Reviewer's opinion
on Ph.D. dissertation authored by
Jakub Jurkiewicz
entitled:
Identification of Events in Use Cases

Dissertation: Jakub Jurkiewicz, Identification of Events in Use Cases, Poznań University of Technology, Faculty of Computing, Poznań, 2013, manuscript, 131 pages, 127 references.

1. Problem and its impact

It should be emphasized at once that the research presented in the dissertation is oriented practically. Its scope and aim is a part of a program carried out for several years in the Institute of Computing at Poznań University of Technology. The main objective of the research is to improve the requirements specification phase of the software development process. An essential part of the requirements specification is to define the functional requirements. The scope and aim of the dissertation are concentrated on specification of the functional requirements expressed by use cases.

Use cases are a widespread technique of expressing of functional requirements. The basis for their identification and description is information usually presented informally in natural language, directly, in narrative or dialog-like form, or indirectly, for example in the form of a set of business rules. A use case defines a unit of service offered by the designed software system. Meaning of the use case is described by a set of scenarios associated with realization of such a service. Scenario is a sequence of interaction between system and its actors participating in use case realization. An interaction may represent a message sent by actor to the system, a message from the system received by actor or an action performed by the system. All enumerated forms of an interaction are equated in the dissertation as events. So, scenarios are understood as sequences of events. Typically, the set of scenarios consists of a main scenario and a set of alternative scenarios reflecting extensions or exceptions – deviations from the main scenario.

Functional requirements can be described at different levels. The dissertation follows the three levels suggested by Cockburn: summary, user and subfunctional levels. This categorization seems to be debatable at least because it mixes the specification of system requirements with specification of business requirements; it violates the separation of concerns principle. Much more clear would be a classification distinguishing two levels: user level and subfunctional level, separately for business and system specifications.

Adoption of the use cases as the main subject of the dissertation is completely justified in the first place due to the role of use cases in the requirements specification, but also for other reasons, but mainly because they provide a basis for estimating the design effort.
In the initial part, the dissertation discusses what is a good and what is a bad textual description of a use case. Good descriptions are those that meet certain recommendations expressed in the form of good practices. It is more difficult however to point these descriptions that are bad. The dissertation defines the so-called bad smells in the descriptions, and next proposes application of NPL tools for their detection.

The above considerations lead to the need of use case quality comparison. For this purpose a use-case-benchmark was proposed. The benchmark was elaborated on the base of more than 500 use cases selected from over a dozen industrial and academic projects. The benchmark specification is available on the website and provides a unique reference base for comparison of use cases. It could be used in replicable evaluation experiments concerning methods and tools oriented toward use cases. Additionally, the benchmark plays also additional role as a recommendation for use case description.

The defined benchmark specification was the base for the research being the main aim of the dissertation, which were expressed in the form of the following research questions:

- Is it possible to automate identification of exceptional situations (i.e. events) in use cases?
- What is the effectiveness of such an approach?

A starting point to answer the questions was an observation that no method aimed at identification of events has been found in the literature. Therefore, in the first step of the research an intuitive, informal ad hoc method and HAZOP method adapted for use cases were described, and experimentally compared. Carefully planned and carried out controlled experiments led to interesting, and to some extent surprising conclusions. General conclusion is that both methods do not offer high accuracy in complete identification of use cases events.

In the second, the main step of the research a method of automatic identification of events in use-cases was proposed. Presented method is very original and effective. The leading idea of the approach is implicitly based on a specific database knowledge, although, the term of the database knowledge is not used. The database knowledge stems from a set of assumptions relating to actors, activities, information objects, and events. On the base of the assumptions an inference engine for identification of events is defined. The inference system is enclosed in semi-logical frame, and consists of a set axioms and two inference rules. Both the axioms and rules are result of in-depth analysis of semantics of use case steps. A deeper reflection on the meaning of these axioms leads to the conclusion that the method of automatic identification of events should be clearly superior to the previously described methods. And indeed this expectation is experimentally confirmed. Results of experiments, after statistical elaboration lead to the conclusion that the proposed method of automated identification of events can achieve higher accuracy and higher precision than manual approaches. Additionally, an average time of automatic use cases analysis is one order shorter then manual analysis.

The proposed method and the implemented prototype of programming tool supporting this method are the main and the most valuable results of this dissertation.

2. Contribution

The main, original contribution of this dissertation is the method of automatic identification of events in use cases presented in the Chapter 7. The chapter is based on the report Automated events identification in use cases elaborated by Jakub Jurkiewicz and Jerzy Nawrocki. The candidate has declared that his contribution to this chapter included the following tasks:

1. analysis of a set of real-life use-cases in order to build a knowledge-base about the abstract types of events and actions occurring in use-cases;
2. elaboration of inference rules aimed at identification of abstract types of use-case event;
3. implementation of the prototype tool (including inference, NLP and NLG layers);
4. evaluation of the accuracy and speed of the proposed method;
5. conducting and evaluating the Turing-test based experiment.

Regardless of the specific contribution of the author to the previous chapters, it is my belief that this contribution is absolutely sufficient for the doctorate. This contribution has important practical meaning – it enables construction of programming tools supporting software developers during use cases analysis, and thus affecting the improvement of the quality of requirements specification.
3. Correctness

The dissertation is very well written. This applies both to form and contents. The dissertation is the result of integration of previously published papers and reports in a single whole, together with supplementation containing explanatory comments.

Particular attention should be paid to accuracy and precision in the formulation of research objectives, methodology of conducting experiments, and formulation and statistical justification the experimental findings. The peculiarity of the research is an analysis and interpretation of informal descriptions of use cases in natural language with the supporting participation of domain experts. The analysis carried out has led to a quantitative conclusions. In other words, on the base of qualitative analysis quantitative conclusions has been derived. The level of detail considerations was chosen so as to allow other researchers to repeat or perform similar experiments.

In summary, the structure and way of reasoning presented in this dissertation fulfil the highest scientific standards.

4. Knowledge of the candidate

In the dissertation its author demonstrates a wide knowledge from the area of software engineering, especially relating to requirements specification. Initial chapters provide review of application of use cases well documented by references to current literature. Further chapters reveal author’s knowledge in the use of natural language processing tools, gathering and analysis of use cases from different software projects, in planning and carrying out experiments, finally in setting and verification of statistical hypotheses.

Additionally, implicitly author demonstrates his skills in design and implementation of programming tools.

Summing up, the candidate shows that he has wide knowledge in the discipline of computing.

5. Other remarks

The following questions arises to discussion.

- What is author’s opinion about suggested two-level categorization of use cases, separately for business and system specifications, instead of Cockburn’s three-level categorization?
- What is the role of information model in use cases specification? Although the information model is mentioned but it is not clearly defined. Usually, especially for large software projects, this model is being developed as the first, and should provide a basis for the description of behavior.
- What is author’s opinion about the role of business rules in identification and description of use cases?
- What is a definition of an event? It is surprising that the key notion for the dissertation has not been defined.

I would suggest to assign to the rules (7.1) and (7.2) explicit conditions of their applicability. In general, inference rules could have the form: \( \text{premises} \rightarrow \text{conclusion} \text{ condition} \).

As it was mentioned already, the dissertation is well-written what does not mean that there are no minor defects. Examples of such defects are few incomplete description of references, and some redundancies contained in introductory sections in some chapters. The last defect is a natural consequence that the dissertation is a merging of separately prepared publications.
6. Conclusion

Taking into account what I have presented above and the requirements imposed by Article 13 of the Act of 14 March 2003 of the Polish Parliament on the Academic Degrees and the Academic Title (with amendments), my evaluation of the dissertation according to the three basic criteria is the following:

A. Does the dissertation present an original solution to a scientific problem? (the selected option is marked with X)

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B. After reading the dissertation, would you agree that the candidate has general theoretical knowledge and understanding of the discipline of Computing, and particularly the area of Software Engineering?

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C. Does the dissertation support the claim that the candidate is able to conduct scientific work?

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Moreover, taking into account achievements of very high practical significance, and especially that the scope of the Chapter 7 would be the base for a separate dissertation I recommend to distinguish the dissertation for its quality.