

Considering Alternative Research Methods: A PhD Course Essay

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Abstract. It appears that research method is typically predetermined by research field and tradition. Failing to actively reflect on research method can lead to missed research opportunities or inferior results due to inadequate method selection. In this paper essay I consider alternative methods that could be applied to my current research of creating graphical user interfaces for PalCom systems. Not all considered methods were natural fits – e.g. case study – but others could (and have) definitely take my research in new directions.

1 INTRODUCTION

Research method generally appears to be motivated by the field of the research being carried out, and also by the tradition of a researcher's group. Such trends can be hard to break and go against, especially as a doctoral student. As an exercise in widening the perspective on possible research methods, this paper essay will consider alternative methods for my current research.

My research group adheres to the tradition of Computer Science. Our research method is that of *Engineering Research*, i.e. we identify a problem, we design and build an artifact – typically a prototype piece of software – and we evaluate it. Evaluation is typically in the form of *evaluation by example/scenario*, i.e. we apply the prototype to some characteristic, real-world problem.

2 CURRENT RESEARCH

The middleware framework provided by *PalCom* [1] is used to combine services offered by devices in an easy and flexible manner. The middleware enables devices to be combined across heterogeneous networks, and the services they offer to collaborate even if they were not designed to do so. By doing so, new functionality can be created by coordinating already existing services in new constellations.

In PalCom, users of any level of technical expertise can *assemble* the services of sin-

gle-purpose devices into new systems that are personally advantageous, all without needing to write any programming code. This concept of *end-user composition* previously did not include the process of creating *Graphical User Interfaces* (GUIs) for such systems; the aim of my research is to rectify that, thus enabling even non-programmers to create GUIs for PalCom systems. To that end, a novel approach that inverts the way GUI functionality is specified was conceived [2]. The results of realizing this idea is a graphical editor and a PalCom specific *User Interface Description Language* – PML – upon which the editor builds. PML descriptions produced with the editor can be interpreted on any platform, Android being one of them.

3 ALTERNATIVE METHODS

When considering alternative research methods for my research, I will draw inspiration from the closely related tradition of Software Engineering. Three methods will be discussed from the perspective of my research: *Controlled Experiments*, *Literature Reviews* and *Case Studies* [3].

Controlled Experiments. Experiments are launched when we want to compare the outcomes of applying different *treatments* to the objects of study. Control over the experimentation situation allows us to block the effect on the results of undesirable factors.

In a typical *technology-oriented experiment* different tools (treatment) are applied to different objects, e.g. problems to solve. This research method lends itself well to the results of my research, to the extent that I am currently in the process of carrying out an experiment with the aim to evaluate the effectiveness of the *Graphical PML Editor* (GPE). The *scope* of the experiment can be summarized as follows:

Analyze the *inverted approach to GUI development of PML*
for the purpose of *evaluation*
with respect to *tool efficiency (user productivity)*
from the point of view of *the researchers*

in the context of *engineering students solving assignments for a “toy” application*.

In the experiment, GPE is directly compared to Android Studio, measuring development times for problems common to the two groups. Preliminary results show that for the context of creating GUIs for PalCom systems, using GPE is faster than using Android Studio, even with limited training in GPE.

Literature Reviews. A Systematic Literature Review is also known as a *Survey* in Computer Science. The aim of a survey is to give a complete, comprehensive and valid picture of “all available evidence related to a specific research question”. The process of performing a survey typically involves three steps: *identification* of research related to the question, *analysis* of identified research, and *interpretation* of the research in the given context.

In 2007, a survey [4] that investigated different approaches of service composition mechanisms was carried out in the context of the PalCom project. Contributions included a classification system which was applied to all identified technologies. For PML and GPE, a similar survey could be considered. Literature review is part of any research endeavor, needed e.g. when considering related work in papers. However, a *systematic* and *complete* survey must be conducted in a scientifically and rigorous way, demanding a greater work effort. Such efforts will definitely be considered for future work.

Case Studies. A case study is an empirical method aimed at *investigating contemporary phenomena* in their context. Typically conducted in real-life contexts, e.g. at a company, it can be hard to isolate the phenomena from its environment. In software engineering, a case study could be used to compare different methods used to solve the same problem at different companies. An advantage of case studies over controlled experiments is that they are easier to plan, scale well, and are more realistic – real-world usage vs. controlled situation. However, since the environment cannot be controlled (we cannot change how they conduct business at a company) as in an experiment, it is harder to interpret and generalize the results of a case study.

A case study is similar to evaluation by example/scenario (EBE), in that they typically take place in a real setting. However, case studies are more intricate with more planning

involved, and there is a difference in context. In EBE we as researchers (out of context) try something in the real world (in context). In a case study, we observe subjects in “their natural habitat” (in context) using something in its context.

Evaluating PML and GPE using a case study is currently not realistic. The tool – GPE – is only used internally in the research group by three engineers. For a case study to be viable, GPE would have to be used by a larger population for an extended period of time. If PalCom and GPE gain traction in the industry, it could be of interest to conduct a follow up case study to investigate how the tool is being received in the real-life context of a company. Perhaps observing users interacting with products produced with PML/GPE, e.g. tablet app for nurses from itACIH project, could be structured as a case study.

4 CONCLUSIONS

Research traditions have different approaches to research, with “preferred” methods of research. In computer science, Engineering Research is prevalent, with prototypes being the typical contribution. During my time as doctoral student, this has primarily been the case. Glancing at the neighboring tradition of software engineering, I have identified two alternative research methods that can be directly applied to my research (one of which currently is), and one method that could potentially be applied in the future depending on the adaptation rate of my results.

REFERENCES

1. PalCom: *Middleware for Pervasive Computing*, <http://palcom.cs.lth.se>
2. Johnsson, B.A., Weibull, G.: *End-User Composition of Graphical User Interfaces for PalCom Systems* (2016)
3. Wohlin, C., Runeson, P., Höst, M., Ohlsson, M.C., Regnell, B., Wesslén, A.: *Experimentation in software engineering*. (2012)
4. Brønsted, J., Hansen, K.M., Ingstrup, M.: A survey of service composition mechanisms in ubiquitous computing. (2007)