

Using AHP for Prioritizing the XP User Stories from the Developers and Customers Perspectives

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Abstract—Prioritizing user stories in Extreme Programming (XP) is an important activity that occurs during the planning game. In order to start development, the stakeholders have to select which user stories should be implemented. Many studies and projects showed that there are many factors that affect the selection of stories. The literature confirms there are many ways to prioritize user stories. In this paper, the Analytic Hierarchy Process (AHP) method is presented. AHP considers various factors from two dimensions: the customer, who is concerned with value and urgency; and the developers, who are concerned with risk, cost of implementation, and complexity. Experimental results show promise for using AHP in XP.

Index Terms—Extreme Programming (XP), User Stories, Analytic Hierarchy Process

I. INTRODUCTION

User stories are “short descriptions of functionality told from the perspective of a user that are valuable to either a user of the software or the customer of the software” [1]. They are an essential tool for capturing software requirements in agile software development. They are equivalent to use cases in the traditional development. Compared to use cases, user stories are simpler, more focused, and written by the customers in small cards.

Since user stories affect the planning game especially in the scheduling and estimation areas [2], the project stakeholders are responsible for prioritizing them. In the literature, more than 15 factors are shown to have an impact on the prioritization processes in different projects domains [3]-[13]. To resolve conflicting opinions among the stakeholders, an XP team can use one of more than 25 options [14],[15],[16].

In this paper, the Analytic Hierarchy Process (AHP) is used as to help the XP teams generate a conclusive and well-balanced list of prioritized user stories.

This paper is organized as follows: section 2, briefly explains the AHP method; the user stories experiment is in section 3; the experimental results and findings are in section 4; and section 5 concludes the paper.

II. ANALYTIC HIERARCHY PROCESS

AHP is a systematic approach that addresses problems that involve the consideration of multiple criteria in a hierarchical model. AHP reflects human thinking by grouping the elements of a problem requiring a complex decision [17]. AHP can easily quantify the qualitative aspects

of many complex decision problems. AHP was developed by Thomas Saaty as a means of finding an effective and powerful methodology to deal with complex decision-making [18].

AHP comprises the following steps. 1) Structure the hierarchy model for the problem by breaking it down into a hierarchy of interrelated decision elements. 2) Define the criteria or factors and construct a pairwise comparison matrix for them; each criterion on the same level is compared with other criteria in respect of their importance to the main goal. 3) Construct a pairwise comparison matrix for alternatives with respect to each objective in separate matrices. 4) Check the consistency of the judgments errors by calculating the consistency ratio. 5) Calculate the weighted average rating for each decision alternative and chose the one with the highest score.

III. USER STORIES EXPERIMENT

The goal of this experiment was to test the effectiveness of AHP applied to XP. This experiment was performed during a course activity in a graduate course on software at the University of Regina. It involved 12 Master’s students. The study was divided into three major sessions: an introduction to the user stories practice and AHP method, the experiment itself, and calculating and analyzing the results. The subjects targeted in this experiment have various levels of programming experiences and familiarity with XP practices.

A. Preparation

Prior to the experiment, the students were given a detailed presentation about extreme programming practices focusing on planning game activities and specifically on user stories to normalize their XP knowledge. In addition, the students were exposed to the AHP through a presentation and several papers. Finally, a survey was distributed among the students to collect their personal experiences and knowledge.

B. Experiment Execution

In order to execute the experiment, the students were divided into two groups: six students acted as developers and the other six acted as customers. The group acting as customers then explained their needs to the developers. The customers wrote the following user stories:

- 1) As a professor, I want to access UR courses to upload my assignments.
- 2) As a professor, I want to access the webmarks page to enter the students’ marks.
- 3) As a student, I want to register for courses for the coming semester.
- 4) As a general user, I want to access the courses calendar to see any conflicts between courses.

- 5) As a student, I want to access my financial services account.
- 6) As a student, I want to submit an assignment so that my professor can have it on time.
- 7) As a professor, I want to access the library to help me find a new publication.
- 8) As a student, I want to view the merchandise at the bookstore for new textbooks.

All the user stories were written in small cards. Many open discussions were conducted between the developers and the customers. The discussion was focused on the customers' perceived importance of the user stories. Some developers gave advice on stories that they thought were not needed. In XP, the user stories most valuable for the customers are prioritized. However, other factors should also be considered when prioritizing user stories. These factors originate from the developers and provide important information on the risk and cost associated with each user story. For this reason, prioritization of user stories using only customer information is not always the best option. Customers should still prioritize user stories, but they should know all factors involved in them.

In this experiment, we asked the students to prioritize the user stories based on specific factors from the perspective of both developers and customers.

The developers considered three factors: risk, cost of implementation, and complexity. The customers instead considered two factors: value and urgency. The prioritization process followed three steps:

- 1) Developers discuss the user stories and answer each other three questions: What is each story's risk level? How costly is each user story? And how complicated is each user story? Then, they apply the AHP to evaluate these criteria and prioritize the stories.
- 2) Similarly, customers discuss the user stories and prioritize them by urgency and value.
- 3) When both developers and customers finish the evaluation and have the results of the AHP calculation, the customers review both results and decide on the final prioritization.

IV. RESULTS AND FINDINGS

We used MakeitRational [19] to calculate the aggregation results for the entire two groups collectively. For the developers, the ordered list of user stories based on risk, cost and complexity is shown in Table I. For the customers the ordered list of user stories based on value and urgency is shown in Table II.

If we order the user stories considering each criterion individually the list will be different as shown in Tables III, IV, V, VI and VII. The relative importance of each criterion for the developers and customers is shown in Tables VIII and IX.

The results of this experiment clearly show that although some agreement exists between the customers' perspective and the developers' perspective (e.g., US 3), there are some marked differences (e.g, US7) that can give customers an added dimension when making prioritization decisions. AHP can be used as well to combine these results if customers

wish to express a preference between the two evaluation methods; but its true value is in giving customers a better view of the development process, which is highly valued in XP.

TABLE I: USER STORIES RANKING FROM THE DEVELOPERS

Stories	Total	Risk	Cost	Complexity
US3	23.50	6.85	10.39	6.25
US5	19.01	8.66	7.61	2.47
US7	17.86	2.80	11.24	3.81
US2	13.70	3.37	4.86	1.47
US6	10.38	3.13	4.69	3.01
US4	6.04	1.13	4.19	0.71
US1	5.69	2.00	2.33	1.36
US8	3.38	1.09	1.34	0.95

TABLE II: USER STORIES RANKING FROM THE CUSTOMERS

Stories	Total	Value	Urgency
US3	35.54	21.39	14.15
US4	15.83	8.89	5.94
US6	10.72	5.99	4.73
US5	9.68	5.49	4.19
US1	9.59	5.89	3.70
US2	8.86	4.97	3.89
US7	6.27	3.19	3.08
US8	3.52	1.67	1.85

TABLE III: RISK RANKING

Stories	Risk
US5	26.22
US2	22.30
US3	20.74
US6	9.46
US7	8.49
US1	6.06
US4	3.41
US8	3.31

TABLE IV: COST RANKING

Stories	Cost
US7	24.10
US3	22.28
US5	16.30
US2	10.42
US6	10.04
US4	8.99
US1	5.00
US8	2.87

TABLE V: COMPLEXITY RANKING

Stories	Complexity
US3	30.77
US7	18.76
US6	14.84
US5	13.51
US2	7.26
US1	6.68
US8	4.68
US4	3.51

TABLE VI: URGENCY RANKING

Stories	Urgency
US3	33.27
US4	16.32
US6	11.12
US5	9.85
US2	9.15
US1	8.71
US7	7.23
US8	4.34

TABLE VII: VALUE RANKING

Stories	Value
US3	37.22
US4	15.32
US6	10.42
US1	10.24
US5	9.55
US2	8.65
US7	5.55
US8	2.91

TABLE VIII: DEVELOPER’S CRITERIA RANKING

Criterion	Weight
Cost	46.66
Risk	33.03
Complexity	20.31

TABLE IX: CUSTOMER’S CRITERIA RANKING

Criterion	Weight
Value	57.46
Urgency	42.54

V. CONCLUSION

After using AHP to investigate the critical factors that influence the prioritization of user stories from the perspectives of both customers and developers, it appears that AHP is an important tool that reconciles the differences of opinion between developers and customers. The idea that developers and customers both play a role in prioritizing user stories is instrumental in XP; AHP provides a way of determining the priorities originating from both parties. When developers inform customers of the risk, cost, and complexity associated with each user story, customers are able to prioritize the implementation of user stories. In fact, not only do the customers have more information and clarity about the

project, but also the developers benefit from participating in the prioritization activity as they increase customer communication and feedback. Thus, AHP introduces a cooperative decision making environment, which accelerates the XP development process and maximizes the effectiveness of the software being developed.

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