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A survey of software engineering practices in Turkey

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ABSTRACT

Understanding the types of software engineering (SE) practices and techniques used in industry is important. There is a wide spectrum in terms of the types and maturity of SE practices conducted in industry. Turkey has a vibrant software industry and it is important to characterize and understand the state of its SE practices. Our objective is to characterize and grasp a high-level view on type of SE practices in the Turkish software industry. To achieve this objective, we systematically designed an online survey with 46 questions based on our past experience in the Canadian and Turkish contexts and using the Software Engineering Body of Knowledge (SWEBOK). Two hundred and two practicing software engineers from the Turkish software industry participated in the survey. The survey results reveal important and interesting findings about SE practices in Turkey and beyond. They also help track the profession of SE, and suggest areas for improved training, education and research. Among the findings are the followings: (1) The military and defense software sectors are quite prominent in Turkey, especially in the capital Ankara region, and many SE practitioners work for those companies. (2) 54% of the participants reported not using any software size measurement methods, while 33% mentioned that they have measured lines of code (LOC). (3) In terms of effort, after the development phase (on average, 31% of overall project effort), software testing, requirements, design and maintenance phases come next and have similar average values (14%, 12%, 12% and 11% respectively). (4) Respondents experience the most challenge in the requirements phase. (5) Waterfall, as a rather old but still widely used lifecycle model, is the model that more than half of the respondents (53%) use. The next most preferred lifecycle models are incremental and Agile/lean development models with usage rates of 38% and 34%, respectively. (6) The Waterfall and Agile methodologies have slight negative correlations, denoting that if one is used in a company, the other will less likely to be used. The results of our survey will be of interest to SE professionals both in Turkey and world-wide. It will also benefit researchers in observing the latest trends in SE industry identifying the areas of strength and weakness, which would then hopefully encourage further industry–academia collaborations in those areas.

1. Introduction

Software engineering (SE) has become a mature field. The term SE first appeared in the late 1960s and was introduced by Bauer to describe ways to develop, manage and maintain software so that the resulting products are reliable, correct, efficient and flexible (Naur and Randell, 1969).

Similar to many other engineering fields, the extent to which the SE academia and industry collaborate with each other is rather limited in many countries. To analyze and characterize the state of SE practices and encourage further academic–industrial collaborations, various authors have conducted and reported surveys on the topic since 1980s (e.g., Aykol, 2009; Aytaç et al., 2003; Beck and Perkins, 1983; Blackburn et al., 1996; Curtis et al., 1988; Cusumano and Kemerer, 1990; Cusumano et al., 2003; Denger et al., 2007; Dutta et al., 1999; Egorova et al., 2009; Groves et al., 2000; Holt, 1997; Kirk and Tempero, 2012; Singer et al., 1997; Sökmen, 2010; Vonken et al., 2012; Zelkowitz et al., 1984). For example, Zelkowitz et al. performed an in-depth survey (Zelkowitz et al., 1984) of 30 companies in which they characterized the state of practice in the SE industry in the USA and Japan in 1984. Their survey revealed that—at that time—practice was around 10 years behind the SE research.

Going on a quote from Strachey at the 1969 NATO conference on SE where he states that "there is a need for a greater mutual understanding between the communities of software development practice

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and software research" (Naur and Randell, 1969), we can only observe that this gap has existed for a very long time. In this respect, literature suggests two distinct ways for reducing the gap that exists between industry and academia: education and technology transfer. For example, Lethbridge et al. (2007) argue that we should better understand the dimensions of the industrial practice so that we can focus education appropriately. Focusing on education can also have direct benefits on practice, first, because academia is currently educating the next generation of software engineers, ready to take recent knowledge from academia to industry, and second, because we should also remember to continue educating existing practitioners to continually increase the level of professionalism in SE.

Turkey has a vibrant software industry. As of 2011, there were about 1600 software development companies in Turkey (Tirpançeker, 2011). Similar to other countries, it is important to continually characterize and understand the state of practices in the Turkish software industry. The IT industry worldwide faces enormous challenges in delivering quality products on time and within budget (The Standish Group, 2001; The Standish Group, 2009). Ongoing challenges of the software industry in delivering projects on time and on budget lead us to question the SE methods and practices used in the industry. Indeed, following proper and systematic SE practices by all the software companies across the globe including Turkey is a major keystone in determining the success or failure of software projects.

The goal of the survey reported in this paper is to characterize the SE practices in Turkey to provide a view on the latest SE techniques, tools and metrics used by practitioners and the challenges faced by them. We believe this information will benefit both SE professionals and also researchers both in Turkey and world-wide, identify the areas of strength and weakness, and encouraging more academia–industry collaborations.

Building on top of our track-record on conducting and reporting similar surveys in SE in Canada (Garousi and Varma, 2010; Garousi and Zhi, 2013) and Turkey (Garousi et al., 2013), and also our international industrial connections (e.g., Garousi, 2010, 2011, 2013, 2014), we planned designed, and conducted a survey in year 2013 across Turkey which received responses from 202 participants. We report and analyze the results in this article.

The remainder of this article is structured as follows. Background and a survey of the related work are presented in Section 2. We describe the design of the survey goal, design and its execution aspects in Section 3. In Section 4, we present and analyze the survey's results. Section 5 summarizes the findings and discusses the lessons learned. Finally, in Section 6, we draw conclusions, and suggest areas for further research.

2. Background and related work

We discuss in this section the following:

- A brief review on the state of the software industry in Turkey.
- Related work:
  - Surveys on SE practices in Turkey.
  - Surveys on SE practices world-wide.

2.1. State of the software industry in Turkey

To provide a review on the state of the Turkish software industry, we provide a brief summary of the existing reports and articles surveying this topic (i.e., Akkaya et al., 2012; Güneş, 2010; Tirpançeker, 2011; Turkish Software Industry Association (YASAD), 2009). Only one of these reports(i.e., Güneş, 2010) is in English, while the rest are in Turkish. Interestingly, all the five reports are recent, published between 2009 and 2012. We discuss a few of these studies below.

We should note that we have separated sources which have explicitly conducted surveys on SE practices in Turkey from the articles only expressing the state of the software industry in Turkey, without getting into technical details of SE practices (e.g., how companies conduct requirements engineering). The former group of papers is discussed in this section, while the latter group is discussed in Section 2.2.1.

The report provided in Turkish Software Industry Association (YASAD) (2009) was put together by the Turkish Software Industry Association (acronym in Turkish: YASAD, www.yasad.org.tr) and discusses the software industry as the new strength of the economy. This report concludes that the Turkish software market needs to grow to compete with hardware and services markets as it owns only 11% of the total information technologies market in Turkey, while this share is usually higher in most other European countries according to the report.

The presentation (Güneş, 2010) by YASAD provided an overview of the software industry in Turkey. The Turkish software industry's potential is highlighted as having the best availability scores for qualified engineers and IT skills among Eastern European countries. This potential is reported to be realized with an increase in the volume of software market from 1.6 to 1.8 Billion USD between 2009 and 2011.

According to Tirpançeker (2011), as of year 2010, the Turkish software industry was worth about $690 million USD. Turkish software companies exported their software products to more than 50 counties in the volume of $250 million USD. These figures were due for changes in age demographics with a 51% of the population being under 25 and more than 1.5 million Turkish small–medium enterprises (SMEs) consuming IT systems in Turkey.

According to a report prepared by Akkaya et al. (2012) in the Turkish Institute of Strategic Thinking, a non-governmental organization, there were, as of 2012, around 1600 software development companies in Turkey with Turkey as their headquarters. There are also many foreign (non-Turkish) software development companies who have R&D offices in Turkey.

There are three major national associations related to Information Technology (IT) and SE in Turkey: (1) Turkish Software Industry Association (acronym in Turkish: YASAD, (2) Informatics Association of Turkey (acronym in Turkish: TBD, www.tbd.org.tr), and (3) Turkish Informatics Foundation (acronym in Turkish: TBV, www.tbv.org.tr) which monitor the state of the industry and organize events in this area. There are also more focused SE-related associations such as the Turkish Testing Board (a.k.a., Turkish software testing and quality association, www.turkishtestingboard.org).

There are national conferences and symposiums related to IT and SE, the main ones being: the Turkish National Software Engineering Symposium (acronym in Turkish: UYMS, www.uyms.org.tr), and the National Informatics Symposium (www.citex.org).

2.2. Related work

2.2.1. Surveys on software engineering practices in Turkey

Our literature search has identified a number of surveys on SE practices in Turkey (Aykol, 2009; Aytaç et al., 2003; Sökmen, 2010; Turkish Testing Board, 2011, 2012, 2013, 2014) which have been summarized in Table 1 (sorted by year of study) and are discussed briefly next.

To the best of our knowledge, the 2001 survey (Aytaç et al., 2003) by Aytaç et al. who were members of the Turkish Society for Quality, was the earliest survey on the topic. Their survey followed the Software Engineering Body of Knowledge (SWEBOK) (version 2004) (Bourque and Fairley, 2004) and the ISO/IEC 15504 standard, also known as the Software Process Improvement and Capability Determination (SPICE) for design of the questions.

Later in 2009, Aykol replicated the 2003 survey (Aytaç et al., 2003) with some revisions, and published the results as a M.Sc. thesis (Aykol, 2009). The goal was to analyze the changes and trends in