Using Students as Subjects - an Empirical Evaluation

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ABSTRACT

An important task in Requirements Engineering is to select which requirements that should go into a specific release of a system. This is a complex decision that requires balancing multiple perspectives against each other. In this article we investigate what students imagine is important to professionals in requirements selection. The reason for this is to understand whether the students are able to picture what industry professionals value, and whether the courses provided to them allow them to picture the state of industry practice. The results indicate that students have a good understanding of the way industry acts in the context of requirements selection, and students may work well as subjects in empirical studies in this area.

Keywords

Education, requirements engineering, students, industry practice, empirical

1. INTRODUCTION

Requirements engineering has evolved from its traditional role, as a mere front-end in the software development lifecycle, towards becoming a continuous activity that is a key activity in software product management; a process that requires a more precise understanding of the field itself [1].

This means two things: first, it is important that newcomers into this industry have realistic expectations as to what will meet them and what will be considered important, and second, it is important to research the field and conduct empirical investigations to evaluate different solutions and/or situations.

In this study we investigate master's students' ability of understanding and assessing multiple perspective involvement in the requirements selection process, and compare this with the perceptions of industry professionals. This has two main aims. First, to understand whether students are actually capable of imagining how industrial engineers act. Second, to study whether it is possible to get similar results when using students as subjects in empirical studies. When conducting empirical investigations, it is not uncommon to use students as subjects (as argued e.g. by Höst et al. [5]). The students are readily available, often willing to participate, and require no or little compensation. However, previous studies (e.g. [2, 5]) indicate that one cannot use students blindly and then generalise to a larger population of software engineering professionals. Only under certain conditions and within certain contexts can the results of studies with students be generalised to a larger population. For example, Berander [2] discusses that students are not suitable for requirements prioritisation studies unless they have a stake in the process, i.e. the system for which requirements are prioritised must matter for the students.

The overall research question relates to the use of students as subjects in empirical software engineering research. However, more specifically the research question is: To what extent are students capable of imagining how industry professionals work in a complex requirements engineering decision process?

The remainder of this article is organised as follows. A brief background is presented in Section 2. The study methodology is presented in Section 3. The results are presented in Section 4 and discussed in Section 5, after which the article is concluded in Section 6.

2. BACKGROUND AND RELATED WORK

The number of empirical investigations that use students as subjects is too large for us to enumerate them in this article. Carver et al. [4] present a literature survey over some of these investigations, and discuss a number of guidelines for how to conduct studies with students as subjects. A number of articles argue for why it is acceptable to use students as subjects (see e.g. [3, 4, 8, 9]), and to some extent under which circumstances. The reason why it is important to make this argument is because most studies try to generalise their findings from investigations with students to a larger population of industry professionals. However, to the best of our knowledge few articles actually investigate empirically whether students are able to imagine and hence behave as industry professionals (exceptions include [2, 5, 7]). This means that there is a need for more evidence regarding the circumstances under which students can be expected to behave as industry professionals. This article makes a contribution to the aforementioned articles with yet another piece of evidence regarding these circumstances.

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3. METHODOLOGY

As argued, requirements selection is a complex task, and the question is whether students have a good understanding of the situation in industry. If so, it also provides some information about whether or not it is possible to use students as subjects in empirical studies. To study this, we performed a survey in relation to requirements selection as part of an advanced course on requirements engineering at Blekinge Institute of Technology. This course assumes that the students already have basic knowledge about how to perform requirements engineering, so that the course can focus on reflecting on and discussing previous experiences from a research and an industry practice perspective.

The subjects' average age is 26 years (with a standard deviation of 3.5 years). Their nationalities are Pakistani (approx. 60%), Polish (17%), Swedish (15%), and other (10%). Their practical experience range from 0 to 2 years, and two students that have 7 years of industry experience.

In order to monitor the students' evolution regarding how they understand and assess multiple perspective involvement in a requirements selection process we apply the Delphi method [6] over a period of four weeks. In the first week, the students answer an individual questionnaire of their personal views and their perception of industry professionals' views. These are presented as an aggregated view in week two. During week two, the subjects are assigned to nominal groups, the group's average is presented to each individual, and the subjects are encouraged to revise their answers. In week three, a revised aggregate view is presented, and each group gets an aggregate of that group, and are encouraged to discuss their answers in the group and revise them accordingly. In week 4, an aggregate view of all students are presented and compared with data from previous studies on industry practices [10].

4. RESULTS

Studying the results for each week in detail, we see that there are no major differences over the weeks, i.e. the subjects have a very stable view of their own opinions as well as that of industry professionals over the weeks (with correlations higher than 0.85 in every case).

The requirements criteria can be grouped into three perspectives, i.e. Business (external customers & markets; criteria 1 to 4), Management (internal, related to project issues; criteria 5 to 8), and System (internal related to technical solutions & development; criteria 9 to 13). Figure 1 presents the data grouped into these perspectives and compares the data with results from a previous study [10] done on Swedish Industry. In this figure we see that the management perspective seems to be accurately perceived by the subjects, and they perceive that industry professionals value the business perspective higher and the system perspective lower than they do themselves. The data from Swedish industry indicates, however, that the business perspective is even more highly valued, and the system perspective is even less valued.

It is thus to note that the students are capable of understanding the situation in industry at the same time as they also have a personal opinion.

Although there are not so many differences in the aggregate perspectives, there are some interesting differences when comparing the views for individual requirements criteria, especially those belonging to the business perspective. The values for individual criteria are presented in Table 1.

For the business perspective, we see in Table 1 that students expect that competitor analysis is much more important than the requirements issuers, which is the exact opposite of the industry practitioners' opinions.

Within the management perspective, the support / education / training criterion is overrated by the students compared to industry professionals, and the importance of delivery date is underrated.

The system perspective seems to be fairly well understood by the students, although it is - as a whole - overrated compared to what industry professionals think.

5. DISCUSSION

When we started this study we - perhaps naïvely - expected that we would be able to influence the students' perceptions through our lecturing, and that we would find differences between each week. As it turned out, this was not the case. Instead, we find that students are able to have both a personal opinion based on their education and background and to imagine how the situation is in a real industrial context. This does not mean that industry professionals are right, but since this is the reality that the students are going to meet once they graduate it is heartening to know that they have a clear conception of what awaits them.

Previous studies (e.g. [2]) indicate that students can be used as subjects in lieu of professionals under certain conditions, e.g. when there is a real commitment. If students have a real commitment, a stake, in what is being studied, they behave closer to industry practices. In this study we see further evidence that the students are capable of separating their own view from their opinion about industry.

Berander [2] suggests that project work is one way of getting more industry-like behaviour from students than in a classroom setting. In this study we made a point of asking for the students' personal perceptions as well as their perceptions of industry, which also yielded more industry-like results. Most likely, this is not the only reason, and further studies are necessary to fully understand under which conditions one can expect students to either understand industry or actually behave as in an industrial case.

6. CONCLUSIONS

This article investigates students' ability to understand and assess multiple perspective involvement in the requirements selection process. We do this by studying the students' perceptions regarding the relative importance of a

Table 1: Comparing Students and Professionals

Conmparing Students and Professionals	Students		Swedish Industry Practitioners
Criteria	Personal View	Perception of Industry	
1. Competitors	10%	14%	7%
2. Requirements Issuer	7%	6%	14%
3. Stakeholder Priority of Requirement	12%	12%	16%
4. Volatility	6%	5%	4%
5. Support/Education/Training	5%	4%	2%
6. Development Cost-Benefit	10%	13%	11%
7. Resources/Competencies	8%	6%	8%
8. Delivery date/Calendar Time	11%	12%	15%
9. System Impact	5%	4%	5%
10. Complexity	7%	6%	7%
11. Requirements Dependencies	7%	5%	6%
12. Evolution	6%	5%	4%
13. Maintenance	7%	6%	3%
Sum	100%	100%	100%

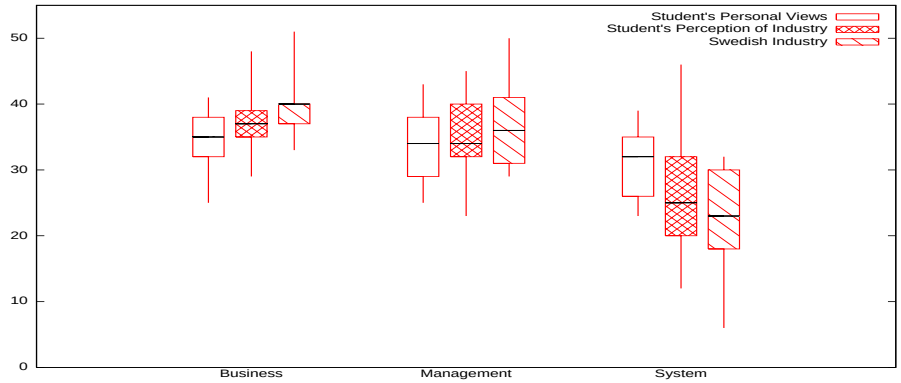

Figure 1: Comparing Students with Swedish Industry Professionals

number of important criteria for requirements selection. The students' perceptions are compared with the perceptions of Swedish industry professionals. The intentions for this are twofold; first, it is a benchmark to see whether students have realistic expectations of industry practises, and second, it allows us to further understand under which conditions students can be used in empirical investigations that are generalisable to a larger population of software engineering professionals.

In this study we find that students are able to both have a personal view and express their opinion about the way it works in industry. As students, (Berander [2] refers to this as a classroom setting), their behaviour and perceptions tend to be more influenced by what they have read and what they have been taught. When they are asked to imagine the situation is industry, their perceptions tend to be more industry realistic, and thus more usable from a research standpoint.

Berander [2] identifies that in a project setting where the students have made a true commitment, students tend to act and think more like professionals. In this study we acquired similar results simply by asking the students for their perceptions of what industry professionals would think. We do not, however, think that this would work in every situation.

From an educational perspective it is good to see that we manage to both provide the students with a personal opinion and to make them understand how it works in an industrial context. Furthermore, the study shows that it may be possible to influence students to provide answers that are in line with industrial practice. This is an important finding, since it may mean that we can indeed use students as subjects under certain circumstances. Having said this, the main question still remains largely unanswered: Under which circumstances, and how, can we influence students to act as professionals in empirical investigations?

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