

A Preliminary Study Of Software Maintenance In e-Commerce Companies In Jordan

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Abstract— The software in e-commerce companies as in other software systems needs to be maintained every time problems occur and to ensure the system works properly. Moreover, Software maintenance has become over the past forty years an important part of software life cycle and it still until today the most important phase in software development life cycle. Numerous studies highlighted the significance of software maintenance in software life cycle

A preliminary study has been conducted in Jordanian e-commerce companies during the period of September to October 2013 in order to obtain preliminary data acquisition about current situation in software maintenance context. During the preliminary study formal interviews were completed with IT managers and senior management personnel. Through semi structured interviews the authors were able to obtain a general idea of the state of software maintenance in e-commerce companies in Jordan.

From the findings of the preliminary study the authors conclude that there was a complex maintenance activity in many of these companies.

Six E-commerce companies out of ten companies who were contacted in Jordan have participated in the preliminary study. The six participant companies showed an interest in analyzing and improving their maintenance activities and interest in participating in the main study.

Keywords— software; software; maintenance; Preliminary; e-commerce; Jordan.

I. INTRODUCTION

A. Software Maintenance

The software engineering environment has made significant progress in the software industry. Software inefficiency is a major obstacle in the software industry, that is why regular software maintenance is required. Although the maintenance phase is the last phase in the software life-cycle, it is still a very key phase of the software engineering process [1].

Many scholars stressed the significance of the software maintenance phase in the software lifecycle

[2-7]. Furthermore software maintenance is a costly phase, the estimated cost of software maintenance phase is between 40% to 90% of the total budget of software projects [6, 8]. Moreover, Abu-Shanab and Al-Saggar [9] reported that one of the significant reasons of failure of IT projects in Jordanian IT companies are related to poor or lack of planning of project stages.

Software systems have been updated to recognize the organization of the business. However, companies can't keep up with the rapid nature of software development due to the high cost of software and the scarce resources in organizations. So the perfect solution is to maintain and enhance the existing software giving greater attention to software maintenance rather than software replacement when a company is trying to improve and increase its business activity.

Consequently, exploring and analysing the factors that influence the cost of maintenance can help IT managers and decision makers to reduce the cost of maintenance by controlling the contributing factors.

B. About Jordan

Officially called the Hashemite Kingdom of Jordan, Jordan is a country located on the east bank of the River Jordan. Almost half of Jordan is covered by the Arabian Desert. Amman is the capital city of the Kingdom of Jordan.

The official and the dominant religion of Jordan is Islam. The official language in Jordan is Arabic language and English is the first foreign language [10].

The country's official currency is the Jordanian Dinar. The Jordanian Dinar fluctuates; in May 2015 it was equal to 0.092 GBP and equal to 1.41 USD [11].

C. E-commerce in Jordan

Today, demand for e-commerce is growing exponentially across whole world, and the demand for software applications in e-commerce companies is increasing too. Software applications play an important role in e-commerce companies. Indeed, no one in this field of work can afford to ignore the significance of software systems and their maintenance.

In this study the authors adopt Jackson's definition of e-commerce. He defined e-commerce as "the type of business that delivers services and products over electronic based systems through marketing, distribution, buying, and selling" [12].

The e-commerce trade is a new trend in Jordan; it has increased significantly in the last few years, The Ministry of Information and Communications Technology [13]. The number of e-commerce companies in Jordan, which according to the latest statistics, is above twenty companies [14]. Although, Arab people in the Middle East are not interested in buying goods or shopping online for security reasons and the conviction that it is not a trusted method [15]. The senior management in e-commerce companies are trying to persuade consumers to buy in safe manner, through adopted payment method "cash on delivery".

This paper will focus in obtain preliminary data acquisition about current situation in software maintenance in e-commerce companies in Jordan.

The content of this paper is organized into 8 sections as follows:

In section 2, preliminary study overview and the aim are stated. Section 3 provides the literature review and the research background. In section 4, the methodology of the study is proposed. Section 5 presents the findings. In section 6, the key findings are listed. In section 7 discusses the findings in light of the literature. Finally, section 8 concludes the paper and recommends future work.

II. PRELIMINARY STUDY OVERVIEW

A preliminary study may be defined as follows: "Preliminary information is gathered by the researcher to narrow the broad problem area and to define specific problem statement [16].

A. Preliminary study aim

The main aim for the Preliminary study is to prepare the companies and the authors for the main study (which is the next stage of this research) and gather information to support the preparation of the plan for the main study.

B. Preliminary study objectives

- Check the availability of the companies for participation in the research.
- To clarify the confidentiality needs and requirements of the participants and any other considerations.
- To explore the major problems experienced by these companies in relation to software maintenance

- To understand the relationships between e-commerce companies and other kinds of companies like finance companies, that relate to e-commerce applications.
- To determine the main types of factors that affect software maintenance in organisations.
- To identify the sources of software applications that are used in Jordanian e-commerce companies.

III. LITERATURE REVIEW

Many scholars discuss the factors affecting the software maintenance process and the effect of these factors in relation to cost and complexity in software maintenance, and they recommended addressing these factors. Some of these factors are: Human resources, software maintenance standards, source of software, and service level agreement.

A. Human resources

Despite advances in technology and major shifts in economy, human resources remain an organization's most valuable resource [17].

An organization maturity term refers to the level and the quality of the organization. High level organizations have expert teams and seek to improve the skills of staff who deal with the development and the maintenance of the system [18].

Sneed and Opferkuch [19], showed that software maintainers' experience is very important in software maintenance and plays an important role in reducing the time, effort, and cost of software maintenance. Often there is a lack of clear practice and domain knowledge as poor technical expertise in software maintenance leads to increased errors and more likelihood of new errors, this then affects the development of software maintenance. In order to improve efficacy of software maintainers, there should be more software maintenance training in this industry. Furthermore, Islam and Katiyar [18] affirm the significance of experts in software maintenance work, they noted that the prior experiences of employees in software maintenance affect the maintenance activity in a positive way in.

Colomo-Palacios et al. [20] stressed there is a high employee turnover in the field of software engineering. Furthermore, Yang et al. [21] report that the turnover and expertise play an important role in software maintenance and productivity. A high turnover rate tends to slow down software maintenance productivity, and they recommended addressing these factors when making planning decisions. Moreover knowing about these factors helps project managers to make plans to increase the likelihood of project success. Islam and Katiyar [18] also confirm that a high turnover of

employees increases the effort and cost in software maintenance.

B. Software Maintenance Standards

Today, software has become increasingly complex requiring a team of specialised people to build the software. Standards therefore are necessary in order to determine common approaches. Furthermore, a standard allows harmonisation practices among deferent countries. Standards include: language, documentation, methods, test plans and errors reporting [22]. April and Abran [5] reported that it is necessary to use standards in software maintenance to improve software maintenance activities. Software maintenance is a specific domain and sometimes is linked to other software organisations, so this needs specific terminology and standards to communicate to other software organisation. Robillard et al. [23] argue that the standards are very important to every organization using software to organise its maintenance process.

In particular, Standards can help reduce the risks in software maintenance, for example ISO 9001 helps organizations to understand the quality process, ISO/IEC deals with tasks to maintain and develop software products [23].

C. Source of software

Sources of software can be divided into two types; in-house and outsourced.

Koskinen et al. [24] defines outsourcing as “using factors which are external to an organization to perform its functions whereas offshore outsourcing relies on using foreign resources to perform those functions.” On the other hand, in-house means developing software internally by the IT team in the organisation [25].

Several companies are outsourcing the software product to reduce costs and to improve efficiency, also because the technical resources are scarce in some companies [25]. Moreover, Jiménez et al [26] stressed that many companies tend to outsource maintenance to reap the benefits and reduce the cost and effort of maintenance, especially when a consumer company lacks the technical expertise.

On the other hand, there are many risks of maintenance outsourcing, which should be addressed in project planning [25, 27], such as:

- Cost and time over-run for maintenance activities
- Lack of expertise in company selection
- Culture mismatch, like language issues

D. Service level Agreement(SLA)

SLA is a legal contract between participants to ensure that their quality of service requirements are met and if any party violates the SLA terms, the defaulter has to pay a penalty according to the clauses defined in the SLA [28].

If the company decided to conduct maintenance via outsourcing, many issues must be addressed in advance before starting the contract of maintenance, including: risk analysis; service level agreement (SLA) and quality of outsourcing organizations. If the software product development outsourcing is in a single organization then the same organization is a good candidate for the maintenance of the same project. This practice should be recommended [25]. Bennett and Rajlich [27] argue that the major challenge in outsourcing is the lack of the liaison between company using software (software consumer/software user) and the software development teams in vendor/service company. Furthermore, sometimes there is a lack of initial requirements definition; this leads to lack of understanding of the maintenance needs.

McCracken [29], states that one of the challenges of providers of outsourced service maintenance is the service level agreement. Approximately 50% outsourcing companies provide maintenance service that lacks prototyping and clarity of the service level agreement.

IV. RESEARCH METHODOLOGY

A case study research strategy is adopted to investigate a phenomenon in depth and within its real-life context [30]. An inductive research approach is adopted to build a clear picture about the existing situation of software maintenance in e-commerce companies in Jordan. To study the phenomena in depth, semi-structured face-to-face interviews were used in the study to make interviews flexible to allow the respondents to raise aspects that the researcher may not have thought about prior to the interviews. The interviews were conducted in the presence of the researcher, IT supervisor or manager of each company.

A. Population of Study

As mentioned previously in section (e-commerce in Jordan) the number of e-commerce companies in Jordan, according to the statistic 2012, is approximately twenty companies. However, the researcher observed when conducting the preliminary study in e-commerce companies in Jordan, there were only ten established office-based companies. The other companies were smaller businesses possibly based from home, although they were registered in the Ministry of Industry and Trade (MIT). The study is focused on office based e-commerce companies. The researcher did approach the managers of all ten office-

based e-commerce companies in Jordan, but only six of them agreed to participate. Four companies expressed their apologies for not participating in the study for confidential reasons.

B. Sample of Preliminary Study

Six participants (IT supervisors and senior managers) from six e-commerce companies in Jordan including one participant from each company.

C. The Interviews

The main source of evidence of the case study strategy is the interviews Yin [30], as interviews study the problem in depth and in specific details [31-32].

The authors generated sixteen questions that were asked to interviewees during the interviews. The researcher focused on open ended questions, because these types of question allow the interviewee to give more information about the situation [33].

V. FINDINGS AND ANALYSIS

A. Interview Questions

Sixteen questions were discussed in the interviews. This section will present the findings of six cases for each question in detail.

To maintain the anonymity of the participating companies, the authors use characters to label the companies as follows:

A: company 1, B: company 2, C: company 3, D: company 4, E: company 5 and F: company 6.

Q1: What does the term "maintenance" mean from e-commerce company perspective?

A common response from the interviewees was: maintenance means to maintain everything related to IT department like hardware, software, network, internet line and communications.

Q2: What are the types of software applications used in the e-commerce company; outsource and/or in-house?

Four companies (A, B, C, D) used outsourced applications (global software for e-commerce companies), and two companies (E & F) built the system in-house and had resident developer employees to develop the system.

Q3: Does the company have IT department? If yes, what is the responsibility of the IT department?

All participant companies had an IT department with different numbers of employees, ranging between one to twenty with four employees on average.

All interviewees stated that the IT department is responsible for everything that is related to technology (hardware, software, internet, and communication tools).

Q4: How could the software application help the company meet its business goals?

All respondents from six case studies said that there is no e-commerce business without software application which confirms that software application is at the heart of work that enables e-commerce to operate.

Q5: What does the term "software maintenance" mean for e-commerce Company?

Two companies (A, C) said that software maintenance means development of software applications, fixing errors, and the need to switch to another system if it's necessary and related to the software maintenance.

One company (B) said that software maintenance means just fix errors and bugs in the system.

Three companies (D, E, and F) said that software maintenance term means maintaining the software application when any errors occurred and maintaining any tools related to software like (Hardware, platform, and network)

Q6: What are the actions taken when problems occur in the software applications?

Companies A, B, C, D explained that when a problem occurs in the system, the alert system sends notification to the system administrator about the problem. The problem is then analysed and resent to internal IT department to solve it within a limited time. If the problem still occurs and wasn't solved by the internal IT, then the senior management takes the decision to consult an external IT support companies. IT support companies are always the provider of the system applications.

Two companies (E, F) solve the problems internally/in-house with the help of the IT department which developed the system from scratch, but sometimes require consultation with external IT support companies.

Q7: Are there any methodology or standard used in e-commerce Company to deal with software maintenance?

Most companies don't use any standard or methodology for software maintenance.

The researcher observed that some companies used part of software maintenance standard such as ISO, IEEE but don't have complete knowledge of the standards.

Q8: Is there any emergency plan for software maintenance?

All companies have an emergency plan for software maintenance. They have a disaster recovery system. They switch the system to disaster recovery when all the systems are down.

The researcher observed that the system is divided into modules and the problems are module-based.

One of the companies has contracts with external IT support companies to deal with emergency application system.

Q9: When you take a decision to buy the software application, what is most important from your perspective, the cost or the quality of software and maintenance?

Two companies (A, B) said that at the beginning of e-commerce business the cost is very important especially if the company is operating on a low budget.

Two companies (C, D) think that it depends not only on the cost of the software but also the quality of the software product and its maintenance requirement.

Other two companies (E, F) stated that they have internal IT department and the cost of the system is related to the salary of the employee who develops and maintains the system internally.

Q10: What are the most important factors that affect software applications especially in the maintenance phase?

Two companies (A, B) said that the quality of the system, age of the system, mother tongue of employees, and employees experience and turnover are the factors that most affect the software maintenance.

The companies (C and D) stated that the factors that most affect the system applications and its maintenance are the system quality, hardware, employees experience, internet speed, platform quality, operating system used, proliferation of system, software tools like browser applications, lack of service level agreement, and employee turnover stability.

The companies (E and F) said that the factors are the platform, hardware and employee turnover.

Q11: IS there any process for monitoring the health of e-commerce software application?

The majority of the participating companies (B, C, D, E, and F) said that they do not have a process for monitoring the health of e-commerce software application.

Company (A) has a process for monitoring the health of e-commerce software application

Q12: Does the processes of e-commerce depend on other systems in other companies, if yes, how does the company deal with other systems when problems occur?

Three of the companies (A, B, and C) said that e-commerce software application depends indirectly on the finance payment and the two systems (finance and e-commerce communicate together via service tools). They also have service level agreement between two companies to deal with problems when they occur in the service tools from both sides.

The software application in three companies (D, E, and F) does not depend on another system like finance system because they use just "cash on delivery" method.

Q13: How does the senior management deal with enhancement and maintenance of software applications in the company?

All participants stressed that the senior management in their respective companies seek to improve the software maintenance in the company through facilitating training for employees, better employee turnover and enhancing the environment which may affect software applications.

Q14: If possible, how much is the estimated budget for software maintenance as a percentage of company budget?

All the companies concealed the estimate budget of software application and software maintenance because they said it is "confidential".

Q15: Do you have a desire to participate in the main study?

All six companies who took part in the preliminary study we happy to participate in the main study

Q16: Are there any requirement or confidentiality and any other considerations for participating in the main study?

All the companies have confidentiality about the budget of IT department, the cost of software application, budget for software maintenance, and sales volume. Also the name of the software manufacturer is confidential

VI. THE KEY FINDINGS OF THE PRELIMINARY STUDY

In this section the authors focus on extracting the main findings from the data obtained from the six participants.

- The e-commerce companies are in infancy stage in Jordan.
- The respondents' feedback revealed that the software maintenance is very costly.
- E-commerce companies have increased over the last four years.
- Six companies desired to participate in the main study.
- Four of the participating companies use outsourced applications and two develop software in-house.
- Two of the companies that use outsourced applications have full permission to update the application and maintain it.
- All the companies have IT departments with varied employee number, the average of IT employees in the participating e-commerce companies is four.
- Only two of the companies don't have any relationships with external IT support companies, and four companies have contracts with external IT support companies although they have their own IT department.
- Different people within the participating companies have different understanding of what maintenance means.
- None of the companies use software maintenance standards or methodology.
- All the companies seek the development and enhancements of software applications.
- The budget of the IT department, cost of software, cost of software maintenance, salary of IT employees, sales volume, and the name of the software manufacturer are confidential in all participating companies.
- The factors that most affect software and its maintenance from participants' perspective are:
 - The budget of IT department and the budget of the company in general.
 - The age of software application.
 - The experience of employees in the IT department.
 - The employee turnover.
- Software tools like browser application.
- Platform and hardware.
- Global proliferation of the e-commerce application.
- The Mother tongue of employees who work in software maintenance.
- Lack of clear service level agreements. The payment method which is used in e-commerce companies in Jordan is "cash on delivery". The use of e-payment method is used in three out of the six participating companies.

VII. DISCUSSION

In this section, the authors discuss findings from the six case study companies in the light of the literature reviewed.

- The respondents' feedback revealed that software maintenance is very costly. This finding is consistent with the following studies: Islam and Katiyar [18] Dehaghani and Hajrahimi [6] and Floris and Harald [8] who report that software maintenance is costly.
- Expertise and turnover of employees were the main factors affecting software maintenance according to the respondents. This confirms the finding by [18, 19, 21], who report that major problems in software maintenance field are due to lack of expertise and turnover of the staff who work in software maintenance.
- Two-thirds of participants use outsourced software. The respondents' feedback revealed some problems which face the company when it depends on outsourced software. Such as loss of control of software and sometimes culture mismatch especially when outsourcing from another country with different culture. This corresponds with the Ahmed [25] and Bennett and Rajlich [27], who believe that there are many risks of maintenance outsourcing, which should be addressed in project plan.
- The authors observe from the interviews that none of the participant companies in the study used any methodology or standards of software maintenance. This finding is not in line with findings from [5, 22, 23], who reported the significance of using software maintenance standards in maintenance process.

- The respondents who have contracts with external IT support companies reported that the service level agreement (SLA) was not clear and was sometimes costly. This finding agrees with findings by Ahmed [25] and McCracken[29] studies where they found that service level agreements in software maintenance sector was not clear in most cases.
- The senior management in most companies sought to use systems that were most widely used in companies around the world, because they believed it had less potential for problems. This finding is supported by the Jiménez et al. [26] who noted that many companies tend to outsource maintenance to reap the benefits and reduce the cost and effort of the maintenance.

VIII. CONCLUSION AND FUTURE WORK

The study describes the current situation and problems facing Jordanian e-commerce companies with regards to software maintenance activities. Employees' experiences, employee turnover, service level agreement (SLA) and the source of software are the main factors that influence software maintenance. The majority of e-commerce companies in Jordan do not have any link with finance companies as they use "cash on delivery". Further, the study shows that six e-commerce companies in Jordan desire to participate in the main study. Furthermore, financial issues and some documentation are confidential at e-commerce companies in Jordan.

The results presented here are preliminary information for a wider main study investigation of the factors affecting software maintenance in e-commerce companies in Jordan.

- The authors concluded that there is a real problem in e-commerce companies and the problem is vague and needs to be addressed in depth. Hence, the main study will take a qualitative approach. The participating companies have a small number of employees who work in the IT department, so face-to face interviews will be adopted in the main study as the main source of data.
 - To examine the factors affecting software maintenance from a variety of views, the participants from each company will be divided into two groups: group A represents employees who work in software maintenance; group B represents senior management of e-commerce companies.
 - The majority of senior managers have a lack of knowledge about the characteristics of software applications used in the company.
- So, the main study will not ask the senior management any question related to characteristics of software adopted in the company.
- The findings show the majority of participants' companies did not use electronic payment method, so in the main study. the researcher will not focus on the factors affecting software maintenance related to the payment gateway

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