and in all stages of its development. This process is very important because there is no material product Such as other physical products where compliance with product quality is easily measured, The quality of the software product is an issue open to discussion and there are different views of more than one author, but most agree that quality means "matching the requirements" and not achieving this is a defect of the software production process and therefore is the commitment of the contract between software developers and customers, Terms of application of the quality of the software products (Daniel Galin, 2004).

Of the defects that are created and the most frequent in the process of production of programs as the function points analysis (FPA) is one of the measures used to determine the description of the quality of the software produced (Stephen H. Kan 2003). Software quality assurance processes have a direct impact on the software product. Here is the difficulty in distinguishing the quality of the process used to develop the software product and the quality of the software product itself, and there are implications for the quality assurance process and the quality of the software

product Process quality processing is done through two important models ISO9001 and CMMI (SEI, 2002). First, ISO9001:2000 (ISO 9001, 2000) is an international standard, while CMMI is a process model. They initially had more difficulty interpreting and implementing the ISO9001 standards (Bouman et al., 1999; May, 2002; Niessink, 2000). Service organizations also experience greater difficulty dissociating the final product from the processes used in its production (May, 2002). Although In order to enhance and strengthen the quality of software developers and software designers are looking for and scouring a number of tools that are a good value for the software product in general and holistic, this is a difficult thing for software project managers (Crosby, 1979).

Software quality verification is carried out during the development and implementation phases of the system and software. It is a continuous and similar process in collecting the system stages from the stage of collecting the system requirements to the applications in order to validate the results and matching the system to the requirements of the users. Standard according to the quality of the program and they must standardize the process of developing the system according to quality requirements (Xie Qian et al., 2008).

On the other hand, the data collected in the evaluation process must be analyzed using the appropriate tools (eg, using the method of economic and statistical analysis). Most of the time, the process of reaching the specified value, but using the software quality model, quality measurement models, and software quality evaluation analysis, and the software quality team within the software development team helps to determine the value of the unit (Chen Wevwie, 2017). The process of assessing the quality of software is one of the most uncertain (Hong Liu et al, 2017). Most of the literature and articles that discussed the quality of the software identified in seven stages are: system identification and evaluation of program quality, quality of requirements, evaluation and evaluation and the establishment of a software evaluation unit, focusing on quality assessment specifications, quality assessment design and finally analysis of software quality evaluation results (ISO/IEC, 2014). Most writers know software quality assessment criteria as a set of mechanisms for evaluating the quality of a software product like the Cayce economic product (Wang Hua et al, 2007). It should be noted that the evaluation of the quality of the software products is the process of evaluating the value accessed through the system and the vision and be appropriate to the standards of software quality and quality characteristics using appropriate techniques and methods (Wang Rui, 2008). Quality standards for software products are effectively measured by analyzing and measuring the system's behavior and its compliance with predefined quality standards (Lan Yuding and Goa Jing, 2003).

2. Related Work

Maria Sagheer et al. conducted a study on the different aspects of the quality of software products. In this study, various factors and variables that play an important role in the quality of software are discussed in terms of producing agile software, launching it before the specified time, running programs in the surrounding environment, and simplifying procedures and methods of cooperation in order to reach customer satisfaction through Continuous communication with customers, according to the requirements of the users, features are put into the software for

customer satisfaction, which in turn leads to a reduction in time and cost, which ensures us the quality of the software product. Through analyzing the factors that affect software quality such as feasibility, reusability, efficiency and maintainability, software team can be achieving to software quality (Maria Sagheer, et al., 2015).

There are many flaws observed in the quality of software products that have been built in many research areas including but not limited to, query programs, test codes and analysis of the program as well as error correction programs, etc., there are processes aimed at improving and improving the quality Internal programs are targeted especially sensitive programs and then work to refactoring again. Refactoring One of the ABCs to remove the defects of the quality of previously produced software is that they were built and developed without the use of a clear approach in the process of building and development, and in order to take advantage of these previously produced software and work to reduce the cost and time of the new software product is used algorithms restructuring software systems with the use of methods to support resale Along with the restructuring of systems and the use of agile and substantial methods directed to the high quality of the software has been restructured again (N. Bodge et al, 2013).

The major transformation process in the software industry, this was in parallel with the development of methodologies in the construction and software industry as well as in the methodologies for measuring and improving the quality of software and here there must be a quality matrix to be the process of manufacturing and software development to ensure the overall quality as the customer wants and seeks to satisfy him the matrix of eight qualities along its qualities and when analyzed was the characteristic of flexibility and understanding and adaptability of the most important characteristics of the development life cycle of the system (J. Ali et al, 2014).

The problem of software and the lack of quality assurance is one of the most important challenges and constraints that stand in the face of software companies in most of the world. Most studies and methodologies work on a radical solution to this problem because the losses of software companies are increasing day by day because of this problem, the researcher focused in his research on small and medium-sized companies in the world in order to get them out of the bottleneck in the process of examination of the software and provide appropriate tools to conduct in industry Software (S. HOSSAIN, 2018). The quality assurance process for software without testing and testing of software has serious effects on the quality assurance of the software product. The researcher conducted a survey to measure the software quality in Bangladesh, and in his research developed qualitative research methodologies for the survey for the period 2017-2018. (47) companies have set standards in order to distinguish between companies based on four main axes are the distinction between organizations, determine their practices, the nature of training in these companies and education and employment opportunities have come to recommendations to the academic and industrial sector in this regard (S. M. Abdur Rouf Bhuiyan et al., 2018).

The subject of this research conducted by the researcher Antonia Bertolino focused on that the science of software engineering origin and the basis is to prevent errors and crashes and work to solve them that occurred during the process of the software industry. The researcher has sought to develop a methodology to verify the accuracy of the scope of the software industry so that these methodologies are more general

and comprehensive for the software industry, but they are still highly specialized it is also expensive, as the process of testing and checking software in order to ensure the quality of the software product is a long and complex process and the researcher has focused on setting a starting point through important previous achievements (Antonia Bertolino, 2007).

Software testing is a broad, diverse and important terminology in the software industry throughout the system life cycle where it plays an important and prominent role in the quality of software products, it improves the effectiveness of the software and validates the reliability of the software. This improves the quality of the software product (Maneela Tuteja and Gaurav Dubey, 2012).

3. Research Problem

Getting high-quality software is very important to achieve effective use of information technology. On one hand we to meet the challenges and on the one hand there are increasing needs. Others, but the problem lies in the concentration of many practices Process, research and academic studies on engineering aspects and professional to improve quality and delusional. The importance of administrative aspects and their role In achieving high quality standards for goods and services, even if We found exceptional cases in this regard, they focus on Some aspects neglect other aspects. I embodied this problem numerous studies and research, where she pointed out that the main reason In software failure and low quality is its focus On the technical aspects with neglect is almost full of aspects (Ravichandran, 2000; Phan, 2001; Kan Administration and Humanity) .and (Baslli, 94)SQM is in fact More than just paying attention to the technical aspects, it is to continue Organization in its success must be concerned with the administrative aspects And humanity in their regulatory environment: (Hart and Schlesinger, 1991);(Wilkinson, 1992) On the other hand, research suggests (Software Quality) SQM is still limited, and that many studies Some SQM principles are used, not all. It indicates Also, most research and studies have focused on aspects Technical and administrative aspects. Software quality required a high-level characteristic which defined in (ISO/IEC 9126) like: functionality, reliability, usability, efficiency, maintainability and portability (Yan, M et al, 2017).

4. Research Questions

Q1) The extent to which software industry companies in Jordan have applied to SQA elements in the software industry, in terms of management commitment High quality, following quality goals and policies, and an incentive system Rewards for distinguished individuals, development of pre-training and education plans, formal methods of analysis and design, management Based on the facts and objectives, controlling processes during software work, sharing clients and systems users in the process of software development, Participation of suppliers in the process of software development, participation and delegation of authority by senior management of engineering project managers in companies Software Industry in Jordan?

Q2) what is the level of quality of the software produced by Jordanian companies and the extent to which they meet the needs of customers and users and the need of the Jordanian market?

Q3) is there a relationship between the characteristics of companies in terms of (number of employees, Capital, age of the company in the labor market, and provides a special section of the quality of the software) and between the extent to which SQA (software quality assurances) elements apply to software products?

5. Research Methodology

This research was based on the analytical descriptive method, which was used Comprehensive survey method, where the study community included all software project managers in Jordan's software industry (248 software project managers). The sample of the study was chosen by simple random method, where the researchers distributed 160 questionnaires where 140 questionnaires were retrieved, they were answered completely and correctly, the distribution was done by hand to software development managers and systems analysts, the researcher used a range of appropriate statistical methods for data analysis it is the frequency, percentages, and averages Arithmetic and standard deviations. A synthesis of the practices found in literature through this systematic review is presented in Table 3. It represents the first version of the classification framework that was then refined in the second phase of the research.

6. Data Analysis

Q1) How well SQM elements are applied in companies Software industry?

To see how well SQM elements are applied General In the software product, Table 1 shows the arithmetical averages and the standard deviations for each An element of SQM has been Determine the level of application in terms of being high, medium or As follows: If the average Is high and if it occurs (2-3) Between (1-2) it is low, Note from this table that the level of application of all elements Total quality management was within medium and middle approval

My account (3.6462) has a standard deviation (0.7121) as seen from table that the application of any component of quality management Overall was within intermediate approval (3.6) except for element Related to customer participation, and Commitment of senior management to quality, Formal and analytical methodology and design was within the high approval (3.7-5) and with an arithmetic mean of (3.8143), (3.8214) and with standard deviation (0.7156) (0.7124), respectively, We see this result as a source of optimism for industry Software in Jordan, which is still at the beginning of its development and growth, Customer engagement is a key focus of quality management Comprehensive, and this is confirmed by most studies and research The relationship to total quality management, and the commitment of senior management to quality It is also one of the main hubs of SQM Such a hub helps greatly ease the application of all Other elements, and the removal of obstructions that stand in the way The overall application can be said to provide two axes or two components Is the right climate for adopting the concept of SQM.

Table 1 The Level of Application of all Components of SQM

No	Paragraph	Average	Standard Deviation	Approval Degree
1	Share customers and user involvement.	3.4357	.7606	Middle
2	Commitment of senior management to quality.	3.8143	.7156	High
3	Participation and delegation of powers to employees.	3.5214	.7536	Middle
4	Formal and analytical methodology and design.	3.8214	.7124	High
5	Control of software design processes.	3.4686	.7343	Middle
6	Quality objectives and policies.	3.6000	.7756	Middle
7	System of incentives and rewards.	3.6000	.6939	Middle
8	Management based on facts and objectives.	3.5214	.7817	Middle
9	Participation of suppliers or consulting firms.	3.6214	.7727	Middle
10	Training and education.	3.4929	.5689	Middle
General average		3.6462	.7121	Middle

Significant $\alpha \leq .05$

Figure 1 Means SQM Elements are Applied in Companies Software Industry

Table 1 and Figure 1 show that all other elements were included the medium approval, where items were arranged in descending order as follows: participation and delegation of powers, formal analysis design, control of software design processes, objectives quality policy, incentive system and bonuses, management based on facts, participation of suppliers or consulting firms, and training education.

Q2) What is the quality of the software produced by Jordanian companies?

Table 2 contains the paragraphs that are measured as a whole the quality of the programs produced by Jordanian companies; Table 2 shows the arithmetical averages and standard deviations of all paragraphs

The degree of approval is arranged in descending order. Using the explicit distribution same to the levels of application of SQM elements, we find that the paragraph reads: "Customers understand that developed software meets their requirements and needs "came first and in the middle average (3.4357) was characterized by a high degree of approval. This is due to the presence of cadres specialized in design processes and programming capable of producing software that meets the needs and desires customers, and this is confirmed by customer engagement results, then the paragraph states: "Programs are often met customer expectations especially regarding fast response, Flexibility, ease of use "at the second rank and with an arithmetic mean (3.1857) This indicates a middle degree of approval which states: " Customers are satisfied with the overall performance of the software quality "came in third place and in the middle (3.0500) indicates a high degree of approval the paragraph on the level of employee satisfaction with the overall performance for the quality of programs ranked fourth and the middle of average (2.7714) indicates a middle degree of approval. And by reviewing the preceding paragraphs, all of which were of a degree we find that these companies are working on the production of programs according to customer needs are always trying to get closer to customers to find out their needs and work to satisfy them in order to achieve a high degree of satisfaction with them through the production of high-quality programs this result can be explained by this companies see in customers a strategic goal to stay and grow in market, so it is very natural to identify their needs their requirements and work to achieve them.

Table 2 *Standard Meanings and Standard Deviations of Program Quality Level Paragraphs*

No	Paragraph	Average	Standard Deviation	Approval Degree
1	The quality and performance of the software provided by the company meets expectations and customer requirements.	2.7714	.59183	Middle
2	Programs often meet customer expectations, especially with regard to responsiveness, flexibility and usability.	3.1857	.70543	Middle
3	Customers understand that developed software meets their requirements and needs.	3.4357	.77004	Middle
4	Customers are satisfied with the overall performance of the software quality.	3.0500	.56677	Middle
General average		3.1107	.65851	Middle

Figure 2 *Standard Meanings of Program Quality*

Q3) Is there a relationship between the characteristics of companies in terms of (number of employees, Capital, age of the company in the labor market, and provides a special section of the quality of the software) and between the extent to which TQM elements apply to software products?

Statistical significance (at $\alpha \leq 0.05$) between properties organization of companies (number of employees, capital, age, provide a special quality unit or section (and application level) TQM elements, application types tends for the largest companies in terms of staff and head money and the presence of a section of quality, ending the element of age he was inclined to apply it to younger companies see Table 3.

Table 3 *Standard Meanings and Standard Deviations of Program Quality Level Paragraphs*

No	Paragraph	Average	Standard Deviation	Approval Degree
1	Number of employees.	3.0786	.77801	Middle
2	Capital.	3.1286	.66617	Middle
3	Age of the company in the labor market.	3.1500	.76889	Middle
4	Provides a special section of the quality of the software.	3.0786	.64672	Middle
General average		3.1089	.69994	Middle

(Significant $\alpha \leq .05$)

Figure 3 *Standard Meanings of Program Quality*

Table 4 Results of Multiple Regression Analysis of the effect of the Total Degree on the First, Second and Third Dimensions

Dimension	R	R ²	Adjusted R ²	F Change	Sig
1	.863	.744	.743	402.091	.000*
2	.958	.918	.917	291.235	.000*

It is clear from Table 4 that the explanatory and predictive ability of the total degree of the first dimension in this study is 74%, depending on the value of Adjusted R ². This shows the importance of the software industry’s commitment to the elements of software quality management

Table 5 Coefficients

Model	Un standardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)1	23.057	1.882		12.254	.000
S1	1.051	.052	.863	20.052	.000
(Constant)2	10.615	1.293		8.208	.000
S1	1.012	.030	.831	33.922	.000
S3	1.111	.065	.418	17.066	.000

We note that the total score had a statistical impact on the first dimension, and this can be explained by the importance of this dimension in managing software quality

7. Conclusion

The application and practice of TQM elements are done with a high degree of commitment to quality management and participation customers, and to a medium extent for the application of the rest of the items. This means that the level of application in all these companies is done or more, but there is a discrepancy in the number of items applied, as some companies focus on certain elements and neglect other five elements. As to the quality of the programs produced by these Companies, the results indicate that the software quality level There is a statistically significant relationship ($\alpha=0.05$) among the elements of TQM) commitment of senior management to quality, quality objectives and policies, incentives and rewards system, training education, formal analysis and design, management based on facts, control of design processes, customer participation, sharing suppliers or consulting firms, participation and delegation. The terms of reference, the quality of programs it was high. In the end we can accept this hypothesis regarding the availability of a department for quality, only apply the following items to manage total Quality: The commitment of senior management to quality, training and education, formal analysis and design, management based on facts, participation suppliers or consulting firms, participation and delegation Powers of employees.

8. Recommendations

1. SQM elements are applied General In the software product, where items were arranged in descending order as follows: participation and delegation of powers, formal analysis design, control of software design processes, objectives quality policy, incentive system and bonuses, management based on facts, participation of suppliers or consulting firms, and training education. that the application of any component of quality management Overall was within intermediate approval (3.6) except for element Related to customer participation, and Commitment of senior management to quality, Formal and analytical methodology and design was within the high approval (3.7-5) and with an arithmetic mean of (3.8143), (3.8214) and with standard deviation (0.7156) (0.7124), respectively, We see this result as a source of optimism for industry Software in Jordan, which is still at the beginning of its development and growth, Customer engagement is a key focus of quality management Comprehensive, and this is confirmed by most studies and research The relationship to total quality management, and the commitment of senior management to quality It is also one of the main hubs of SQM Such a hub helps greatly ease the application of all Other elements, and the removal of obstructions that stand in the way The overall application can be said to provide two axes or two components Is the right climate for adopting the concept of SQM.
2. Table 2 contains the paragraphs that are measured as a whole the quality of the programs produced by Jordanian companies; Table 2 shows the arithmetical averages and standard deviations of all paragraphs the degree of approval is arranged in descending order. Using the explicit distribution same to the levels of application of SQM elements, we find that the paragraph reads: "Customers understand that developed software meets their requirements and needs "came first and in the middle average (3.4357) was characterized by a high degree of approval. This is due to the presence of cadres specialized in design processes and programming capable of producing software that meets the needs and desires customers, and this is confirmed by customer engagement results, then the paragraph states: "Programs are often met customer expectations especially regarding fast response, Flexibility, ease of use "at the second rank and with an arithmetic mean (3.1857) This indicates a middle degree of approval which states: " Customers are satisfied with the overall performance of the software quality "came in third place and in the middle (3.0500) indicates a high degree of approval the paragraph on the level of employee satisfaction with the overall performance for the quality of programs ranked fourth and the middle of average (2.7714) indicates a middle degree of approval. And by reviewing the preceding paragraphs, all of which were of a degree we find that these companies are working on the production of programs according to customer needs are always trying to get closer to customers to find out their needs and work to satisfy them in order to achieve a high degree of satisfaction with them through the production of high-quality programs this result can be explained by this companies see in customers a strategic goal to stay and grow in market, so it is very natural to identify their needs their requirements and work to achieve them.

3. Ensuring conviction among senior management and employees in all organizational levels of the importance of software quality assurance (SQA), and benefits resulting from their application, and without the management's conviction of the importance of management total Quality Any effort is made and at what level it will not He writes success, so it must be translated into conviction concrete physical practices, and the provision of material and human resources and adequate facilities
4. Working to provide qualified and capable human resources applying the concept of SQA, providing software training and education for SQA program development and quality managers, to empower them knowledge and management skills are as important as technical skills (Such as analysis, design, programming), as well as reinforcement manage training and change the outlook for training and consider it a strategy essential and supportive of SQA application, rather than Consider an additional cost.
5. The need for companies to implement all elements of quality management progressively comprehensive and practical humble and not focus on certain elements other items.
6. Take care to develop and follow standards or metrics to measure performance All phases of software design and development processes, and non-use only in the initial stages such as analysis and design programming, but must continue to be used across all stages of program production, such as testing, testing and operation maintenance, and also careful to change and modify those Standards and renew them to ensure the production of software is suitable for the needs and desires of renewable customers.
7. Work to instill an organizational culture commensurate with the requirements of this introduction (as a culture of quality) based on values and concepts management as customer wishes, teamwork, and broadcast spirit of cooperation, employee participation and delegation of powers them, and other principles and values that help in finding the appropriate rule for the application of SQM.
8. Provide a specialized database on the software sector in Jordan and the companies operating in it, similar to the available data from other sectors, through cooperation between government Agencies, Companies and Jordanian Computer Society so that everyone, whether they are researchers or investors from to benefit from them, preferably if future research towards search for other variables not covered in the current study, such as a comparative study of the process of applying SQA is conducted companies that have a special unit or department of quality and those

This does not have such a unit or section in order to know different degree of application of these elements.

9. System analysis must be based primarily on the business requirements, although there is a leadership to these requirements by the developers of the system in order to control the software product because any error in the interpretation of these requirements are a result of serious and may lead to heavy losses on the system Here it should be noted that developers should avoid the following things
 - a. Original misunderstanding of requirements as they are
 - b. Misunderstanding of requests for change in requirements
 - c. Misunderstanding of not mentioning problems

10. The software project manager should evaluate the duration of the stage, identify the logical sequence of the phase, accurately assess the external resources needed to complete the project, and work with knowledge to identify the critical path to start and complete the project.
11. Software companies in the Jordanian market should work to improve the quality of software products through:
 - Working on the development of software products to prevent defects and detect them in the early stages of program development.
 - The application of local expertise in organizations and companies are experienced people who know the causes of failure and worked to avoid it as much as possible in the future is done through the causal and logical analysis during the life cycle of the system.
 - Take a sample of the methodology for the detection of errors and defects and apply them to the database to be reviewed firstly.

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