An empirical investigation into the adoption of Software Engineering Practice in Saudi Arabia

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Abstract

The objective of this paper is to investigate the state of software engineering practice for software industry in Saudi Arabian organizations. The main goal was mainly to gain insight into the ways these organizations are using to adopt software engineering techniques and also the sources of obstacles and difficulties faced by these organizations. To achieve that, we have designed and conducted a survey that measures the adoption of various software engineering practices. Results clearly reveal that there are several weaknesses in applying software engineering practices in Saudi Arabia especially for small organizations.

Keywords: *Software engineering practice, software development, software process improvement, Saudi Arabia*

1. Introduction

Although Kingdom of Saudi Arabia (KSA), with about 22 million people, is not the largest country in the Middle East and also not considered a developed country, it is one of the largest consumers of computing products in that area of the world as government has committed several hundreds of millions to information technology [1]. Comprehensive and consistent statistics on Saudi software sector is lacking, but IT spending reached $3.4 billion in 2008. It is forecast to reach US $5.6 billion by 2013 with an increase by 9% annually [2]. There has been tremendous demand of software development in different business sectors in the country such as banking, petrochemical and general trade organizations.

On the other hand, software development industry in KSA is dominated by a myriad of small and medium size organizations. It is expected that some software engineering practices are being adopted in these organizations. However, it is not clear how far these practices are implemented and whether the right skills and knowledge are used. To help improve the software industry, it is necessary to determine the current status of use to software engineering practices. To achieve that objective, we have designed and conducted a survey on software engineering practices in KSA that measures the adoption of various software engineering practices.

In this paper we report and discuss the outcomes of our survey and the main lessons we learnt from that survey. We present the outcomes of the survey conducted on organizations with different business types and size.

Many studies about software engineering practices have been performed in several countries, especially in Europe and united states [6,7] . Few studies have been conducted in Asia [8]. However, the research literature related to software engineering practice in developing countries is very little if not diminished. To our knowledge there is no study that has been conducted to measure the adoption of software engineering in Saudi Arabia. To our knowledge, this research is the first of its kind in that country and may be in the Middle East.

The rest of the paper is organized as follows. In the next section a detailed description of the survey is presented. The objective of our study is illustrated in that section. Analysis and results of the survey are then presented and discussed in section 3.Recommendations are discussed in section 4, and a final conclusion is drawn in section 5.

2. The Survey

The main objective of our survey is to assess the current status of Software engineering practices in KSA and the level of adoption to these practices and to see how widely software engineering techniques are being adopted in Saudi Arabian organizations. The unit of the survey analysis is organizations in KSA that have software development as part of their role. These organizations develop software either for sale or for their own use(i.e. in-house development).

The survey consists of 21 questions that were selected mainly from SE literature [9]. The number of questions was intended to be short for a better number of respondents. Most of the questions are closed with specific answers. Questions were categorized as follows:

- Demographic data about the organization and respondents background.
- Software development methodologies
- Software engineering tools
- Problems and difficulties encountered towards adoption of software engineering techniques
- Training and education in software engineering

Our survey approach follows the usual steps of conducting a survey. That is, a survey design, a trial test of the survey, and finally the actual survey process and data collection and analysis. The survey was conducted in 2011. After preparation of the survey we decided to validate it using a trial run with five different organizations. The validation process is important to ensure that questions of the survey are clear and complete. We have received some valuable comments from organization involved in the validation process. Based on these comments we have added some questions, revised some, and changed the answers of some questions. Data were collected and filled using direct contact. Some of the topics and terminologies were new to the interviewees and explanations were often required.
A sample of 160 organizations was selected from different sizes and various business areas for the purpose of this study. This sample includes organizations from different government and business sectors. A total of 82 valid responses were collected and analyzed which constitute the basis of the study giving a response rate of 51% of total distributed surveys.

3. **Analyses and discussion of survey results**

In this section we present the results and findings of the survey. Section 3.1 describes organizations that participated in the survey. Section 3.2 presents the types of software development methodologies used by surveyed organizations. While section 3.3 discusses the kind of used tools

3.1 Background and demographic information

Organizations from government and private sector were well represented in the survey. The percentage of government organization in the survey is 36% and of private sector 64%. As shown in Table 1 below, 13% of respondents were from large organizations with more than 200 employees. Intermediate organizations with employee number ranging between 50 and less than 200 formed 38% of respondents. The rest are small organizations with less than 50 employees which formed 49% of respondents.

Table 1: Distribution of organization size

Organization size	**Percentage**
Small (1-50)	49%
Medium (50-200)	38%
Large (>200)	13%

As can be seen from table 1 above, it is clear that the highest ration of responses came from small organizations due to the fact that software development industry is dominated by small organizations in the country.
Software development firms formed the most significant business sector that responded to the survey with a percentage of 43%. The largest percentage of survey answers came from organizations staff who have a software development related positions with a percentage of 61%. Organizations managers formed the second highest percentage with 24%, followed by technical executives with 12%. The rest 3% of respondents positions were not specified.
21% of respondents were involved in the development of 4 to 6 projects. 34% of respondents worked with 2 to 3 projects. Respondents who worked with one project formed 29% and the rest with 16% had no project development experience at all.

3.2 Methodology usage

A software development methodology or system development methodology in software engineering is a framework that is used to structure, plan, and control the process of software development. It is a basic and important aspect of software engineering practices. A wide variety of such frameworks have evolved over the years, each with its own recognized strengths and weaknesses[10].

In our survey, approximately 67% of organizations said that they use a form of software development methodology. The rest with approximately 33% stated that they do not use any form of methodologies. Table 2 below presents the findings of adopted methodologies by the size of surveyed organizations.

Table 2: Software methodologies and their use

Methodology	Total Use		Usage by organization size					
			Small Org. (40)		Medium org. (31)		Large org. (11)	
	Total	Percent.	Total	Percent.	Total	Percent.	Total	Percent.
Waterfall	28	34.00 %	10	25%	15	48.5%	3	27%
Structured	5	6.09%	0	0%	5	16%	0	0%
RUP	4	4.90%	0	0%	1	3.3%	3	27%
Agile	3	3.06%	1	2.5%	1	3.3%	1	9%
XP	1	1.25%	0	0%	0	0%	1	9%
Customized	10	12.29%	2	5%	7	22%	1	9%
Other	4	4.90%	1	2.5%	1	3.3%	2	19%
None	27	32.90%	26	65%	1	3.3%	0	0%

Table 2 above illustrates clearly that most of organizations that use no methodology are of small size and that methodology usage is significantly more likely in medium to large organizations. 26 out of 27 organizations who answered that they do not use any form of methodologies are small organizations. The same was noticed in other investigations of methodology usage elsewhere [3,4] which suggests that larger organizations are more likely to adopt software development methodologies. Only one out of thirty one medium size organizations was reported not to use any form of development methodology while all large organizations use different types of methodologies.

It was interesting to notice that for small organizations that use software development methodology, the traditional waterfall approach is the dominating approach while new emerging methodologies were used much more in medium and large organizations.

Respondents who did not use any kind of software development methodology were asked to indicate the reasons behind that. The most important cited reason is that learning and implementing a software development methodology is a complicated task. In their opinion, methodologies were cumbersome and time consuming. In organizations that do not adopt any methodology, developers will start programming on the fly without any plans just to get something working. Other reasons are the startup cost, the loss of guidance, and the unavailability of subject matter experts. When asked about their willingness to adopt a software development methodology, 85% answered that they are willing to do so.

3.3 Software engineering tools.

In this part of the survey, we asked organizations that currently use any kind of software engineering methodology to indicate whether they are familiar with or using a wide variety of software engineering tools such as case tools, planning tools, testing tools and etc. We attempted to make our list as comprehensive as possible. Table 3 below summarizes the responses to this part of the survey.

Results in here are similar to those in the last section which indicate that the smaller the organization, the fewer tools that are used. Small organizations use basic project management and scheduling tools. However when it comes to the more advanced tools, they tend not to use any. Respondents in small organizations were asked to indicate their reason behind the limited usage of these tools. Different reasons were given such as the smaller size of their projects, The unavailability of resources and expertise, and the feeling that the cost will not justify the expected benefits. Requirements engineering is used by little of medium organizations while 81% of large organizations use that tool as shown in the table below. A very good percentage of medium organizations use case tools while all surveyed large organization show that they are fully using them. 38% and 72% of medium and large organizations respectively use testing tools. When it comes to the more advanced software quality tools a very small percentage of both medium and large organizations adopt that.

Table 3: Usage of Software engineering tools by organization size

Software Engineering tool	Organizations using software engineering tools categorized by organization size					
	Small Organizations 14 out of 40 answered yes to software methodology usage		Medium Organizations 30 out of 31 answered yes to software methodology usage		Large Organizations 11 out of 11 answered yes to software methodology usage	
	Total	Percent	Total	Percent	Total	Percent
Project management and scheduling tools	13	92%	30	97%	11	100%
Requirements engineering and documentation tools	0	0%	11	10%	9	81%
CASE tools	1	0.71 %	23	74%	11	100%
Testing tools	0	0%	12	38 %	8	72%
Configuration Management tools	0	0%	4	13%	4	36%
Software metrics tools	0	0%	3	9.6 %	1	9%
Software quality assurance	0	0%	1	3.2%	2	18%

4. Recommendations

Overall, there is clearly a lot of work to be done with regards to getting software engineering techniques widely used in Saudi Arabian organizations. It is obvious that most of the problems related to the adoption of software engineering techniques reside in small organizations and to some extent in medium organizations. Most of these organizations are aware of that problem but do not have the appropriate knowledge and capacity to deal with it. Some recommendations can be drawn here to improve the adoption of software engineering practice and techniques:

- Weakness areas: The key issue in accelerating the adoption of software engineering practices is firstly to identify the areas that need most improvement and then find the best way to support organizations in improving these areas.

- Education and training: One important factor that influences the adoption of software engineering techniques is proper and regular education and training of technical staff. This is an important aspect that leads to improving the specialized skills on staff in the discipline.

- increase of acceptance to software engineering concepts and techniques: Some of the recommended subjects are introduction to the basics of software development methodologies, software project management, Computer Aided Software Engineering (CASE) tools , personal software process (psp) and team software process (tsp).

- Software process improvement (SPI): A software process improvement initiative should be considered to guide the correct and systematic adoption of software engineering practice. Process improvement is recommended to software development organizations as a means to improve effectiveness in terms of cost, schedule, quality, performance and to enhance competitiveness.

5. Conclusions

We have presented the results of a survey that was carried out in the year 2011 to investigate the status of software engineering adoption in software engineering organizations in KSA. Our survey reveals that minimum software engineering approaches and techniques are being used in small organizations. However medium and large organizations are making good use of these tools and

approaches. Appropriate training courses are essential to these organizations in order to provide the up to date knowledge and expertise to their staff to be able to tackle obstacles that face them to adopt software engineering techniques and methodologies.

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