Software requirements elicitation to support internal monitoring of quality assurance system for higher education in Indonesia

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Abstract. The Internal Quality Assurance System (in Indonesian: SPMI (Sistem Penjaminan Mutu Internal)) is a systemic activity of quality assurance of higher education in Indonesia. SPMI should be done by all higher education or universities in Indonesia based on the Regulation of the Minister of Research, Technology and Higher Education of the Republic of Indonesia Number 62 of 2016. Implementation of SPMI must refer to the principle of SPMI that is independent, standardize, accurate, well planned and sustainable, documented and systematic. To assist the SPMI cycle properly, universities need a supporting software to monitor all the activities of SPMI. But in reality, many universities are not optimal in building this SPMI monitoring system. One of the obstacles is the determination of system requirements in support of SPMI principles is difficult to achieve. In this paper, we observe the initial phase of the engineering requirements elicitation. Unlike other methods that collect system requirements from users and stakeholders, we find the system requirements of the SPMI principles from SPMI guideline book. The result of this paper can be used as a choice in determining SPMI software requirements. This paper can also be used by developers and users to understand the scenario of SPMI so that could overcome the problems of understanding between this two parties.

1. Introduction

The Government of Indonesia participates in ensuring the provision of higher education in Indonesia. Therefore, the Indonesian government has released regulations to support the Quality Assurance System for Higher Education (in Indonesian: SPM Dikti (Sistem Penjaminan Mutu Pendidikan Tinggi)). Higher Education is a highly qualified education that produces graduates who have a capability in develop their potential in science and/or technology that useful for society and nation [1]. SPM Dikti consists of Internal Quality Assurance System (in Indonesian: SPMI (Sistem Penjaminan Mutu Internal)) and External Quality Assurance System (in Indonesian: SPME (Sistem Penjaminan Mutu Eksternal)). SPMI is implemented internally by all universities in Indonesia and SPME is held by the government through higher education accreditation. SPMI is a substantial activity to achieve a well-guaranteed business process that yields qualified and standardized university products. The Government of Indonesia through the Ministry of Research, Technology and Higher Education has released a guideline for the implementation of SPMI which was recently revised in 2016. This instruction shall be followed by all providers of higher education in Indonesia in the mode most appropriate to history, vision, mission,
mandate, culture of the college organization concerned. These guidelines contain the stages that higher education providers must follow to implement the internal quality assurance system. SPMI is a systemic activity of quality assurance for higher education in Indonesia to control and improve the accomplishment of higher education in well planned and continuously events [1]. The foundation of SPMI is the Regulation of the Minister of Research, Technology and Higher Education of the Republic of Indonesia No. 62 of 2016 on the Quality Assurance System of Higher Education. SPMI through the activity cycle: Determination, Implementation, Evaluation, Control, Enhancement or can abbreviate as DIECE (in Indonesia: PPEPP) as described on figure 1.

![Figure 1. SPMI Cycle](image)

In the implementation of the SPMI cycle, every university should apply the SPMI principle which consists of:

- **Autonomous/independent**, SPMI is developed and implemented independently by every college. This SPMI should be performed in all level on University like n department (program study), faculty and other units.
- **Standardized**, SPMI is applied based on SN Dikti established by the government and the university.
- **Accurate**, SPMI employ accurate data and information from a valid database.
- **Well Planned and Sustainable**, SPMI is implemented by using 5 (five) quality assurance steps: Determination, Implementation, Evaluation, Control, Enhancement or can abbreviate as DIECE.
- **Documented and systematic**, all levels in the SPMI cycle are systematically recorded.

To assist the SPMI cycle properly, universities need software on monitor all the activities of SPMI. But in reality, many universities are not optimal in building this SPMI monitoring system. One of the obstacles is the determination of system requirements in support of SPMI principles is difficult to achieve. SPMI software should support the implementation of DIECE cycle independently, accurately, standardize, well planned, continuously, documented and systematically. Implementation of SPMI should also involve all stakeholders in the university. Therefore, it requires a process engineering requirements in collecting software requirements based on the principles of SPMI. The requirements engineering is the first phase of software engineering process, in which user requirements are gathered, understood, and specified [2]. The early stage of requirements engineering is requirements elicitation. Requirements elicitation is practice of collecting requirements of a system from user, customers, and stakeholders. This process may appear simple: ask the customer, the users, and others what the objectives of the system is, what is to be accomplished and how the system or software fits into the needs of business. But on SPMI software design it is not that simple. A large number of stakeholders involved in the SPMI activities made the access and authorized user's level to become very wide and complex. Another problem is the implementation of autonomous SPMI's action chooses SPMI application model to become unlimited. Some universities do not have full understanding of the problem domain to deploy SPMI, and it causes problems of perception where the customers/users are not entirely sure of what is needed. For that purpose, we offer a concept to collect SPMI software requirements based on SPMI's principle from SPMI guidelines.

The purpose of this paper is to provide a concept of requirements collection based on the business scenario of SPMI implementation process. This idea can be an option for universities in Indonesia to
collect the requirements to build the SPMI software. This paper can also overcome the problems understanding between developers and users in conceive the SPMI Scenario model.

2. Related Works
Related works about quality control on higher education observation had been done by [3-8]. But most of these researchers focus on applying quality control practice in a college. Requirements engineering research has been done by previous researchers [2, 9-12]. The purpose of [2] is to analyze the problems of the requirements engineering from several viewpoints. According to [2] one of the issues of this process is users have incomplete understanding of their needs. The work done by [9] observed the roadmap of requirements engineering. A study by [10] identified and analyzed existing prioritization techniques in the context of the formulated research questions. This study observes various software engineering literature sources that discuss prioritization in the determination of software requirements. Other research is to consider about systematic review of requirement elicitations techniques done by [6][11]. Another study done by [6] concluded that identified requirements must be clear, consistent, modifiable and traceable to produce a quality product. Research [12] describes a computational mechanism for deriving use cases from object system models, simple rules for use case composition, taxonomies of classes of exceptions which give rise to alternative courses in scenarios, and a computational mechanism for generation of multiple scenes from use case specifications. Based on these earlier studies it can be concluded, there are no single techniques which fulfill all the demand of requirement elicitation and information gathering. One of the most important goals of elicitation is to find out what problem needs to be solved and hence identify system boundaries, identification of stakeholder and user classes.

3. Research Methodology
The purpose of this paper is to provide a concept elicitation requirements based on the principle of SPMI. The stages of this research are SPMI Model Determination, SPMI Principles Observation, Scenario of Business Process Determination and Requirements Elicitation. The SPMI principle is a foundation in determining the requirements elicitation. The meaning of requirements itself is a condition or ability that must be met by the software to fulfil the specification standards based on user requests or based on a valid document like SPMI’s guideline.

3.1 SPMI Model Determination
Based on the higher education assignment there are two models in implementation of SPMI. The first model is the college establish a Quality Assurance Unit (in Indonesian: UMM (Unit Manajemen Mutu)). With this model, all the implementation of quality assurance at the university will be arranged by this unit. The second model is the implementation of SPMI integrated into the university's management. Universities can choose from either of these models or can also do a combination of these two models. In this study, we used the first model of SPMI implementation and involved three main components. These components are Quality Assurance Unit at department/program study/level unit (In Bahasa Indonesia: GJM / GKM), internal auditor and quality assurance unit at university level. GJM / GKM provides internal quality monitoring and controlling activities on their department. The GJM/GKM should do quality self-assessment on their unit. Internal auditors are staffs of the university that capable and certified to do auditing in department level. The report of the self-assessment from GJM/GKM and the report from internal auditor will be analyzed by UMM staff, and the result is given to the university leader.

3.2 SPMI Principles Observation
The implementation of the DIECE cycle (in Indonesian: PPEPP (Perencanaan, Pelaksanaan, Evaluasi Pelaksanaan, Pengendalian, Pelaksanaan, Peningkatan) for SPMI activities must be implemented by all universities in Indonesia. In the implementation of SPMI must refer to the principle of SPMI that is
independent, accurate, national standardize, planned, sustainable, documented and systematic. Autonomous means in SPMI implementation, the universities are not justified in involving external parties. Therefore, all SPMI activities are carried out autonomously including selection of SPMI model and SPMI scenario selection. The implementation of SPMI should be standardized. It means that the university should establish the standards or SN Dikti based on the government regulation and university policy. The application of SPMI must also be accurate based on a valid source like university database. Implementation of SPMI also must be well planned and documented.

3.3 Scenario of Business Process Determination
Selection of SPMI implementation scenario is the independent right of the university. Each university can determine the model of the plot that best suits with the university policy. Each scenario should be able to cover the principle of SPMI. In this research, we offer a scenario of SPMI activity as in figure 2.

![Figure 2. Scenario of SPMI Implementation at University](image)

We offer a continuous DIECE cycle scenario with Deming's philosophy to ensure constant quality control. The scenario cycle processes are Plan, Do, Check and Act process. The plan stage is a stage of determining the SN Dikti. The SN Dikti can be described as a group of policies, regulations, standards, and rules that established based on higher education national standards and university's standard. All the level and university's component from university's level should Do these SN Dikti as university's business process guideline. In the evaluation stage, university's level like unit/department/program study/faculty has to examine and verify whether the SN Dikti that established in plan stage under the implementation. The examination is performed by university's unit level through their GJM/GKM, internal auditors, and UMM staffs. GJM/GKM assess the accordance with self-assessment examination. The internal auditors evaluate the compliance through auditing process to all university's level. Furthermore, UMM staffs will analyze and report the comparison result of self-assessment from GJM/GKM with auditing result from internal auditors. After that, based on this report, the university leader, GJM/GKM and UMM can analyze the existing SN Dikti to repair the standards or raise up the standard. These new enhancement standards become new SN Dikti to the next quality control cycle.
3.4 Requirements Elicitation

Requirements elicitation is the practice of collecting the system requirements. We collect the system requirements from SPMI scenario business process based on SPMI guideline. In this stage, we substitute the scenario business process into software functions. We observe the procedures that can be supported by the software and implement them into Unified Modelling Language which is Use Case and Sequence Diagram. Use case is a diagram to describe a function or procedure that can be performed by an actor system. There are four levels actor in this software, each of these actor levels has its authority in access some functions in the software. The level actors in this software are:

- **U-QA** is an actor level in charge of managing SPMI software. These actors could be the staffs of Quality Assurance Unit (UMM) in University level.
- **D-QA** is an actor level that responsible for the implementation of quality assurance at the faculty, department or unit level. There are two kind actors in this level, for faculty level or GJM staff and department/unit level or GKM staff.
- The internal auditor is an actor level that capable of auditing the quality control process of department/unit in the university.
- University leader is an actor level for the leader of university like Rector, Dean, department/unit leader. The use case and sequence diagram can be seen in figure 2 and figure 3.

![Use Case Diagram](image)

**Figure 3. Use Case Diagram**

![Sequence Diagram](image)

**Figure 4. Sequence Diagram**

Some functions can only be done by a certain actor level and certain phase only. Based on the scenario and sequence diagrams that have been described in the previous stage, there are functional requirements required for SPMI software design. These functions/procedures list can be seen in Table 1. All these functions are integrated into a whole software that can support SPMI activities.
Table 1. Functional Requirements

| Scope Function                     | Information                                                                 | Functional Requirements                                                                 |
|-----------------------------------|-----------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|
| User Management                   | A set of functions to manage the actors/users who involved in the SPMI system | ▪ Function for user login settings  
▪ Function to divide user permissions based on user level authority  
▪ Enables/disables users in certain SPMI cycles. |
| SPMI Cycle Management             | A set of functions to manage SPMI cycle                                      | ▪ Function to start the new cycle of SPMI.  
▪ Function to view the old cycle documentation.  
▪ Search cycle based on keywords. |
| Document Management               | A set of functions to manage documents.                                      | ▪ Function to upload documents based on user authority  
▪ Function to search for documents  
▪ Function to create metadata automatically for documents uploaded by user. |
| Self Assessment / Scoring          | A set of functions to do self-assessment                                     | ▪ Function to display a questionnaire assessment.  
▪ Function to receive input assessment by the user assessment.  
▪ Function to calculate the scoring of the assessment.  
▪ Function to display the scoring in graphical form |
| Internal Auditing                 | A set of tasks for internal auditing                                         | ▪ Function to check unit/department scoring result (desk Evaluation)  
▪ Function to input scoring value according to field visit  
▪ Function to calculate the scoring audit.  
▪ Function to display comparison result of unit/department scoring VS auditor result scoring.  
▪ Function to send audit results to nit/department and Quality Assurance Unit. |
| Problem Identification            | A set of functions for input problem identification                           | ▪ Function for input identification problem if scoring value is low.  
▪ Function to report if we want to revise SN Dikti or SN University. |
| Quality Assurance Report Management| A set of functions for report management                                      | ▪ Function to find report auditing a unit/department.  
▪ Function to display reporting comparisons between multiple unit/department  
▪ Function to recap the audit report. |

4. Conclusion

The result of this paper is functional requirements in the design of software support SPMI. Stages of collecting elicitation requirements are done by observing the SPMI guidelines and principles which are then formulated in a choice of business process scenario. Users or clients can add specific requirements according to the needs of each college. This paper can also be a bridge for developers and users to understand the scenario of SPMI implementation better so that the problems of understanding between the two parties can be overcome.
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