

An Evaluation Framework for Requirements Definition of Software Development

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Abstract

Requirements establishment and definition are very critical tasks in software development. This study discusses the process of requirements definition, and key characteristics affecting the success of software projects development. An evaluation framework is proposed in order to verify users' requirements and reduce associated risks on software project development. The framework was developed based on the relationships between the components of software project request. A preliminary assessment study was conducted and confirmed the applicability and usefulness of the proposed framework in detecting errors in user's requirements.

Keywords: *Requirement evaluation, Project objectives, Business requirement, Project initiation*

1. Introduction

In last decades, software products are rapidly increasing. Thus, researches have often tried to improve the quality of the software product. Users mainly care about the quality of software product without understanding its internal contents, and with no concern about how it was developed. This makes the communication between software developers and users difficult, and consequently this affects the understanding of the project requirements, objectives, and results.

A software is described successful, if it fits the users and environmental requirements [1]. Project proposal is the main base of software development and an essential key of software project success, it contributes to a better understand of users' requirements [2]. Furthermore, it helps the stakeholders to understand the development objectives and the process of solving the business problems.

Attarzadeh [3] presented the top ten factors that contribute in success software projects development, four of these factors are existed in system proposal and requirements definition. These factors are user involvement (15.9%), clear statement of requirements (13.0%), proper planning (9.6%) and clear vision and objectives (2.9%), which equal to 41.4% of the factors that affect the success of software project. Verner [4] presented the factors of software project failure that have been considered in the literature, five from twenty one factors are caused by misunderstanding the users' needs. The factors are: Unrealistic or unarticulated goals, software that fails to meet the real business needs, badly defined system requirements, user requirements and requirements specification, poor communication among customers, developers and users, and customer satisfaction.

Several factors affect the project success such as requirement gathering, customer involvement, and project management [5]. One of the most challenges faced in software development, is the lack of communication with the stakeholders [6]. Handshaking between project manager and stakeholders is a success key in software development project.

In any information and communication technology system, human is one of the main factors involved in the development [7]. The human can either be users, managers, designers, developers and others, whom affect the system either positively or negatively. The main problem of using a human is that the probability of making mistakes is higher. The main problem of requirement elicitation is its dependence on understanding human needs. Therefore, good interface between stakeholders and project manager is important to understand business problems, which helps to identify a right solution.

Normally, problems are not caused by the agreement between requirements and architecture, it comes from understanding requirements that impacts the architecture design [2]. In the same concern, Rasmusson [8], describes that most of the failures occurred in software projects, are caused by lack of

consideration in project goals, objectives, and context during project planning. The definition of project objectives is considered as a main aspect of software project initiation. This is because planning tasks rely on the project objectives.

Project initiation is the foundation of software development; however, there is no evaluation base that can be relied on in order to evaluate this phase. This work presents a new framework to evaluate project initiation by considering the relationships between a set of components; including project sponsor, business needs, business requirements, business values, and software project objectives. The elements of project initiation are evaluated from two perspective, software development team, and business group team (project sponsor). The team of software development evaluates the ability to develop a system that can solve the business problems and achieve the sponsor's requirements. Project sponsor evaluates whether the project requirements represent the business problems as they defined.

2. Requirement Engineering

Requirement definition is one of the main tasks in product development. The importance of this phase has been realized since 1990s, in which researchers have focused on enhancing and improving the process of requirement engineering [9]. Requirement engineering is a main phase of software project life cycle, which is considered mandatory to start the development process. It mainly includes the process of identifying and describing system functionality, and system goals and constraints. Hence, any mistake in the process of collecting requirements, threatens the success of software project development [10].

Requirement elicitation is the initial task in requirement engineering. It is considered as a very important and crucial task in software development, and is the basis of product life cycle [11]. Requirement elicitation includes the process of requirements negotiation, documentation and validation of future intended systems. Hence, any mistakes in accomplishing this task, causes poor requirement quality or failures of identifying overall requirements [7].

3. Project Initiation

In modern software development process, project planning is one of the most critical activities [12], which is considered as an essential task to facilitate the problem of understanding and implementing the solution [13]. The planning is defined as thinking through five questions: who, what, why, when, and how. These basic questions define the current situation and how it is required to be? In addition, these questions identify the problems in the current situation and how it can be solved. According to the answer of these questions, the reminder activities included in the project plan are defined.

In software development, the lack of comprehensive project initiation is a very pervasive failing. According to Greer [14], software project initiation is included in Software Engineering Body of Knowledge (SWEBOK) under 'Software Engineering Management' topic. Project initiation is a process of defining business requirements with a certain level of specification and presents the proposed solutions for the intended problem [14]. Project initiation is a creative process, in which new ideas are proposed in order to solve the defined problems. This process is started with a system request, which defines the business problems in the current system, the business requirements to enhance the productivity, and proposed solution to overcome these problems and achieve the required goals.

System request is the process of identifying reasons behind building a system, and the expected values from the new system [15]. This process consists of identifying a group of components; the project sponsor, business needs, business requirements, and business value. Project sponsor is the person who initiates the software project, and is a key point for the communication between software developers and business side. Business needs are business reasons to build a new system. Business requirements are the business capabilities to be provided by the system. Business values are benefits created for the organization. As a result, the system request describes the objectives required to be achieved by developing a system.

4. Evaluation Framework

The evaluation framework is developed based on the relationships between system requests components being defined in the previous section. Project initiation is developed mainly based on project sponsor definitions. Project sponsor is the main factor proposing strong reasons to develop new system, including business problems, and business processes required to be improved.

The sponsor can be measured by calculating his/her experience in both business and information systems. The business experience guarantees that the sponsor has fully understood state of current system and procedures of achieving the business goals. Information system experience guarantees the sponsor understanding the information system capacity in solving business problems, and to enhancing business productivity.

Business needs are high levels of business requirements, identifying reasons of developing new systems. The analysis of the current business status allows identifying problems faced in business processes, and the required enhancements to overcome these problems. This task is measured by identify whether the proposed reasons are enough and justifiable to build new system.

The evaluation process is conducted in both business and information system perspectives. Business requirements define business desires from the information system, in order to solve problems and achieve required goals. This task requires advanced experience from project sponsor in the information system. In which, project sponsor should fully understand what the information system can provide to solve business problems and enhance business services. Project manager examines business requirements, to decide whether the information system is able to provide the required functions. The manager also checks whether the requirements are suitable to the defined problems.

Business values defines benefits resulted from the required system. Project sponsor defines values expected to be added to the business. Project manager verifies whether these values can be achieved from the system.

Project objectives represent the users' requirements. As a result of system requests, the initial requirements are defined. The importance of defining project objectives is to link system request components, whereas these elements are related sequentially. Figure 1 presents the framework of software requirement definition. The framework consists of the main components of the software requirements definition and the relationships between them. These relations are identified according to certain rules, which will be discussed in the following section. Moreover, discusses the proposed criteria that can be used to measure the quality of these components and their relations.

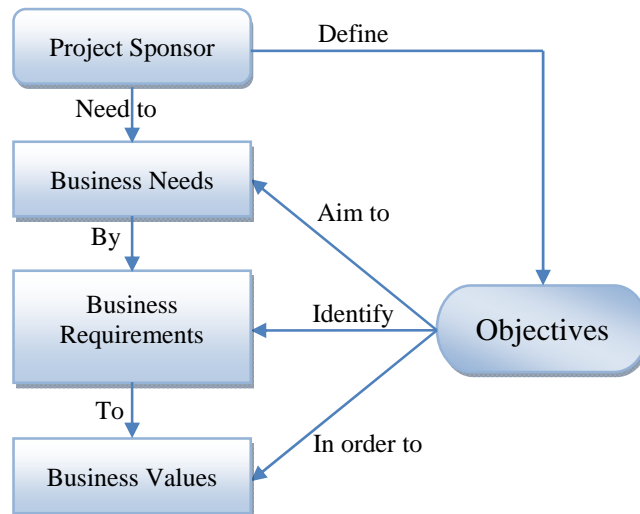


Figure 1. Evaluation Framework

5. Quality Criteria

This section describes characteristics of project initiation components and their relationships, which is used to measure the quality of the requirements definition.

5.1. Project Sponsor

Project sponsor is a main contact point with software development team in the business side. Therefore, project sponsor has to fully understand both business needs and information system capability. The following questions can be used to measure the ability of the sponsor to identify the business needs and communicate with project development team.

- Is the sponsor able to identify business problems?
- Is the sponsor able to present business requirements?
- Is the sponsor able to understand the IT infrastructure of the business?

These questions can be measured from the sponsor experience in both business and information system sides.

5.2. Business Needs

Business needs are considered as reasons of why new system is needed. Therefore, the evaluation process describes whether the proposed reasons are enough and worthy to build a new system. Moreover, enough experience in information systems help to define reasonable requirements. The following questions identify if the business needs are enough to develop a new system.

- Are these needs enough to initiate a system?
- Do these needs present overall business needs?
- Are these needs clear for both business sponsor and project development team?

These questions are to be answered from both business and information System sides. The business side evaluates whether the defined needs completely represent the business problems. The information system side evaluates whether these reasons are enough to build a system.

5.3 Business Requirements

Business requirements are identified by the project sponsor in order to solve the business problems and enhance the business productivity. Normally, these requirements are defined based on business needs. Therefore, in the evaluation framework, the business needs are considered as a base of business requirements evaluation. The criteria of evaluating the business requirements are developed based on these questions:

- Do these requirements completely represent the business needs?
- Do these requirements clearly represent the business needs?
- Are these requirements sufficient to help the business?

The evaluation covers all problems that are defined in business needs.

5.4 Business Value

The decision of developing new system is made based on planned benefits and on new values expected to be added to the existing system. The business requires a new system in order to enhance its services and increase its productivity. Therefore, the following questions, defines the values to be added by the new system:

- Are these business values enough to build a system?
- Do these business values completely represent the result of the requirement?

The request of new system is considered in business side as a commercial transaction. Therefore, the business value is used to calculate the expected profits from this contract.

5.5 Objectives

Objectives discussed above, are essential in the evaluation of system request. Therefore, the following questions are defined based on the relationships between the objectives and other elements of the project request:

- Do these project goals cover all business needs?
- Do these project goals considered suitable for business needs?
- Do these project goals maintain all business requirements?
- Are these project goals suitable for business requirements?
- Do these project goals achieve business values?
- Are these project goals suitable for business values?

The relation based questions evaluates the consistency of the sponsor requirements. Therefore, the completeness, suitability, and clarity characteristics are considered in the objectives evaluation.

6. Case Study

In this study, the proposed framework is applied on a course registration system. Which is documented in the Rational Unified Process (RUP Version 2003.06.00.65), document as an example of web site project. In this concern, questions being discussed in order to evaluate components of requirements definition and their relationships are discussed in Table 1.

The proposed evaluation criteria is based on a questionnaire study which was developed in closed form with four rank levels (1 strongly disagree, 2 somehow disagree, 3 somehow agree and 4 strongly agree). The questionnaire represents all previously defined framework evaluation questions. Ten PhD holders specialized in information systems have participated in the study, checked the requirements and filled up the evaluation form. Results of the evaluation process are presented in Table 2. The accuracy of the evaluation was not highly considered in this study, whereas the study considers the applicability of the proposed framework.

Table 1. List of requirements for C-Registration System

Objective	Business Needs	Business Requirements	Business Value
Allow Registrar to maintain professor's information	Improve the services	Provide online access to information	Provide online information
Allow registrar to maintain student's information	Improve the services	Provide online access to information	Provide online information
Allow the registrar to close registration	Decrease defects in registration processes	Produce registration report	Decrease defects in registration processes Increase the speed of process
Allow the registrar to send notification to finance department	Decrease defects in registration processes	Notify the finance department	Decrease defects in registration processes Increase the speed of process
Allow lecturer to view and select course to teach	Improve access to information	Provide online course selection Provide online access to information	Decrease number of employee Decrease number of defects Increase the speed of process
Allow lecturer to send students' result	Improve the service Decrease defects	Provide online grades' submission	Decrease number of employee Decrease number of defects Increase the speed of process
Allow students to view and select courses to study	Improve access to information	Provide online course registration	Decrease number of employee Decrease number of defects Increase the speed of process
Allow students to view their result online	Improve access to information	Provide online access to information	Increase the speed of process

Table 2. The Result of the Requirement Evaluation

No.	Question Description	Average
1	The sponsor able to identify the business problems	3.2
2	The sponsor able to present the business requirements	3.7
3	The sponsor able to understand the capability of the IT to help the business	3.1
4	The reasons of initiate a system enough	3.5
	The reasons completely present the business needs	3.5
6	The reasons are clear	3.2
7	The requirements completely represents the business needs	3.0
8	The requirements clearly represents the business needs	3.3
9	The requirements are sufficient to help the business	3.4
10	The business values enough to build a system	3.5
11	The business values represents the result of the requirements	3.2
12	The business values completely represents the result of the requirement	3.5
13	The project goals covers all of the business needs	3.7
14	The project goals maintains all of the business requirements	3.5
15	The project goals achieves the business values	3.0

7. Discussion

This study presents a new framework to evaluate user's requirements based on the relationships between components of software project request. The relationships measure the suitability, completeness, and consistency of the project components. In addition, clarity measure is considered in both business and information system perspectives. Moreover, the economic profit of the new project is estimated, as an essential base and main goal in the business side. A new component is added to the requirement definition, which is the project objective. The objectives component used to define new relationships between other components from new side. This helps to evaluate the relationships between components from different sides, whereas the linear relation is not enough to present an accurate quality result.

Components of requirements definition must be shared with each other; otherwise any missing relation shows that there are problems in the requirements being defined. The relationships between components can be 1-1, 1-N, N-1, and N-M. For example, the business value may involve more than one requirement to be achieved and one requirement may result more than one business value.

The applicability and usefulness of the proposed framework is measured using a subjective case study. In which participants were involved in analyzing a course registration system to go through the process of organizing, defining, and measuring the requirements definition. Table 1, describes the list of requirements distributed based on the framework components. Table 2 presents the result of evaluating system components and their relationships. The average value of participants' answers was approximately 3.5, representing an agreement rank level for the evaluation framework questions, with reference the system underassessment. This indicates that business requirements are based on the business needs, and booth components are considered sufficient enough to develop the new system. In the same concern, evolved business values are expected to enhance the productivity of the current system. Finally, business objects are very well defined based on the relationships between the system components.

8. Conclusion and Future work

The main problem discussed in this work, was the lack of base for evaluating the user's requirements. Hence, a relational evaluation framework was defined to be used for business needs and requirements analysis. In which, every business component is assessed according to its relation with other components. Moreover, the system objective element is defined to evaluation every component for more than one side. This work has defined fundamental questions showing the quality of each business component, and identifying relationships between these components. These questions were answered from both business and information system sides, ensuring the measured business requirements are suitable for business problem and can be achieved by project development team. The applicability and usefulness of the proposed framework were evaluated based on a questionnaire case study. Results have shown that the proposed framework is capability for evaluating requirements definition and useful in detecting errors caused by the users in the requirements elicitation phase.

For future work, more case studies are managed to be conducted in order to confirm the applicability and usefulness of the proposed framework. Moreover, the experts' views are required to confirm the validity of the proposed measures and the relationships between the components of the framework.

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