Acceptance of the Methods of Decision-making: A Case Study from Software Development Companies in Ukraine and Malaysia

Vitaliy Mezhuyev  
Universiti Malaysia Pahang, Gambang, Malaysia  
vitaliy@ump.edu.my

Oleg M. Lytvyn  
Ukrainian Engineering and Pedagogical Academy, Kharkiv, Ukraine  
academ_mail@ukr.net

Iuliia Pershyna  
Ukrainian Engineering and Pedagogical Academy, Kharkiv, Ukraine  
yulia_pershina@mail.ru

Olesia Nechuiviter  
Ukrainian Engineering and Pedagogical Academy, Kharkiv, Ukraine  
olesya@email.com

Oleg O. Lytvyn  
Ukrainian Engineering and Pedagogical Academy, Kharkiv, Ukraine  
loo71@bk.ru

Vladimir Lavrik  
Berdyansk State Pedagogical University, Berdyansk, Ukraine  
vladimirlavrik1975@gmail.com

Oksana Kovalska  
Kiev National University of Civil Engineering and Architecture, Ukraine  
ottakoval@gmail.com

Yurii Gunchenko  
Odessa National University, Odessa, Ukraine  
7996445@mail.ru

ABSTRACT

Any software development company encounters issues that need decision-making. At the same time, the use of reliable and proven methods of decision-making does not become a common practice in software companies worldwide. The issues here are the need for extra staff training, allocation of additional time, and inertia of the software industry. This research studies the problems of adoption of the methods of decision-making in the software development companies of Ukraine and Malaysia. The survey was conducted to evaluate software engineers’ attitudes toward the use of the methods of decision-making. Research outcomes can be used to raise the level of adoption of the methods of decision-making in software companies worldwide.

CCS Concepts

• Social and professional topics → Industry statistics
• Software and its engineering → Collaboration in software development

Keywords

Methods of decision-making; software development; acceptance; attitudes; Ukraine; Malaysia.

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ICSCA ’19, February 19–21, 2019, Penang, Malaysia
© 2019 Association for Computing Machinery.
ACM ISBN 978-1-4503-6573-4/19/02…$15.00
https://doi.org/10.1145/3316615.3316677

1. INTRODUCTION

Decision-making commonly represents the procedure of making a choice by the management in an organization or a company. Based on the types of problems, decision-making can be made by employees of different qualifications and positions. Although a final decision to be approved by the manager, the ideas and suggestions from employees regarding the problem are very important. Besides that, different people may have specific visions on the solution to a problem. It is accepted, that groups of people can make decisions that are more reliable.

Methods of decision-making (MDM) are critical to manage the business and solve the arising problems, especially taking into account the rapid changes in software technology. Unfortunately, most of the software development companies are not aware of the methods of decision-making and correspondingly do not use them in daily practice.

This paper aims to analyse problems, preventing the use of MDM in software development companies. Besides that, it evaluates software practitioners’ attitudes to the use of the methods of decision-making. A questionnaire survey was developed and distributed in software companies of Ukraine and Malaysia in March-April of 2018. Statistical Package for Social Sciences (SPSS) was applied to check the instrument validity. ANOVA test was used to check hypotheses about the significance of difference in the properties in the groups of responders. Achieved results give insights on how to improve the acceptance of MDM in software development companies worldwide.

This paper is organized as follows. The literature review discusses the studies on the MDM and their use in software companies. Instrument development chapter demonstrates the methodology to implement the empirical study. The questionnaire survey is
2. LITERATURE REVIEW

2.1. Methods and Tools for Decision Making

Numerous studies focusing on the development of the methods and tools for decision-making.

One of the most mature and well known is the DELPHI method, which was designed to achieve consensus in a group of experts by exposing them to a sequence of questionnaires combined with managed opinion feedback [1].

Problems, linked with multiple objectives and criteria are generally known as multiple criteria decision making (MCDM). MCDM is a domain of research related to discovering optimal results in complex situations [2]. MCDM considers trade-offs between multiple criteria or goals in order to prioritize alternatives. A decision maker needs to identify the alternatives based on the solution domain and then rank them based on some criteria. Alternatives must be available, comparable, actual, practicable and feasible.

Analytic Hierarchy Process (AHP) was presented in 1980 by Thomas Saaty [3] as the method for MCDM. AHP assists a decision maker to set the priorities of alternatives, capturing both objective and subjective aspects. AHP reduces a complex choice to a series of pairwise assessments and then synthesizes the results. In addition, it includes a method for checking the reliability of evaluations, allowing to reduce the bias in the process of decision making.

AHP contains a set of assessment indicators that measure the extent to which decision-making objectives are comprehended. Following AHP, decision makers have to determine the criteria for assessing alternatives to make the right choice. Selected criteria must be consistent with the decision, independent of each other, expressed on the same scale, measurable, and related to the alternatives.

There is numerous research dedicated to AHP extension, e.g. work of Da-Yong Chang [4] devoted to handling fuzzy AHP. Hepu Deng [5] proposed an approach to solving qualitative multicriteria problems by application of the fuzzy pairwise comparison.

There are also a number of literature reviews made on the problems of MDM. Stewart [6] studied the main directions of thought in MCDM concept and practice. His work identified pitfalls in the MCDM usage in various applications and suggested the most robust and effective approaches to the non-experts in MCDM. O’Fallon and Butterfield [7] made a review of the experiential ethical MDM related literature issued in 1996–2003. Kumar et al. [8] considered various MCDM techniques in the context of renewable energy applications.

2.2. Decision Making in Software Engineering Research and Practice

Decision-making plays a crucial role in the design of software systems by counting diverse criteria and objectives at different levels. David G. Ullman [9] argued the importance of decision-making in the engineering domain. The decision made and the corresponding to it information are the keys to manage the robust software design process.

Considering the software engineering domain, there are many processes that need decision-making. For example, a decision to allocate the subset of most important requirements, the choice of the code design alternatives, the ranking of test cases etc.

Huey-Ming Lee [10] considered group decision making by application of the fuzzy sets theory for assessing the rate of aggregative risk in the software development process.


Damian and Zowghi [12] considered challenges of requirement engineering in multi-site software development companies. It was shown that the big time-zone difference has a significant impact on decision-making.

Wanga and Linb [13] developed a fuzzy MCDM approach to select configuration items in software development. The proposed model can help decision makers in selecting an appropriate pool of configuration items, increasing the software quality and reducing the development resources.

Lai, Wong, and Cheung [14] utilised AHP to support the choice of a multi-media approving system in a group decision environment. Six software engineers were taught to AHP and next asked to apply the acquired skills to select the most suitable product. The results implied that the AHP outperforms Delphi as AHP helps colleagues to concentrate a discussion on objectives, rather than alternatives. They additionally found the AHP is more contributing to consensus development in the group decision scenarios.

Aurum and Wohlin [15] illustrated how to integrate classical MDM with requirement engineering (RE) process models. This combination helps in expressing a common terminology and allows enhancing the processes manageability. It also contributes to the validating and verifying the reliability of decision-making in all RE activities.

 Büyükozkan, Kahraman and Ruan [16] proposed a methodology to enhance the quality of MDM in the software development project under uncertain conditions. The methodology is based on the extent of fuzzy AHP to evaluate adequate cost-effective and quality balance.

Büyükozkan and Feyzioğlu [17] extended the quality function deployment method by introducing a new group MDM that accounts for multiple preferences and combining different expressions into a uniform group by involving fuzzy set theory.

Acuna, Juristo and Moreno [18] explored MDM in the context of HR management for assigning people to software development roles. This procedure is vital for producing productive teams and can help software organizations to develop long-term expertise.

Büyükozkan and Ruan [19] presented an evaluation model built on the fuzzy MCDM method for assessing the performance of software design and development projects.

Badampudi et al. [20] made a systematic review and identified eleven aspects affecting the decision to choose a component origin in component-based software systems.

Anthony and Majid [21] proposed a model that assists in decision making in software management to support sustainability in software industries.

Prakash and Barua [22] focused on the recognition and categorising the solutions of reverse logistics (RL) adoption in integrated circuit technology. They proposed a methodology...
based on fuzzy AHP to identify and grade the results of RL acceptance to overcome its limitations. The empirical study of Indian industry was done to show the applicability of the recommended method.

Choosing a research design in SE research is a demanding task. Wohlin and Aurum [23] provided a foundation for research decisions in empirical SE in order to guarantee that researchers make well-grounded decisions. Misirli and Bener [24] investigated the applications of Bayesian networks to improve evidence-based MDM in SE.

2.3. Challenges of Adopting MDM in Software Development Companies

McAvoy and Butler [25] considered the role of project management in unsuccessful decision making within Agile software development methodology. It is known that agile software development teams are authorized to make decisions in contrast with traditional software development. At the same time, numerous potential factors can negatively influence the value of decision-making. One of the conclusions of [25] was that the high level of authorisation of consistent software teams might meet a negative aspect such as groupthink or the Abilene Paradox. McAvoy and Butler claimed that the responsibility of the project manager in Agile development needs to be reviewed.

García-Crespo et al. [26] explored the effect of difficult decisions in the situation of the management of global software development (GSD) teams. They hypothesized and experimentally tested the belief that complex decision making in the common development projects is very similar to GSD and the differences occur from the type of the relationship and the categorizing of issues.

Drury, Conboy, and Power [27] considered barriers to decision making in Agile software development. They analysed decisions formulated during the iteration phase and identified six significant obstacles to these decisions - reluctance to commit to decisions; contradictory priorities; volatile resource availability; and lack of implementation, rights and authorisation. The consequences of these obstacles contain a lack of longer-term, strategic emphasis for decisions, an accumulation of delayed work from previous iterations, and a lack of team engagement.

Rekhav and Muccini [28] learned the methods for group decision making and explored how the developers make group conclusions in software systems architectures. They discovered what issues companies faced when making a decision on software architecture. The study was conducted by using a survey distributed to both industry and academia practitioners involved in the group design decisions.

Solanki et al. [29] discussed problems of adoption of test-driven development, which may not fit all the conditions, so engineers have to decide at every phase when and how to apply it. They explored the developers’ expectation over the increase in time, cost, effort etc. required to develop the unit tests.

Mendes et al. [30] emphasized that companies must make a paradigm shift to guide their decision-making. Such need is evidently persistent in ICT and is a centre of value-based software engineering. They detailed a framework for decision-making related to the development of software products and services. Practical application was shown on the sample of a large ICT company in Finland. Problems influencing acceptance of different software and information technologies were also the topics of our previous research [31; 32].

3. INSTRUMENT DEVELOPMENT

The questionnaire was developed to check the status of MDM acceptance, attitudes to using the MDM and related problems. The first part of the questionnaire aimed to collect personal data of respondents and information about their company. The 5-point Likert scale was used for the evaluation of attitudes to the use of MDM. The last section contains open-ended questions to find out the problems preventing acceptance of the MDM and collects suggestions on how to increase the level of MDM acceptance. Google forms were used for the development of web-based questionnaire survey. The link to the questionnaire was distributed by email to employees working in software development companies of Ukraine and Malaysia.

3.1. Reliability Analysis

After collecting data, SPSS tool was applied to test the survey reliability. To measure the survey internal consistency (considered as a measure of scale reliability) Cronbach's alpha was used. For all calculated items, Cronbach's alpha showing values more than 0.75, suggesting that the survey has high internal consistency.

4. RESULTS AND DISCUSSION

Totally, there 100 responses were received from software development companies in Ukraine and Malaysia. Analysis showed that 37% of the respondents were 20-27 years old and 44% belong to the 28-39 age group. The male were 54% of respondents and the female were 46%. Tables 1-5 show the descriptive analysis of data on respondents’ education, position in the company, maturity (age) of the software company, number of employees and software development methodology used.

4.1. Educational Level

There four categories were considered at the educational level of respondents - undergraduate, bachelor, master and doctorate. From 100 responses, the master was found the most frequent educational level (Table 1 gives details).

<table>
<thead>
<tr>
<th>Educational Level</th>
<th>Ratio, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undergraduate</td>
<td>14</td>
</tr>
<tr>
<td>Bachelor</td>
<td>27</td>
</tr>
<tr>
<td>Master</td>
<td>52</td>
</tr>
<tr>
<td>Doctorate</td>
<td>7</td>
</tr>
</tbody>
</table>

4.2. Position in the Company

There eight position categories were proposed as a possible answer. The software developer was found the most widespread position between responders. Table 2 gives more details.

<table>
<thead>
<tr>
<th>Position</th>
<th>Ratio, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Software analyst”</td>
<td>8</td>
</tr>
<tr>
<td>“Software designer”</td>
<td>7</td>
</tr>
<tr>
<td>“Software developer”</td>
<td>39</td>
</tr>
<tr>
<td>“Tester”</td>
<td>8</td>
</tr>
<tr>
<td>“Technology officer”</td>
<td>15</td>
</tr>
<tr>
<td>“Support Specialist”</td>
<td>12</td>
</tr>
<tr>
<td>“Team/Project manager”</td>
<td>2</td>
</tr>
<tr>
<td>“Other”</td>
<td>9</td>
</tr>
</tbody>
</table>
4.3. Age of Software Company

There were three categories to evaluate an age of the company: 0-2 years, 3-6 years, and above 7 years. Most of the responders worked in the companies having age above 7 years (Table 3).

<table>
<thead>
<tr>
<th>Age</th>
<th>Ratio (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2 years</td>
<td>17</td>
</tr>
<tr>
<td>3-6 years</td>
<td>28</td>
</tr>
<tr>
<td>Above 7 years</td>
<td>55</td>
</tr>
</tbody>
</table>

4.4. Number of Employees

The number of employees in software development companies was divided into 5 categories. Table 4 shows the distribution of employees in software development companies.

<table>
<thead>
<tr>
<th>Number of Employees</th>
<th>Ratio (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-5</td>
<td>3</td>
</tr>
<tr>
<td>6-19</td>
<td>12</td>
</tr>
<tr>
<td>20-49</td>
<td>33</td>
</tr>
<tr>
<td>50-249</td>
<td>32</td>
</tr>
<tr>
<td>250 above</td>
<td>20</td>
</tr>
</tbody>
</table>

4.5. Development Methodology

Table 5 shows the analysis of development methodologies used by the companies. The most popular development methodologies are Agile software development, Rapid Application Development, Waterfall and Scrum.

<table>
<thead>
<tr>
<th>Software development methodologies</th>
<th>Ratio, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agile Software Development</td>
<td>45</td>
</tr>
<tr>
<td>Scrum</td>
<td>15</td>
</tr>
<tr>
<td>Rapid Application Development</td>
<td>10</td>
</tr>
<tr>
<td>Waterfall</td>
<td>8</td>
</tr>
<tr>
<td>Extreme Programming</td>
<td>6</td>
</tr>
<tr>
<td>Other (Lean Development, Crystal Methods, RUP, Spiral etc.)</td>
<td>16</td>
</tr>
</tbody>
</table>

4.6. Experience and Attitudes to Use of MDM

65% of respondents did not have experience of the use of the methods of decision-making. From 35%, who had an experience in the MDM, 85% have 1-2 years’ experience. Respondents, who had no experience in MDM, were asked to express their intention to use MDM (Table 6).

<table>
<thead>
<tr>
<th>Intention to future MDM use</th>
<th>Ratio, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Interesting, and I would like to use it because it fulfils my needs.”</td>
<td>74</td>
</tr>
<tr>
<td>“Interesting, but I would not like to use it because it does not fulfil my needs”.</td>
<td>14</td>
</tr>
<tr>
<td>“Not interesting, and I would not like to use it because it does not fulfil my needs”.</td>
<td>12</td>
</tr>
</tbody>
</table>

4.7. ANOVA Analysis

The ANOVA test was used to check formulated hypotheses.
6. ACKNOWLEDGEMENT
This research study was made with the support of the Faculty of Computer Systems and Software Engineering, Universiti Malaysia Pahang under the grant RDU170101.

7. REFERENCES


