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Software quality assurance
Best practice
IEEE 730-2002 standard

ABSTRACT
Ideally, the development of an application should follow a software development methodology in order to provide a clear direction of the development process that ultimately will yield a high quality software product. However, many cases happen when the development of software is failed to adopt any software methodology and in addition to that, absence to consider the standard used for assuring the quality of software. These lead to some problems: 1) the control to the software quality assurance was too difficult to conduct, 2) the deviation of requirements, 3) error founds during validation and verification processes and 4) the difficulty for future development. All this time, there is no such comprehensive instrument available to help developers ensure the quality of software development process. This study is intended to identify a document and instruments required by a developer team in assuring the quality of software during development phase. To identify the document and instruments, we first need to find out the software development methodology of an application and then adjust the software methodology with the IEEE 730-2002 standard. To do so, we use School Social Network (SSN) as our case study. This study contributes to complete literature on software quality assurance that currently is still absence to provide a comprehensive literature about document and instruments used for developers.

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1. INTRODUCTION
School Social Network (SSN) is a social network application developed by Al-Azhar Foundation on Education. This application serves as a means to facilitate the communication among teachers, students and the managerial of schools. There are two types of SSN version: mobile application and web based application.

By the time this study is being conducted, the development of SSN is in the testing phase. However, the developer of this application encounters several problems related to lack of control to ensure the quality of the application. Having an interview with them, this problem was occurred due to: 1) the software was developed without following any software development methodology. There was no clear direction as well as appropriate flows to develop the software so the team was difficult to control the software project. As a result, the scope of project was then bigger and thus, the project is overtime and over budget; 2) the software developer team did not utilize any software quality infrastructure (such as templates, checklists, procedures, work instructions, et cetera) during the software development process. Several drawbacks were then appeared: a) deviation to software requirements since there is no uniformity in procedure and work instruction for each development activity, b) during verification and validation to client, there were many errors found. This was the result of absent in using checklist to document and detect erroneous of software
since the very beginning and c) difficulty to reengineer and maintain SSN since there is no document that
guides the development and maintenance process.

Those problems are likely encountered by many software developers. This study contributes to
overcome those aforementioned problems. This study aims to identify a document and instruments required
by a developer team in assuring the quality of software during development phase. The identification is based
on IEEE 730-2002 [6] and software development methodology. The result of this study is expected to help
the software development team of SSN control the future development of SSN. In addition, the result of this
study can also be a guideline for other software development teams in developing their software.

2. LITERATURE REVIEW

2.1 Software Development Methodology

Software development methodology is a methodology used to plan, structure and control software
development [9]. Choosing a right software development methodology is necessary to help software
developers deliver projects on time, within the budget while meeting the requirements of customers. The
software methodology itself covers techniques, tools, procedures, standards and documentations that help
software developers develop software.

There are many types of software development methodology. However, there is no project that suits
all of methodologies. Instead, choosing the right methodology that fits the nature of the project is of
important. Several factors that influence the selection of software methodology are [2]: number of team
members, the level of changes that will be occurred, the aim and the scope of a project, and the intensity of
communication and relationship between developers and clients.

The methodology to develop software development is classified into two categories, traditional and
Agile methodology. There is a main difference between these two categories, according to [3]. Traditional
methodology focuses on completing requirements before moving into the next stage of software
development, that is, design. The other methodology, agile methodology, promises a quick adaptation to
collaboration, changes, process, tools, contract and planning.

Many models to develop software are categorized into either traditional, agile or perhaps the
combination of both. Waterfall model, V-model, prototype model are the common methods of traditional
methodology of software development. Agile methodology also comprises of many models. Some of the
prominent models are Extreme programming (XP Model) and Scrum.

2.2 Software Quality Assurance

According to IEEE [2], software quality assurance is a set of planned activities aimed to produce
software that complies with requirements. In addition to that, software quality assurance is a set of set of
activities intended to evaluate software development process. In a project to develop software, software
quality assurance is conducted in the entire project life cycle, started from initiation, planning, execution,
closing and monitoring and controlling.

In his book, Galin [1] proposes architecture of software quality assurance that consists of 3
components: 1) pre-project SQA components. These consist of activities to ensure the quality of software
during project initiation and planning process, 2) project life cycle SQA components that consist of activities
to ensure the quality of software during software development process, and 3) quality infrastructure
components that consist of tools and practices required to control and monitor software during initiation,
planning, development and monitoring and controlling process, 4) quality management components that are
used to ensure the software quality during monitoring and controlling process, 5) standards components.
These components consist of standards used to ensure the quality of software in the entire project life cycle,
and 6) organizational or human components. These activities are also conducted to ensure the quality of
software in the entire project life cycle.

Among other components, the nature of quality infrastructures components is common to many
projects. These components are infrastructure in a project and they serve as main tools used to prevent
erroneous of software and to keep the software in certain level of quality. Some types of infrastructure
components are procedure and work instruction, templates, checklists, preventive and correction actions,
software configuration management, et cetera.

In this study, we identify a document and some infrastructure components that are commonly used in
many projects. The infrastructures are checklist, procedures, and work instructions.

2.3 Software Quality Assurance Standards

IEEE 730-2002 is one of standards used in software quality assurance. Some tasks included in this
standard [6] are the evaluation of system requirement and analysis, the evaluation of software and system
design, media specification, the evaluation of unit implementation, integration and software testing. The
IEEE 730-2002 only specifies the above points. However, the standard is still absent on the output or deliverable of each point. In order to determine the output of each point, other standards are required such as IEEE Std. 829-1998 System & Software Test Documentation as the deliverable of software testing process [7] and ISO IEC 12207 / IEEE 12207-2008 as the deliverable of requirement gathering and analysis phase which is usually called Software Requirement Specification document [8].

3. METHODOLOGY

In order to identify instruments used to ensure the quality of software development, we use this following methodology.

![Diagram showing methodology]

4. RESULTS AND ANALYSIS

In this chapter, we present the result of the each process in the methodology.

4.1 Determining the Software Development Model of SSN

Determining the software development model of SSN was started by an interview with development team, sponsor and the client of SSN. The interview result is used as a base to classify the most appropriate methodology of the SSN. We then compare the review result with the characteristics of each software development model written by [3][4].

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Number of developers</td>
<td>Less than 10 people</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Changes during the project</td>
<td>Level of changes is high</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Project objective</td>
<td>Supporting application emphasizing on system security</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Requires rapid development time</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Requirement management</td>
<td>Requires baseline</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Flexibility to encounter any change anytime</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Communication</td>
<td>Intensive communication and most likely face-to-face communication</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Customer relationship</td>
<td>Requires a contract that clearly defines the relationship between developers and the client</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Organizational culture</td>
<td>Unspecifc, only project manager and programmer which have a clear role definition</td>
<td>✓</td>
<td>✓</td>
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</tbody>
</table>

Table 1 shows the result of our comparison in selecting software method for SSN considering selection factors taken from [3]. According to the checklist, the most appropriate software method for SSN is
agile methodology. However, there are many models included as Agile method. So, the next stage is to
determine which Agile model that suits the nature of SSN.

<table>
<thead>
<tr>
<th>Software Development Models</th>
<th>Key Points</th>
<th>Special Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme Programming (XP) [5]</td>
<td>- The development of software is oriented to customers, small team, daily builds.</td>
<td>- Refactoring. The process of system redesign is conducted to improve the performance and respond to changes.</td>
</tr>
<tr>
<td>Features Driven Development (FDD)</td>
<td>- The process consists of 5 steps, object based components, short iteration.</td>
<td>- Simple method, design and system implementation based on features, object modeling.</td>
</tr>
<tr>
<td>Scrum</td>
<td>- Independent, small project, self-organizing team, 30-day release cycle.</td>
<td>- Emphasizing on the paradigm of “definition and repetition” in the new product development.</td>
</tr>
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</table>

Table 2 shows how we select the Agile model for SSN. We compare the key points and special features of three models, i.e. Extreme Programming (XP), Features Driven Development (FDD) and Scrum. The bold and underlined key points and features indicate the suitability with the nature of SSN. Considering the comparison of the three models, the most suited Agile model for SSN is Extreme Programming.

### 4.2 Adjusting the Selected Software Development Model of SSN with IEEE 730-2002 Standard

The next stage after having Extreme Programming as the software development model is to adjust the model with the IEEE 730-2002 standard. The standard comprises of all tasks and activities applied for all models. Since SSN tends to use Extreme Programming, we need to adjust the IEEE 730-2002 with the processes and practices of assuring quality in Extreme Programming.

Each activity requires deliverables. However, there is no such document explained in the IEEE 730-2002. Therefore, we require other standards as our guideline to define the deliverables as well as documents. The related standards are IEEE Std. 829-1998 (System & Software Test Documentation) and ISO IEC 12207-2008/IEEE 12207-2008 (System & Software Test Requirement Specification). The tasks, activities, input and also the output are presented in Table 3.

### 4.3 Identifying the Instruments Used in Developing Software

The document of software development quality assurance which is the output of this study consists of two parts: 1) Main document and 2) supporting document. Main document is the guideline document to ensure the quality of software development of the SSN. The creation of this document refers to IEEE 730-2002 standard. However, we need a supporting document in order to conduct the activity of assuring the quality of software development of SSN such as procedures, checklist, work instruction, form and template. Table 3 shows an example of tasks, activities, input and output and also the related documents required in one Extreme Programming phase, that is, exploration phase.

<table>
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<tbody>
<tr>
<td>Exploration phase</td>
<td>Evaluation on exploration phase</td>
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<td></td>
<td></td>
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<td></td>
<td>Procedure:</td>
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<td></td>
<td></td>
<td></td>
<td>[PR-01 R00] Evaluation Procedure of Requirement Elicitation of SSN</td>
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<td></td>
<td>Policy:</td>
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<td>[KE-01 R00] Requirement Elicitation</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td>Verification that participations are involved in determining system</td>
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<td></td>
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<td></td>
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<td></td>
<td>Input:</td>
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<td></td>
<td></td>
<td>Discussion result about job description of each element of SSN</td>
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<td></td>
<td></td>
<td>Form:</td>
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<td>[FM-02 R00] Discussion on role/responsibilities of each element in developing SSN</td>
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Requirements development | Responsibilities matrix | IEEE Std, 730-2002 Software Quality Plan

Output:
- System Requirements Analysis
- Process Audit Checklist

Figure B-3. IEEE Std 730-2002 Checklist: [CH-01 R00] Checklist Evaluation on Requirement Elicitation of SSN

Extreme programming consists of four phases: exploration, planning, iteration to release, productionizing, maintenance and death phase. Due to space limitation, we only present the identification of instrument for assuring software development in one phase only, i.e. exploration phase. However, the process of identifying tasks, activities, input, output and the document in other phases is similar to the exploration phase.

5. CONCLUSION

It is necessary for software developers to develop their software following the appropriate software development models that fit the nature of their project. Maintaining the quality of software development with regard to certain software development model is a must but a difficult task to do. IEEE 730-2002 provides a comprehensive set of tasks and activities to assure the quality of software development applied for all software development models. However, this standard is still absent in providing required documents and also instruments to assure the quality of software whereas these kinds of documents and instruments are necessary for software developers.

In this study, we begin with a problem where the software developers of our case study, SSN, have several challenges in developing the software. The challenges appear due to inability to define which software development model that fits the nature of SSN. As a result, the practice to assure the quality of software development encounters some problems. This study reveals that the most suited software development model for SSN is Agile methodology. More specific than that, the development tends to adopt an Extreme Programming model, one of Agile methodologies. Having known the software development model, an observation was conducted to adjust the IEEE 730-2002 standard with Agile model. Document and related instruments to ensure the quality of software development are then identified based on the mapping between Agile model and the standard. The document and related instruments can be used as a guideline for software developers of SSN to develop the next version of SSN or can be used for other developers of Extreme Programming model to develop their software.

The document and instruments in this study are only generated from our case study, which is limited to one software development model. For future research, it is interesting to complete the study with other software development models.

REFERENCES


### BIBLIOGRAPHY OF AUTHORS

<table>
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