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Quality Models Engineering for Evaluation of Academic Information System Quality Instrument (AISQI)

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Abstract— Academic Information System Quality Instrument (AISQI) in this paper is developed by engineering the software of quality model ISO/IEC 9126, ISO/IEC 25010:2011, web-based application quality model (WBAQM), and COBIT. Academic information system software currently does not fully adopt quality models as system instruments. Each of the quality models has different quality instrument. In order to provide safety quality in software domain of Academic Information System (AIS) a safety instrument framework is adopted from quality model ISO/IEC 25010:2011. By providing quality assurance to software with minimum error, lower defect level, high reliability, the quality model ISO/IEC 9126 is the most complete reliable quality model because of its comprehensive characteristics and ease of use. A Web-Based Applications Quality Model (WBAQM) is a web-based quality model that has become the main framework of an academic information system with its main purpose to support processes in an education institution. COBIT (Control Objective for Information and Related Technology) is a specific framework to build and audit an Academic Information System. COBIT technology is needed to monitor and assess the performance of an academic information system. This paper proposes the quality model engineering by utilizing quality model metrics, making a measurement framework of quality models and evaluating quality characteristics and utilizing auditing quality model technology to determine the performance quality of an academic information system software.

Keywords—AISQI, quality model, AIS

I. INTRODUCTION

Quality model is a software that becomes a reference for quality measurement of a product. Quality model is used to measure the quality of academic system software quality. An academic information system is an administrative module used to display academic data such as students, academic staffs, lecture subjects, academic activities and curriculum information.

Software engineering quality models used to build an academic information system software by adopting the quality factors of each quality model. It will be a reference for academic information system software.

There are several qualities that become a reference for quality of an information system software including

portability, usability, safety, maintainability, and reusability of a system. In addition to quality factor that becomes an measurement object of a software, quality model is also used to audit the maturity of Information and Communication Technology (ICT) in an educational institution or organization.

Some of the quality model that can be used as software measuring tool are McCall quality model, Boehm quality model, Dromey quality model, and ISO/IEC 9126. These quality models are used to assess the quality of a software in general. There are three perspective with twelve factors of quality to assess the quality of an academic information system software, all of them are grouped in the academic information system quality instrument. The Academic Information System Quality Instrument (AISQI) combines quality factors in quality model ISO/IEC 9126 and completed with ISO/IEC 25010: 2011, WBAQM, and COBIT 4.1. Portability factor from developer perspective is adapted from quality model ISO 9126-3 [1]. Quality factor of portability in AISQI is a factor that examines software ability to be moved from one environment to other environment. This characteristic examines a software not only from its system, but also the hardware used, users organization, and rules related to system portability.

To evaluate the usability behavior in a academic information software, quality model ISO/IEC 9126 is used. The usability characteristic of quality model ISO/IEC 9126 have five sub characteristics: understandability, learnability, reliability, attractiveness, and usability compliance. ISO/IEC 9126 is the most complete quality model because it is the most comprehensive characteristics and easy to use. Quality model ISO/IEC 9126 has three measurement metrics, namely internal, external and quality metric use. ISO/IEC 9126 is developed to improve the product quality and provide evaluation results on a measured software product.

Security is one of the important quality aspect that need to be considered. In a software, the security aspect is related to data and information security. Academic Information System it has different characteristics compared to other software. Quality model ISO/IEC 25010 is the new security quality measurement framework which is capable of measuring the security quality in Academic Information System application field comprehensively. The reason to

choose quality model ISO/IEC 25010 as the basic to develop security framework of an academic information system is because the quality model ISO/IEC 25010 is the refined model from quality model ISO/IEC 9126. One of its improvements is the addition of security characteristic. In addition, ISO/IEC 25010 is used due to its flexibility and generality, making it easy to adapt to quality model to measure specific application domain. Sub characteristic of security quality of quality model ISO/IEC 25010 consists of five sub-characteristics namely: confidentiality, integrity, accountability, authenticity, security compliance.

Academic information system software is a web-based software, where a web-based application quality model (WBAQM) is a model to measure the quality by implementing the bottom-up approach and focuses on definition of quality factors and sub-factors variation according to the framework of ISO/IEC 9126[2]. The general quality framework of Dromey becomes a basic method to develop the quality model with bottom-up method. This depends on decomposition of higher quality attributes into the component properties of software product that determine qualities.

COBIT (Control Objective for Information and Related Technology) is a quality model used as performance measure of an academic information system comprehensively. The auditing process has played an important role to increase the performance of academic information system in a higher education institution [3].

II. LITERATURE REVIEW

A. ISO/IEC 9126 Quality Model

ISO/IEC 9126 is a model to evaluate the standard of a software quality. ISO/IEC 9126 has four parts including ISO/IEC 9126-1, ISO/IEC 9126-2, ISO/IEC 9126-3 and ISO/IEC 9126-4. ISO/IEC 9126 is issued by International Organization for Standardization and International Electrotechnical Commission. The first part of ISO/IEC 9126 explains the term of software quality characteristic and defines the sub characteristics of the characteristics. Whereas the second part explains the external metrics used to measure the behaviors of computer-based systems. Measurement is conducted when the software is operating. The last part explains the quality in use metric. Generally, the characteristics and sub-characteristic of ISO/IEC 9126 can be presented in Table 1 as follow.

TABLE I. ISO/IEC 9126 QUALITY MODEL [4]

Characteristics	Sub Characteristics
Functionality	Suitability
	Accuracy
	Inter-operability
	Security
	Compliance
Reliability	Maturity
	Error tolerance
	Recoverability
	Compliance
Usability	Understandability
	Learnability
	Operability

Efficiency	Attractiveness
	Compliance
	Time behavior
Maintainability	Resources utilization
	Compliance
	Analyzability
	Changeability
	Stability
Portability	Testability
	Compliance
	Adaptability
	Installability
	Co-existence
	Replaceability
	Compliance

There are several evaluations that use ISO/IEC 9126. From previous studies, several cases had been evaluated using ISO/IEC 9126, such as spreadsheet [5], source code [6], and e-learning [7].

B. ISO/IEC 25010 Quality Model

ISO/IEC 25010 is an improvement of ISO/IEC 9126[8]. One such improvement is the addition of the security characteristics. Security is one important quality aspect to be considered. In software, the security aspect related to data and information security. There are five characteristics on ISO / IEC 25010 safety standard they are confidentiality, integrity, accountability, authenticity, and security compliance.

1) Confidentiality

Confidentiality assesses the extent of protection from illegal disclosure provided by academic information system on data/information contained in the system. Data/information in academic information system of a university can only be accessed by university stakeholders, in this case students, faculty staffs, and academic staffs. Confidentiality has 11 metrics consisting of access controllability, access control to AIS source code, log information protection, AIS test data protection, control on malicious code, peripheral media management, session time-out, cryptographic algorithm strength, data encryption accuracy, and cryptographic key managements.

2) Integrity

Integrity assesses how accurate and complete are the AIS assets can be maintained. In AIS, the assets are data/information related to academic processes in the university such as student academic data. Integrity has seven metrics consisting of data integrity suitability, internal data corruption prevention, asset inventory, information backup, documented operating procedure, AIS error logging, AIS security documentation.

3) Accountability

Accountability assesses the extent to which an activity of an entity (user or system) can be traced backward to the entity itself. Data/information in AIS can only be accessed by stakeholder of university AIS owners. Some of the information have limitation so that only users with certain authority that can access data. Accountability has three

metrics consisting of access audibility, audit logging, and system log retention suitability.

4) *Authenticity*

Authenticity assesses the extent to which the subject identity, which can be in form of user or system, can be proved true. In AIS, there are many users with different interest and privilege. Therefore, it is necessary to prove the user identity in order that the data/information can be protected from illegal disclosure. The authenticity have 5 metrics consisting of authentication protocol suitability, user registration, user password management, privilege management, and information access limitation.

5) *Security Compliance*

Security compliance assesses the extent to which AIS follows the prevailing regulations and standards, particularly those relating to system security. This sub-characteristic is important because the AIS characteristic itself that changes according to prevailing regulations, either the law regulation or academic regulation of each university. Security compliance has three metrics that consist of identification of prevailing regulation, protection of personal information data, and cryptographic control regulation.

III. WBAQM (WEB-BASED APPLICATIONS QUALITY MODEL)

Web-Based Application (ABW) expands rapidly into all sectors of social life and is being an integrated platform of computer application. ABW is very complex, constantly evolves, and quickly updates the software systems. Since 1994, manu ABW quality models have been introduced with 9 aim to assess the characteristics of ABW explained in six quality characteristics of ISO 9126 they are functionality, reliability, usability, efficiency, and maintainability[2].

Functionality	Indicates the existence of a group of functions and their properties. Function to fulfill the stated or implied needs.
Reliability	The ability of a software to maintain its performance level under certain conditions during a specific time period.
Usability	Attributes that determine the attempts needed for using and assessing such using by a group of users.
Efficiency	Relationship between software performance level and resources needed under certain conditions.
Maintainability	attempt needed to perform certain changes.
Portability	The ability of a software to transform from one environment to another environment.

Web-Based Application (ABW) is one of the most rapid developing trend in software world that provide a new method to expand software application. ABW is developed by several different languages, technologies, and programming models, and used to implement applications interactively with very high quality requirements. ABW integrate itself into software application. In the other hand, ABW has its own features and problems related to the new ABW features. This leads to inadequate traditional software quality models for all ABW features. Conceptual quality model developed based on ISO/IEC 9126 for software quality model.

IV. COBIT

Control Objective for Information and Related Technology (COBIT) is designed as an TI Governance tool to assist in understanding and handling risk, benefit and evaluation related to TI [9]. COBIT standards have been issued by IT Governance Institute which is a part of ISACA (Information System Audit and Control Association). COBIT guides consist of several directions, which are Control Objective, Audit Guide, and Management Guide. In order to provide information required by organization to achieve goals, the COBIT basic principles explain:

A. *Business requirement*

This relates to effectiveness, efficiency, confidentiality, integrity, availability, compliance, and information reliability.

B. *Process orientation*

IT Domain	IT Process	Activities
- Plan and organize	- IT strategy	- Note new problems
- Acquire and apply	- Computer operation	- Analyze
- Deliver and support	- Incident handling	- Propose solution
- Monitor and evaluate	- Acceptability testing	- Monitor solution
	- Change management	- Note known problems
	- Contingency plan	- Etc.
	- Problem management	

C. *IT Resources*

IT Resources such as data, application system, technology including hardware, operating system, database management system, multimedia; facilities; human including expert staffs, awareness and productivity to plan, organize or implement, acquire, distribute, support and monitor the information system services.

COBIT framework consists of 34 high-level control targets with each TI process is group into four main domains: Planning and Organizing (PO), Acquisition and Implementation (AI), Distribution and Support (DS), and Monitoring (M).

The process of IT COBIT will define the Critical Success Factor (CSF), which will be used as limitation to determine the criteria of performance measurement for each process. The measurement criteria for performance are symbolized by its indicators, namely KGI (Key Goal Indicator) and KPI (Key Performance Indicator). CSF and related indicators are determined by COBIT. The definitions of CSF and KPI of an information system are provided so that activities are performed under control to provide guarantee that IT process goal is achieved.

V. THE STUDY OF CHARACTERISTIC USING, METRIC AND QUALITY MODEL TO EVALUATE THE PERFORMANCE QUALITY OF ACADEMIC INFORMATION SYSTEM QUALITY INSTRUMENT (AISQI)

A. Usability Metric to Evaluate the Quality of Academic Information System Software

In order to know how good is the performance behavior of an academic information system software, an evaluation is conducted in its system. Evaluation is conducted in a software of academic information system by using characteristics or quality factors of a quality model.

Evaluation by using usability characteristic of quality model ISO/IEC 9126 intends to determine the usability behavior of an academic information system. The usability characteristics of ISO/IEC 9126 have six sub-characteristics, namely understandability, learnability, operability, attractiveness and usability compliance. There are several steps that need to be passed to know the usability behavior of an information system, namely:

- Collecting software documentation, such as software requirement specification document, design document, and document review. The objective of collecting this document is to identify the attributes needed to evaluate.
- Define the evaluation attributes.
- Evaluate usability on academic information system software. Evaluation process used evaluation tool, usability of ISO/IEC 9126
- The next step is analyzing evaluation results. Analysis is performed manually according to values issued by instrument usability.

B. Framework to Measure The Security Quality of Academic Information System Using Quality Model ISO/IEC 25010

Academic Information System is a CASE tool that can increase operational efficiency and effectiveness of a university. An academic information system needs a guarantee for its security quality. In addition, AIS has different characteristics compared to other software.

ISO/IEC 25010 quality model is used as the framework to measure security quality in AIS software. Evaluation of security quality of academic information system is intended to know the security quality of an academic information system software.

From measurement results by using ISO/IEC 35010 quality model it is observed that ISO/IEC 25010 quality model could measure 20 additional security aspects and produce an integrated security value compared to the available quality measurement standards. ISO/IEC 35010 quality model framework can also increase the security value in academic information system software.

C. Evaluation of Portability Characteristic by Using Metric in Academic Information System Quality Instrument

There are three metrics used to measure the portability characteristics in an academic information system software:

organization environment adaptability, system software environment adaptability, and availability co-existence. When the quality of academic information system software has good performance, the system can adapt well at all organization level. This results are observed from organization environment adaptability metric. In addition, the calculation result of availability co-existence metric should indicated the ability to share hardware resources with other AIS model.

D. Quality Factor of Web-Based Application Quality Model as Quality Instrument of AIS

Quality instruments of AIS are divided according to quality factor of Web-Based Application Quality Model (WBAQM) into three perspectives: visitor perspective, developer perspective, and institutional perspective.

Visitor perspective focuses more on visitor satisfaction and goal achievement in using AIS. Quality factors contained in visitor perspective include access ease, functionality, usability, internationalization, and created content.

Developer perspective focuses more on AIS dynamic according to bureaucracy policies. AIS requires dynamic management of software engineering and good maintenance, and AIS development that support educational institution target. Quality factors that are contained in developer perspective are credibility, innovation, and profitability.

E. COBIT Technology as A Framework Model of Academic Information System Auditing

Control Objective for Information and Related Technology is a technology that can facilitate Higher Education to measure their performance comprehensively. COBIT is a basic framework to audit an academic information system. COBIT is designed as an IT Governance tool to assist in understanding and handling risk, benefits, and evaluation related to IT.

VI. CONCLUSION

Implementation of an academic information system software with Web-Based Application Quality Model (WBAQM) as the main framework by using visitor perspective, developer perspective, and institutional perspective based on quality factor of WBAQM is an appropriate step. In order to determine the usability behavior of an academic information system software, evaluation is conducted for usability characteristic using ISO/IEC 9126 quality model. There are six sub-characteristics of ISO/IEC 9126: understandability, learnability, operability, attractiveness, dan usability compliance. Evaluation of portability for AIS software performance by utilizing the three metrics of academic information system quality instrument (organizational environment adaptability, system software environment adaptability, and availability co-existence) can determine whether the sub-characteristics values achieve the maximum value or not. Security testing in an academic information system software by creating measurement framework according to ISO/IEC 25010 quality model can improve the security of an academic information system. And utilization of COBIT (Control Objective for Information and Related Technology)

technology is the basic framework to audit an academic information system.

Engineering of quality models to perform evaluation of performance of an academic information system software by quality model metrics, creating measurement framework from quality model and evaluation quality characteristics and utilizing quality model technology for auditing are the methods of evaluation the performance of an academic information system software.

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