Preface to the special issue on advances in software measurement

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1. Background

Measurement processes play an important role in software development – they are one of the cornerstones making it an engineering discipline and they support working with customer data. The use of software measurements dates back to the beginning of the discipline of software engineering and has evolved together with it, from measurements of software properties to the measurement of both software and process properties and the measurement of customer behavior. In 2002 an important standard was introduced in the area of software measurement – ISO/IEC 15939 (Software measurement processes), and was revised in 2007 to include systems engineering (Software and systems engineering – measurement processes, [1]). This standard describes the processes of measurement collection alongside the definitions of basic vocabulary of metrology within the field of software engineering. Recently the ISO/IEC 25000 series of standards (Software Quality Requirements and Evaluation, SQUARE, [2]) was introduced to improve the measurement of software quality, partially aligned with the metrology definitions of ISO/IEC 15939. The SQUARE series of standards will influence the modern ways of working with software measurements as they define quality processes, traditionally related to measurements.

At the same time the use of measures in software engineering moves from data collection to using the data (in particular the customer data) to drive decisions on product development and deployment, new features development, supporting disruptive software innovations and affecting such activities as predictions, data analytics and visualization.

Observing the current research in the area leads to identifying a number of trends.

Organizational diversity and dynamics In the last decade we have observed trends in the organization of software development, such as outsourcing, agility, insourcing and using post-deployment experimentation to better understand the customers. These trends in the organization of software development lead to a large diversity of the ways in which software is developed today – combining open-source with proprietary software, new supplier–client relationships [3] and customer-data driven development [4]. The diversity of the software development models, combined with the fast pace of the software market, required new ways of handling measures as strategic value for software enterprises, e.g. by using the customer analytics to discover new business areas.

Growing quantity of data collected in software development This trend arises from the previous one. The ability to use Internet based delivery channels and therefore use tools like Google analytics framework to understand the customers, allows modern enterprises to cross-validate data from multiple sources in order to take both business and technical decisions [5]. Such an increased availability of data sources demands more efficient ways of data handling and ability to make decisions using new data sources.

Growing number of measurement tools and measures As the abilities to collect the data increases so does the number of ways in which measures are obtained. New tools are constantly developed to measure more specific aspects of software and its surrounding. These tools require a sound metrology background [6] and novel, semantic ways of combining these tools in order to obtain meaningful measurement results.

The special issue with the advancements in the area of software measurement contributes to the increased understanding of these trends and provides new insights on how these trends can be tackled.

2. Content of the special issue

The special issue presents papers that provide insights into these trends.

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Evolutionary Coupling Measurement: Making Sense of the Current Chaos by Serkan Kirbas, Tracy Hall, and Alper Sen. This paper presents challenges related to the trend of increasing number of measures. In this paper the authors contribute to the field of software metrology by identifying criteria for evaluating coupling measures. The criteria identified in the paper are grouped into five groups, relating to:

- objectives of the measurement
- identification of measured entities and their attributes
- usage of sound empirical relation systems
- definition of measurement method and procedures, and
- usage of scale types and mathematical validation

Based on the above criteria the authors evaluate the most widely used coupling measures. The results show that there is a need for further development of the existing measures to fulfill these properties.

An Ontology-Based Approach for Integrating Tools Supporting the Software Measurement Process by Vinícius Soares Fonseca, Monalessa Perini Barcellos, and Ricardo de Almeida Falbo. The paper addresses the problem of semantic integration of heterogenous measurement tools in such a way that semantic conflicts are minimized. This problem is related to the first trend of the increasing number of measurement tools. The authors present a process of integration (OBA-MSI) using the software measurement task ontology as an input. The proposed process is evaluated in a case study in a software development organization which uses measurement tools such as SonarQube. The results show that using the ontology allows to integrate measures both on the syntactic and semantic levels, helping to deal with conflicts in the definitions of the integrated measures.

On Tackling Quality Threats for the Assessment of Measurement Programs: A Case Study on the Distribution of Metric Usage and Knowledge by Regina Hebig and Haoyu Wang. The paper addresses the trends of increasing diversity of measurement programs. In particular, the paper addresses the problem of how to holistically assess a measurement program, while introducing as little respondent bias as possible. The case study presented in the paper includes interviews with both managers and engineers. The conclusions from the study are that the managers answer more consistently than the engineers (i.e. they have a similar view on the measurement program). It also concludes that there is often more understanding about the infrastructure of the measurement program while the individual measures can be perceived differently by different individuals.

Benchmarking IT Operations Cost Based on Working Time and Unit Cost by Masateru Tsunoda, Akito Monden, Kenichi Matsumoto, Sawako Ohiwa, and Tomoki Oshino. The paper addresses one of the challenges in the trend of diverse and dynamic organizational contexts – benchmarking IT costs in the presence of outsourcing. The paper explores the primary drivers of cost (work time) and the secondary ones (size of the software). The results show that the main driver of the cost is the work time and the main driver for the work time is the size of the software.

Functional Change Impact Analysis in Use Cases: An Approach Based on COSMIC Functional Size Measurement by Mariem Haoues, Asma Sellami and Hanêne Ben-Abdallah. The paper addresses the trend of increasing amount of data available. In particular they study the possibility of using the COSMIC Function Points to provide more information when estimating the impact of a functional change in the software. The results show that using the function points in estimating the impact of the functional change helps in the decision, if a given functional change can be accommodated within the given project budget and scope.

Analyzing the Performance of Two COSMIC Approximation Sizing Techniques at the Functional Process Level by Francisco Valdés-Souto. The paper addresses the trend of growing quantity of data in software development. In particular, the paper studies the possibility of using the equal size bands approximation and the fuzzy logic based approximation to estimate project effort with higher accuracy early in the project planning process. The results show that the EPCU (Estimation of Projects in the Context of Uncertainty) fuzzy logic approximation method with a cut-off upper boundary of 16.4 COSMIC Function Points, provides the most accurate estimates compared to the actual values.

3. Summary and outlook

The goal of the special issue is to inspire new research and development in the area of software measurement. The selected papers provide some insight into the three trends presented in section 1 and inspire to novel work in this area. We have received 11 submissions and after two review rounds we have selected 6 papers for the publication in the special issue.

For the future directions, we see also that the field of software measurement is moving into using machine learning to make sense of the larger quantities of data, more flexible software development based on the data from typically non-software intensive domains (e.g. Industry 4.0) and finally increased focus on dynamic visualization of large quantities of data.

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