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Requirements Analysis for an Automated Quality Assurance System

Abstract

The 1999 National Education Act (1) mandates that all education institutes conduct quality assurance process. Quality assurance is usually performed manually; hard copies of document are stored in a file cabinet and the performance for each indicator is calculated by hand. This paper seeks for an automated approach for performing quality assurance in education. The result is a set of requirements that specifies capability of automated quality assurance application software. This set of requirement was partially implemented by a commercial software package that is being marketed in Thailand.

1. Introduction

1.1 Requirements Analysis

Requirements analysis is one of several stages in system development lift cycle (SDLC) as depicted in **Figure 1.** It is an important stage that specifies the "what to do" of the application being built. Several software projects have failed because of improper requirement analysis. The inputs and outputs of the requirement analysis phase are shown in **Figure 2.** The requirement analysis phase takes the system description, usually in plain natural language text, and generates a detailed system specification. The specification can be stated in form of software requirement

specification (SRS) which may include Unified Modeling Language (UML) diagrams or data flow diagram (DFD). This paper can be regarded as a summary of SRS for on automated quality assurance system for education institutes.

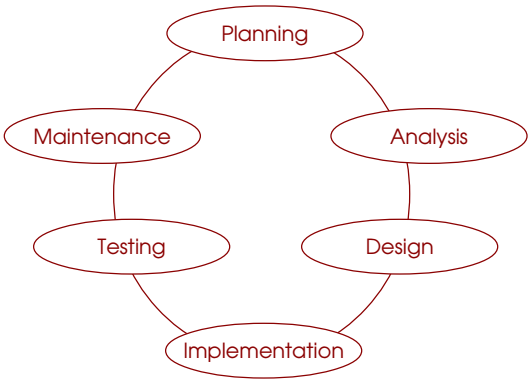

Figure 1 System Development Life Cycle

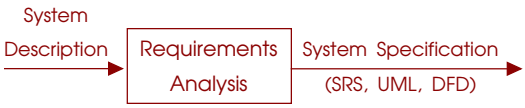

Figure 2 Inputs & Outputs of Requirement Analysis

1.2 Quality Assurance in Education

Quality assurance is a required process for all education institutes in Thailand since 1999. It is a process that assures the public that the institute has quality in its related field. However, the existing process of perform quality assurance as shown in **Figure 3** and **Figure 4** is rather tedious. Instructors or QA officers need to repeatedly perform tasks that can be easily automated by using computers. Examples of these tasks are searching for related documents and calculating performance indices. All of these tasks can be done automatically if the computerized system is employed instead of the "manual" system.

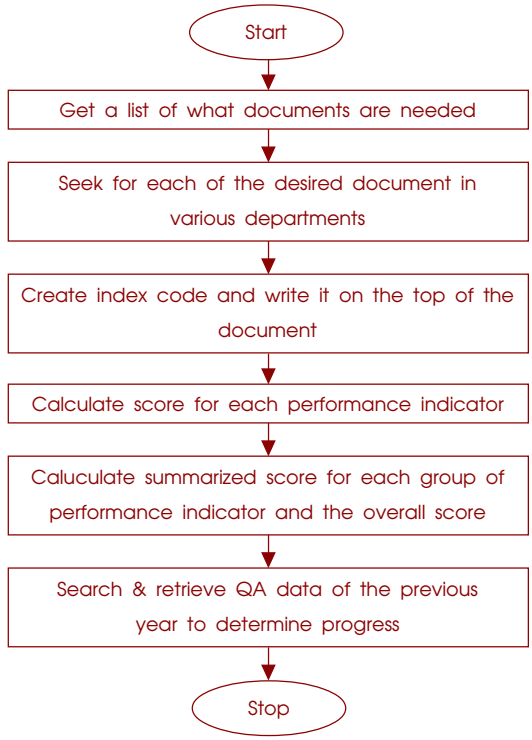

Figure 3 Quality Assurance Activities for QA officers

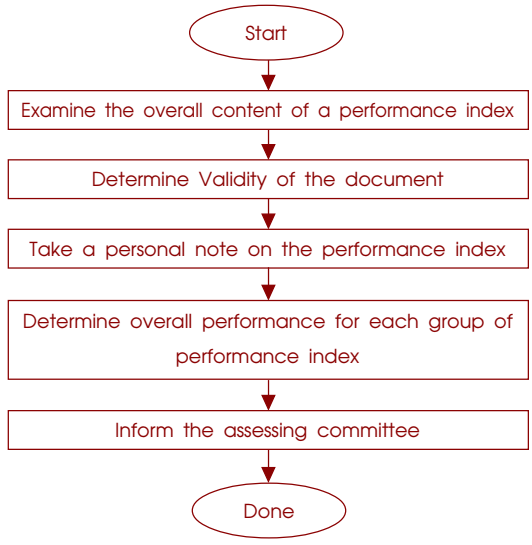

Figure 4 Quality assurance activities for assessor

2. An Automated Quality Assurance System

An automated QA system is the target system that we want to analyze in this paper. The objective of the system is to minimize the amount of work that needs to be done by QA- related personnel such as instructors, officers or auditors. Success indices of the system include the ratio of the amount of time saved by using the automated system and the level of user satisfaction.

2.1 QA Activities

The activities for QA officers in the new system is depicted in **Figure 5.**

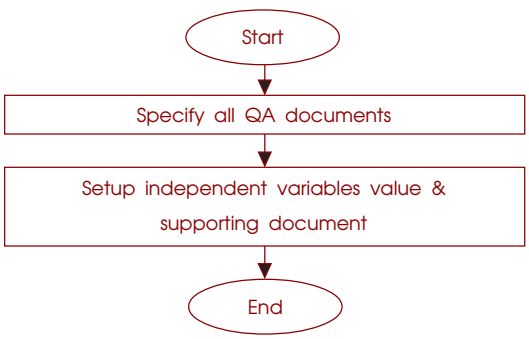

Figure 5 Quality assurance activities in automated system for QA officers

2.2 Requirements for the automated system

In general, software requirements may be classified into many fields such as functionality, data, reliability, efficiency, usability (user--friendliness), maintainability, portability and security. This paper will address only the functionality requirement.

2.2.1 Functional Requirements

Functional requirements of the system is broken into 6 areas, which are 1) Document management 2) QA Functions 3) Project management 4) E–Faculty support 5) Collaboration Support 6) Personal Tools. All of these tools are aimed to support quality assurance; however, in some areas such as E–Faculty, quality assurance support is just a by-product of the system.

2.2.1.1 Document management

Document management is the primary activity in quality assurance process for both manual and automated systems. Most documents act as a supporting document that is referred by performance indices. In preparing documents, there are two operation models: a pull-system and a push-system as shown in **Figure 6** and **7** respectively.

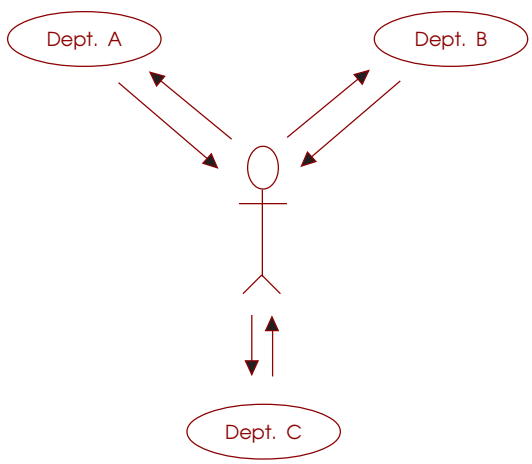

Figure 6 The pull system for document management

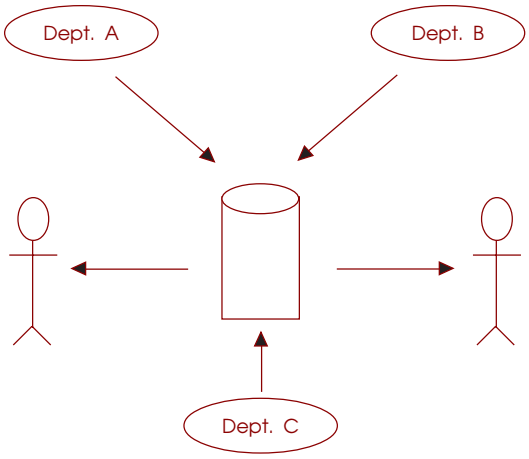

Figure 7 The push system for document management

In the pull model, when a QA officer needs to get a document, he will contact the department that has it. If there are several departments, this method can be time-consuming. Moreover, once the document has served its purpose in quality assurance, it needs to be brought back to the originating department; otherwise the normal flow of operations of the department might be interrupted. This technique is employed in the manual quality assurance system. The automated system takes a different approach as shown in **Figure 7.** In this system, all departments that have QA-related documents will "push" their documents to the central repository that is shared by all QA officers. QA officers no longer need to ask each department for QA documents. The soft copy of the document is stored in the repository and ready to be referenced.

The system should support all document formats. Examples of common document formats include Microsoft Word, Excel, PDF, images, HTML and ZIP files. Documents should be easily managed without time or location constraints. The program should support the following operations on documents in the simplest possible way: adding document, deleting document, updating a new version, searching for desired documents, filtering document, sorting the document according to title, date, type, or submitter.

2.2.1.2 Quality Assurance Functions

There are several quality assurance-related functions that will be very useful in performing QA activities. These functions are1) automatic calculation 2) automatic scoring 3) dataset comparison 4) dataset consolidation 5) progress analysis and 6) assessment management

Automatic Calculation

Automatic calculation is a process of computing the value of a formula specified by a performance index. An example of a formula is shown in **Equation 1.**

$$value = \frac{Number\ of\ Accredited\ Active\ Curriculums}{Total\ Number\ of\ Active\ Curriculums}$$

Equation 1 An example of a formula

A formula specified in a performance index contains a set of independent variables. One in dependent variable may be used by many formulas.

The system should take the value of each independent variable and automatically compute the obtained value for each formula. Most formula takes one or two independent variables as their inputs. Commonly used formula types are shown in **Equation 2.**

$$Value = A$$

$$Value = \frac{A}{B}$$

$$Value = \frac{A}{B} \bullet 100$$

$$Value = \frac{\left[\frac{A}{B} - C\right]}{C} \bullet 100$$

Equation 2 Commonly used formula types in quality assurance

The system should be able to display the formula, substitute the value for each independent variable and compute the final result for the associated performance index.

Automatic Scoring

Automatic Scoring is a process of computing the obtained score automatically by using the value obtained from automatic calculation and comparing the value with each of the performance level given by the user. The system must be able to recognize a subset of natural language text that describe the performance level. Examples of performance level are shown in **Table 1.**

Performance Index Score	Performance Level
1	1-59
2	60-70
3	> = 80

Table 1 Example of performance level that the system must be able to recognize to perform automatic scoring

Dataset Comparison

A dataset is a set of all document and data that are used in a single quality assessment by a unit of an organization. For an organization with 10 faculties to be assessed yearly, there would be at least 60 datasets in five years (50 for internal yearly assessment, 10 for external assessment). Once a dataset is generated, the user should be able to compare the dataset with the dataset of another department. The comparison is possible because all departments of same institute use the same set of quality assurance for a particular time frame. Comparison

can be done in 5 aspects: comparing document, comparing QA standards, comparing performance indices, comparing performance levels and comparing independent variables.

Dataset Consolidation

Dataset consolidation is a process of merging entities from multiple dataset into one entity that represents the whole set of datasets. There are 4 levels of merging: variable level, performance index level, QA standard level and dataset level. Merging of variables in different department is simply an addition of variable values. For merging of performance index, the user must specify how the merge is to be done. There are six possible merge operations to be done at the performance index level: Mean, Median, Mode, Minimum, Maximum and "Use Formula". For the first five methods, the consolidated value of a performance index is calculated from the specified statistical operation of values obtained from datasets being merged. For the last method of merging ("Use Formula"), the system should perform automatic calculation and automatic scoring operation on the merged independent variable without using any score obtained from the datasets being merged. For the QA standard level, the consolidated value of a QA standard is the sum of weighted score of all performance indices in the standard. For the dataset level the consolidated value of the dataset is the sum of weighted score of all performance indices in the dataset.

Progress Analysis

Progress Analysis is a feature of the system that displays the obtained scores of a particular organization in a time-wise manner. Progress analysis is not quite straight forward because quality assessment specification is not static. A specification may have 10 standards this year, but only 8 in next year. Therefore, to be able to display progress on a particular item, some manual work is required to specify items that are comparable. There are 4 types of comparable items: independent variable, performance index, QA standard, and dataset. For each type, the user should be able to specify the organizational level that he wants to the progress of.

Assessment

Assessment is one of the key processes in the PDCA cycle. Assessments are usually done manually because the evaluator can simply fills in the assessment form and bring it back to QA officers. However, it is a very time-consuming task for QA officers to statistically compute the assessment result dues to the volume of the work. The system should allow users

to create different types of assessment. Assessment types include curriculum assessment, exam assessment, grading assessment, teaching assessment, syllabus assessment, student assessment and executive assessment. The users should be able to perform assessment on-line and all results are automatically computed. The assessment result page should be easily linked from the referring performance index page. Answers to assessment questions could take the form of single-answer, multiple-answer and text. Some assessment types such as curriculum assessment may not be repeated in a fixed cycle-time fashion, while other assessment types is repeated according to some external trigger events such as beginning of a semester or ending of a semester. The program should be able to handle all of these cases with minimal user interaction.

2.2.1.3 Project Management

The PDCA cycle in quality assurance can be viewed as various kinds of activities to be performed on a single project. Many QA-related projects are to be tracked, such as personnel improvement project or social service project. For each project, there should be several associated data items such as project objectives, feasibility studies, project plan, specification, project issues, project risks, checklists, assessment, and lesson learned.

2.2.1.4 E-Faculty support

E-Faculty is an automation of operation in an education institute. It has the record of all students along with the grades that they receive in each semester. E-faculty is related to quality assurance because both process need to share the same data. For example, the list of all students to conduct online teaching assessment is stored in the E-Faculty system. The grade letter that a student receives must pass quality assurance process before it is stored in the E-Faculty system. If the institute is already employing an E-Faculty system, then the automated quality assurance system being built should be able to communicate with such system and reduce the amount of duplicated work or duplicated data storage to minimum.

2.2.1.5 Collaboration Tools

Because quality assurance process is usually done by a team of interacting people, collaboration tools can be very useful. Collaboration can be in the form of making announcement, discussing on a particular issue, shared calendar, submitting a work report or assigning tasks to other people. These collaboration items can be used as a supporting document that is linked from a performance index.

2.2.1.6 Personal Tools

Personal tools manipulate data that are not shared. Its purpose is to facilitate operations commonly done

by a user. These operations include personal document management, personal calendar, and personal notes. Users may use these tools for QA or non-QA related purposes.

3. Summary

This paper has presented core functionalities of an automated quality assurance system for education institutes. Such system helps minimize the amount of time required to perform quality assurance tasks. Examples of tasks that are no longer needed to be done are printing and storing physical documents, making document indices, calculate score for each performance index, generating comparison reports, summarized reports and progress reports.

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(2) สำนักงานรับรองมาตรฐานและประเมินคุณภาพการศึกษา (องค์การมหาชน), การประเมินคุณภาพภายนอกระดับอุดมศึกษา (กรกฎาคม 2549), **http://www.onesqa.or.th/th/download/uni_download/manual_uni(0849).zip**