

THE IMPACT OF DETAIL LEVEL IN SOFTWARE REQUIREMENT SPECIFICATIONS ON THE ESTIMATION OF COMPLEXITY AND TIME FOR THE PROJECT COMPLETION

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Abstract: Research interests for factors that influence developers estimates of time and effort required for completion of software project is increased in last decade. Since, there were no studies, neither lab, or field that reported influence of amount of details in the requirements specification for software project on time and complexity estimates, a lab experiment was conducted to investigate this influence. Sophomore students were participants and they were divided into two groups. One group was presented with requirements that are 270% longer than those given to the other group. Longer version of the requirements did not contain any additional information or any irrelevant data. Two hypothesis were tested, Hypothesis 1 stated that when amount of details in the specification increase, time estimates will also increase and Hypothesis 2 stated that complexity estimates will decrease when developers are presented with more detailed specification. Based on the statistical analysis of the results of the experiment, both hypothesis were rejected. It is concluded that two major reasons caused rejection of both hypothesis. First, due to lack of experience, sophomore students had to be presented with fairly simple projects that were easy to estimate, so variation between groups was very small. Second, number of available participants was not large enough to render significant statistical difference between groups.

Key Words: Requirement Specifications/Estimation/Complexity/Students

1. INTRODUCTION

One of the main problems faced by today's modern companies is creating a realistic time estimation in which it will be able to fully respond to the set requirements of clients in order to optimally distribute and organize their resources, but also maintain competitiveness by meeting the expectations of these clients. Optimal estimation of the time and difficulty of making certain tasks can depend on many factors. Many of these factors are closely related to the type of respondents personality and their relation to the task presented to them. Others, on the other hand, may be the result of different organizational factors, so they need to be examined and verified in greater detail. Positive results of this research can be an easy task and a motivation for creating a larger scale field study in a much larger number of respondents, which could result in the results obtained in more realistic conditions.

2. BACKGROUND AND RELATED WORK

Perhaps the most important factor is the very length of the user specification that is presented to the team members as a kind of guide to the development of a complete project. The main goal of this research was to determine the dependence between the length of the given user specification and the estimation of the time and difficulty of compiling the task envisaged by this specification. Previous research experiences on this topic show that there is a certain link between these factors. Perhaps the biggest and most serious research done on a similar topic was carried out by Magne Jørgensen and Stein Grimstad, studying the impact of Irrelevant and Misleading Information on Software Development Effort Estimates [3]. Leading preliminary research in laboratory conditions on smaller samples, they created a field study experiment involving 546 outsourcing companies from different parts of the world. As a result, they have been given an indication of the considerable influence of these factors. However, since the length of the user specification can not be identified with the specification of extended irrelevant information, the results of our research need not be in the same or similar correlation with the results of the aforementioned research. The influence of some of these factors has been examined in various studies, such as: The client's expectation of the effort that will be expended [1] or increased amount of information, even when this information has nothing to do with the effort required [2].

3. DESIGN OF THE EXPERIMENT

The aim of this study was to examine if more detailed explanation of users requests for software project has an influence on developer's estimates of complexity and time. Participants were divided into two groups. Both groups

were given the same software requirement but the level of details presented in the specification were different in a way that one group obtained much more detailed specification. Longer specification did not contain any irrelevant information, nor was differently formatted. In addition to the set of requirements, each group was given a questionnaire for estimates of time and complexity of the project. Each experimental group had 30 minutes to complete the survey. Students were informed that their estimates will be used for further improvement of teaching process on course "Introduction to programming".

3.1 Research Questions and Hypotheses

This study was driven by two main research questions:

- Does the level of details in a requirement specification of software project affect the estimation of time required for project completion?
- Does the level of details in a requirement specification of software project affect the estimation of complexity of software project?

Based on those research questions, two hypotheses were tested in this paper:

- With increased level of details in requirement specification, estimated time required for software project completion will also increase.
- With increased level of details in requirement specification, estimated complexity of software project will decrease.

Inspired by [3], [4], [5] and by the fact that in the research of literature that was conducted, there were no published papers about the correlation between the level of details in requirement specification and estimated time for software project completion or estimated complexity of software project, the aim of this study was to examine whether these factors are correlated and to provide a deeper understanding of this issue.

3.2 Participants

Participants of the study were sophomore students of Information System Engineering Study program, Faculty of Technical Sciences, Novi Sad, Serbia. All students attended "Introduction to programming" course. Students were randomly divided in two experimental groups. There were 12 students per group.

3.3 Material

Material for both groups consisted of:

- Software requirements specification (more or less detailed version) - One group received less detailed version, while the another group received more detailed version. Both versions were divided into 4 sections by functionalities. Longer, more detailed versions of software requirements were described in more verbose manner. There were no additional requirements or irrelevant data in the longer version. Formatting of both versions was the same. Shorter version had 216 words, 1087 character without spaces and 1328 characters with spaces, while longer version had 805 words, 4004 character without spaces and 4907 characters with spaces included. If versions are compared by number of words, longer version is 273% longer. If they were compared by the number of characters without spaces, longer version is 268% longer and if they were compared by number of characters with spaces, longer version is 270% longer. On average, longer version is 270% longer than shorter one.
- Precise instruction how to complete the survey - Precise instructions were given, so that students could easily understand what they were expected to do.
- Survey - A survey was divided into 4 sections. Sections referred to 4 functionalities given in requirements specification. For each section, students should estimate time (in minutes) and complexity using Linkert type, 5-points, bipolar scale for estimating the difficulty. 5-points scale is used, instead 7-point scale since students don't have experience with estimation of complexity of software projects, so it is easier for them if the scale is less granular.

3.4 Statistical analysis

For each student, estimated time for the completion of the software project was calculated as a sum of estimates for each of the functionalities. Results are given as Mean $\pm$ S.D. Due to small sample size, Mann-Whitney test was used to compare the differences between the two experimental groups. A probability level less than 0.05 was considered statistically significant. For each student, estimated complexity of the software project was calculated as median and mode of estimates for each functionality, given that Linkert type scale was used. Results are given as median and mode for each of the groups. Based on [6], Mann-Whitney test was used to compare the differences between the two experimental groups.

4. RESULTS

Mann-Whitney test was use for checking if there was any significant statistical difference between groups. Calculated P value was 0.5439 and it is larger than 0.05, which shows that no statistical significance was observed. Results of Mann-Whitney test for time estimation are presented in Table 1.

Box plot chart that represents time estimation is presented in Figure 1. Based on this figure, we can see that half of the respondents who received the short specification as a task, estimated the time for the main tasks to be made, more than 100 minutes (more precisely 101.5), while the other half of the respondents estimated the interval of less than 100 minutes. As for the longer specifications, half of the respondents estimated more than 92.5 minutes, and half of them less than that. If we look at the minimum and maximum values, based on this plot, we can conclude that the respondents who were tasked with estimating the time of a shorter specification gave more extreme estimates than those with a longer specification. For longer, this distribution is at significantly lower limits, which may be indicative of the fact that a more detailed specification contributes to a better understanding of the problem and therefore a more realistic time estimate.

Table Analyzed	Main Assignment
Column A	Group with shorter specification
vs	vs
Column B	Group with longer specification
Mann Whitney test	
P value	0,5439
Are medians signif. different? (P < 0.05)	No
One- or two-tailed P value?	Two-tailed
Sum of ranks in column A,B	139 , 161
Mann-Whitney U	61

Table 1. Mann-Whitney Test for Time Estimation

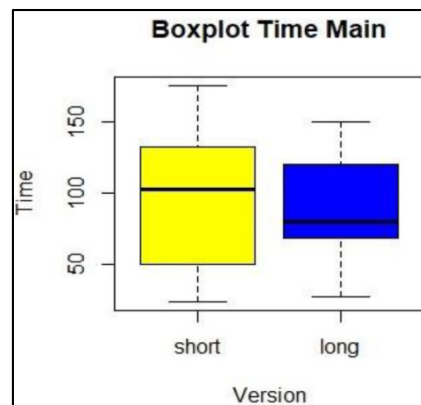


Figure 1. Box Plot Chart of Time Estimation

For calculating statistical significance of the assignments complexity, Mann-Whitney test was used and P value was 0.4377 which means that there was no statistically significant difference observed.

Box plot chart that represents complexity estimates of the assignment is presented in Figure 2. On the basis of the above, we can see that 75% of the respondents who received the assignment longer than the specification gave an estimate of weight greater than 3. On the other hand, we note that the weight estimation for a shorter specification is significantly lower and that the majority of the respondents gave the rate smaller then 3. This can lead us to conclude that the shorter version seems easier than the longer, and thus reduces the value of the estimation of weight of the task itself.

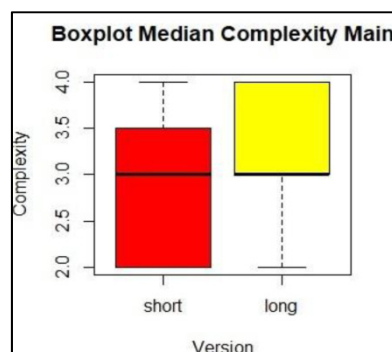


Figure 2. Box Plot Chart of Complexity Estimation

4.1 Hypothesis 1

The null hypothesis was: "There will be no statistical significance between estimates of time required for finishing software project obtained by the groups presented with different details level of requirement specification." Alternative hypothesis is that the mean time estimate for the group with more detailed specification will be statistically significantly bigger than the mean time estimate for the group with less detailed specification. As it is shown in the presented results, mean estimated time in the group that was presented with a shorter specification was 91.17 minutes, while mean estimated time in the group that was presented with a longer specification was 95.58 minutes. This shows that estimated times in both groups had been almost the same regardless of the amount of details in the specification. Based on these test results and P value of 0.5439, calculated by Mann-Whitney test, Hypothesis 1 was rejected.

4.2 Hypothesis 2

The null hypothesis was: "There will be no difference between median and mode of complexity estimates among groups with more and less detailed requirement specification." Alternative hypotheses stated that statistically significant difference will appear between median and mode calculated for groups with more and less detailed specification and that group with more detailed requirement specification will perceive software tasks as easier. Results of complexity estimates shows that median value for each of the groups of students was 3, which demonstrates that there was no significant difference between estimation of complexity given by the group that was presented with more detailed specification compared to the one given by the group that was presented with less detailed specification. Mann-Whitney test was used to calculate P value and the result was 0.4377. Based on these two factors, Hypothesis 2 was rejected too.

5. DISCUSSION OF RESULTS

This study was planned to serve as laboratory experiment that possibly could lead to larger scale field study. The precondition was that both Hypothesis are confirmed. The root cause for dismissing hypothesis could be the fact that sophomore students were participants in this study. That was the reason why experimental assignments were very trivial making very easy for students to discard the length of specification. Since neither Hypothesis 1 nor Hypothesis 2 was confirmed, field study is postponed. It is planned to repeat the experiment, but with greater number of participants and with senior year students. With senior year students, it is possible to give much more complicated projects, so the outcome could vary.

6. CONCLUSION

This was the first study that investigated effect of amount of details in requirements specification for a software project on time and complexity estimate. The aim was to create lab study using sophomore students and to see if the results of the study could lead to larger field study. Hypothesis 1 stated that estimated time will increase with larger amount of details provided in requirements specification. Based on conducted statistical analysis, Hypothesis 1 is rejected. Hypothesis 2 stated that estimated complexity will decrease if requirements specification had more details. This Hypothesis was rejected too. Based on the experiment results, it is shown that level of details in requirements specification has no impact on perceived time and complexity required for completion of software project. Some of the potential reasons for this outcome of the study might be the fact that participants in the study were sophomore students and the fact that groups were too small. It won't be feasible to present sophomore students with more challenging software projects that would be more realistic, so before rejecting field experiment completely, repeated lab experiment with senior students might be conducted in the future. Additionally greater number of participants may introduce bigger variation in future experiments.

7. REFERENCES

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