Resilient Document Management System for Programmatic Accreditation with Analytics

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Abstract - *Accreditation is a process of assessing a higher learning institution's capability to provide the needed facilities and resources for a certain program. It covers different aspects of program development and operation including vision and mission, faculty, curriculum and instruction, student services, research, extension and community involvement, library, physical plant and facilities, laboratories and administration. This paper presents the development of a Resilient Document Management System for Programmatic Accreditation with Analytics. The system was developed mainly for managing the documents needed for accreditation. It is composed of four (4) modules: content management which allows system modifications; document flow which includes routing of documents for signing; accreditation requirements which covers the collection and validation of all documents needed for accreditation; and report which produces self-assessment, progress, non-conformance, risk analysis, non-compliance impact analysis and prediction reports. A decision tree algorithm was utilized for the prediction report in which a total of 92.16% correctly classified instances was perceived. Assessments using evaluation forms adapted from the International Organization for Standardization (ISO) 25010 were then conducted to ensure that the developed system passed the software quality standards. As a result, for the product quality, functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability obtained a mean of 4.43, 4.34, 4.57, 4.62, 4.60, 4.63, 4.60 and 4.96 respectively. Meanwhile, an overall mean of 5.00 was obtained for the acceptance testing. The results entail that the system passed the required product quality and quality in use characteristics of a software.*

Keywords – Accrediting Agencies, Accreditation, Decision Tree, WEKA.

INTRODUCTION

Learning through education, or simply attending school, has been a common thing for everyone [1]. An individual who is equipped with the appropriate knowledge and skills obtained through proper education can also be said as someone who obtained a vital tool for future success. With this, educational institutions, especially those under the higher education category, are doing their best to give high-quality education by eyeing for continuous educational improvements. One way is through the so-called Accreditation [2].

Accreditation is a process in which institutions of higher learning are being evaluated, specifically if they are capable of providing the needed facilities and resources for a certain program [3]. It covers different aspects of program development and operation including vision and mission, faculty, curriculum and instruction, student services, research, extension and community involvement, library, physical plant and facilities, laboratories and administration.

One of the educational institutions that undergo accreditation is Cavite State University

(CvSU). As a learning institution which aims to provide excellent, equitable and relevant educational opportunities as well as produce professionals who are skilled and morally upright for global competitiveness, undergoing regular accreditation activities is one of their priorities. It has ten satellite campuses including Bacoor, Cavite City, Imus, Marogondon, Naic, Rosario, Silang, Tanza, Trece and Carmona.

CvSU – Carmona prepares itself for an upcoming accreditation activity with the help of the Quality Assessment and Assurance Committee (QAAC) office. This office is responsible for the collection of all documents related to accreditation which includes those that were produced by the instructors for their courses (e.g. examinations, syllabi, quizzes) every semester as well as the accomplishment reports of the different offices at the end of every Academic Year.

As a preparation for the upcoming accreditation, documents are retrieved, reproduced and prepared. However, management of documents submitted to the QAAC office is a problem experienced by the University for it concerns document flow, efficiency and knowledge sharing. The document flow starts from the document being created, printed then submitted for approval. Yet, if there will be modifications then revisions in the document shall be made before resubmitting it again for approval. The same process shall be repeated until all signatories have been satisfied with the document's format and content. Hence, this uses a lot of the resources, time and effort before its completion. A similar case appears when documents for signing are unfortunately being misplaced by the signatory for whatever reason/s which causes the delay in finalizing the documents.

In terms of efficiency, time and effort are also being sacrificed when documents are needed to be retrieved, especially for new employees or when the document being retrieved was not even handed down to the QAAC office. In short, efficient monitoring, management or storage has been disregarded.

Sudden changes in the administration also become a problem to the process. Personnel is being promoted to new positions or even transferred to other satellite campuses. It is expected that not all knowledge related to the position will not all be shared properly on its turnover. This makes newly appointed ones find, learn and do things on their own. If an important document is not found, they tend to recreate documents from scratch taking longer time instead of just using what is already existing.

OBJECTIVES OF THE STUDY

A system intended for managing of documents needed for accreditation was developed. It specifically aims to design and develop four (4) modules namely content management which allows system modifications; document flow which includes routing of documents for signing; accreditation requirements which covers the collection and validation of all documents needed for accreditation; and report which produces self-assessment, progress, non-conformance, risk analysis, non-compliance impact analysis and prediction reports.

METHODOLOGY

Software Development Lifecycle (SDLC) is a set of activities followed for a development project. It generally includes planning, analyzing, designing, implementing, and supporting an information system. The cycle defines a methodology aimed to improve the software's quality and its overall development process. There are several SDLC models designed and followed based on various aspects like availability of resources, the size of the project or even time constraints. One is the RAD model. The RAD model (Fig. 1) of Reference [4] was used in developing the system which consists of four phases namely requirements planning, user design, construction, and cut over.
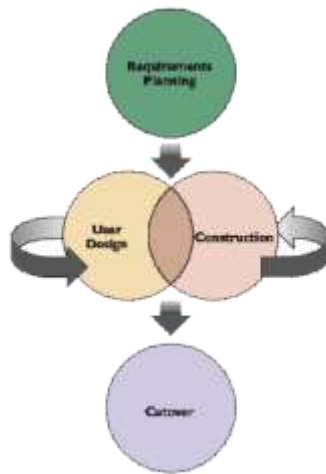
Figure 1. Rapid Application Development

As shown, there is a continuous interaction between the user design and construction phases which allowed the users to examine a working model as early as to determine if the needs were met and changes were necessary. The working model was then modified based on the inputs given by the user and the interactive process continued until the system was completely developed and the users were satisfied with it [4].

System planning and analysis were both performed in the requirements. The University's needs, project scope, constraints and system requirements were outlined, discussed and agreed together. Unless there was an approval from the stakeholders, the development process did not proceed. The researcher regularly met the client unless there was no concern with the system. Suggestions from the experts were also considered since the developed system is expected to be resilient or possess the ability to adapt to whatever needs of the institution where it might also be implemented and used in the future.

For the User design phase, context diagrams, system architecture, use-case diagrams, activity diagrams and entity-relationship diagrams were constructed. The designs of the system were implemented in the next phase – the construction. Along with the actual system development is the implementation of the decision tree algorithm wherein the historical data from the last five Academic Years which is a total of 570 were gathered.

Table 1. Input variables

VARIABLE	DESCRIPTION	FREQUENCY/STATISTICS	
Appointment status	The employment relationship between the University and the employee	Contractual	– 59 (10.35%)
		Job Order	– 436 (76.49%)
		Permanent	– 53 (9.30%)
		Temporary	– 22 (3.86)
Designation status	The status identifying if an employee has a position	Without designation	– 432 (75.80%)
		With designation	– 138 (24.20%)
Number of preparation	The number of unique courses handled by an instructor	Minimum	– 1
		Maximum	– 5
		Mean	– 2.923
		Standard Deviation	– 1.319
Teaching unit	The unit of time involved in the class instruction	Minimum	–6
		Maximum	–34
		Mean	–22.877
		Standard Deviation	–9.341
Extra work status	The status identifying if an employee is currently studying or has another work not related to the University	Without extra work	– 453 (79.47%)
		With extra work	– 117 (20.53%)

Table 1 shows the specific data collected (which is presented as a variable), its description and frequency/statistics.

Attribute selection was then performed. According to Reference [5], this "involves searching through all possible combinations of attributes in the data to find which subset of attributes works best for prediction". This was made possible by using three techniques of attribute selection – information gain, gain ratio, and relief. Information gain refers the amount of information gained by knowing the value of the attribute [6]. The ratio between information gain and the entropy of the feature is the gain ratio. This measure is used to avoid favoring features with more values, which is the natural behavior of previous measure. Meanwhile, Relief is a technique which can handle discrete and continuous attributes but at the same time takes the relation among features into account [7].

Two types of evaluation were then conducted before implementing the developed system. One was an evaluation with the algorithm using WEKA and the other focused on its quality standards using the International Organization for Standardization (ISO) 25010.

Installation and user training are the activities that were performed in the cutover phase. When the developed system passed all the required evaluations, its installation and user training were conducted. As noticed, this phase is compressed which made it possible for the researcher to deliver the finished system much earlier than expected – one of the strengths of this model.

RESULTS AND DISCUSSION

A. System Overview

The Resilient Document Management System for Programmatic Accreditation with Analytics is a system intended for managing of documents needed for accreditation. It was developed with the aim of being capable to adjust to the needs of its environment or the area where it will be used despite the fact that it is first implemented at Cavite State University (CvSU) – Carmona. The content management,

document flow, accreditation requirements and reports modules are the core components of the system.

A.1. Content Management

This module allows the administrators to modify some of the system's content such as accrediting agency, programs, courses, and requirements. On the same module, it is also where the designation of each faculty member can be assigned by the QAAC coordinator.

A.2. Document Flow

This module is where the routing of documents for signing can be made. The process starts by uploading and sending of documents for approval (Fig. 2). The user must select a file category, course, file to upload and signatories. After uploading the file, its preview can be seen. The sequence of routing will highly depend on this since the system will follow the first in, first out concept. Meaning that the document will first be forwarded to the first selected signatory and once approved, the document will be sent to the next signatory. The process will be repeated until all signatories have approved the document.

Figure 2. Document Flow module

Submitted documents are then subject either for approval or revision. The users may also monitor the detailed submission logs of a specific document. A Quick Response (QR) code can then be generated for each approved document which includes the date when the document was submitted and approved.

A.3. Accreditation Requirements module

This is the module assigned for submitting and managing accreditation requirements. It all starts from the QAAC requirements where course, credentials and designation requirements must be submitted. A table which includes the information and submission status of the courses assigned to the user are listed is shown (Fig. 3).

Figure 3. Accreditation Requirements module - Submission

Selecting the checklist button placed on the last column of the table will display the checklist page where the user may upload and submit course requirements. Submission of credentials and designation requirements (only if a user has a designation) can also be performed on the same module.

All uploaded and submitted documents under this module will be forwarded to the administrator for checking. Then, all approved documents will be automatically classified/categorized to its designated area (Fig. 4). The area will vary depending on the accrediting agency selected in the content management module.

Selecting a requirements from the list of documents will display all requirements submitted three years ago up to the current year (Fig. 5).

Figure 4. Accreditation Requirements module – Compilation List

Figure 5. Accreditation Requirements module – Compilation Content

A.4. Report module

Several types of reports are also automatically generated by the system namely self-assessment, non-conformance, risk analysis, non-compliance impact analysis, and prediction reports. Self-assessment report includes the compliance status of the documents needed per parameter which is rated from 0 to 5 (0 being the lowest) (Fig. 6).

Figure 6. Self-assessment report

Progress report states the overall and individual (per program) completion status of each area in a form of graph and table. Non-conformance report shows the number of instructors under a specific department who was not able to submit the requirements and their level of non-compliance (Fig. 7).

Figure 7. Non-conformance report

Risk analysis report includes a detailed and explained report of the possibility for a certain area to fail based on the non-compliance of its parameter's requirements and the possibility for an entire program to fail due to the non-compliance issues of its areas.

The non-compliance impact analysis report lists down the requirements that must be submitted, responsible instructor, affected programs, affected areas, level of severity and impact.

The last report that can be generated is the prediction report. This includes the list of instructors and programs who/which may not be able to comply with the requirements on time (Fig. 8).

Figure 8. Prediction report

B. Software Evaluation
B.1. Data Analytics

The Weka data mining tool was utilized in identifying the accuracy of the results. As shown in Figure 9, the training set has a total of 102 instances wherein 94 out of 102 (92.16%) was correctly classified and only 9 (7.94%) were incorrectly classified.

Figure 9. Summary of the evaluation of the training set

The results entail that the training set was consistent and clear since most of its data include correct values.

B.2. Unit testing

The content management, document flow, accreditation requirements, and reports were evaluated with accordance to their previously set functions.

The content management module underwent a total of 5 evaluations wherein each expected function was tested individually. As a result, the only problem encountered existed in the assigning of designation. Users were registered and assigned with different designations. However, even when the registration requests were approved, the functions which can be accessed by the user based on the assigned designation were not properly applied.

A similar approach was made in testing the document flow module. The entire process of routing documents was evaluated thoroughly. The problems occurred during the selection of signatories where the sample file was forwarded to the signatories in an incorrect manner; the

status of the sent file was not updated; and a QR code was not generated.

For the accreditation requirements module, issues existed when files were submitted and classified per area. Lastly, under the reports module, an error occurred when rating a certain parameter. In contrast, all other generated reports are accurate.

B.3. System testing

Since there is only a total of 60 instructors and staff in the University, all of them except for the QAAC coordinator was

considered as the probable users of the developed system since the total population is relatively small (< 100). The respondents rated the developed system in terms of functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability.

A Likert's scale of 1 to 5 where 1 means poor, 2 means fail, 3 means satisfactory, 4 very satisfactory and 5 means outstanding was used for answering this evaluation.

Table 2. Product quality: Overall

CHARACTERISTIC	MEAN (N=60)	ADJECTIVAL RATING
Functional suitability	4.43	Outstanding
Performance efficiency	4.34	Outstanding
Compatibility	4.57	Outstanding
Usability	4.62	Outstanding
Reliability	4.60	Outstanding
Security	4.63	Outstanding
Maintainability	4.60	Outstanding
Portability	4.96	Outstanding
OVERALL	**4.59**	**Outstanding**

Table 2 shows the overall result of the system testing wherein the product quality characteristic portability obtained the highest mean of 4.96 while performance efficiency for the lowest of 4.34. This entails that the adaptability and installability characteristics of the system have been very evident to the respondents. They might have also appreciated the fact that the system can be accessed in the

most common web browsers which are, of course, a convenience to them.

B.4. Acceptance testing

The results of the evaluation of the system's effectiveness, efficiency, satisfaction, freedom from risk and context coverage are discussed in this section.

Table 3. Quality in use: Overall

INDICATOR	MEAN	ADJECTIVAL RATING
Effectiveness	5.00	Outstanding
Efficiency	5.00	Outstanding
Satisfaction	5.00	Outstanding
Freedom from risk	5.00	Outstanding
Context coverage	5.00	Outstanding
OVERALL	**5.00**	**Outstanding**

An outstanding mean of 5.00 was obtained for the acceptance testing as shown in Table 3. This means that the developed system met the required specifications and criteria for delivery to the end users.

CONCLUSION

With the results of the evaluations conducted, it is concluded that the system met the required specifications/ criteria for delivery to the end users. It specifically proved that the content management module can be used to modify the accrediting agency, programs, and courses and assigning of faculty designation for identifying their level of accessibility. Meaning that the system can be used in any higher learning institution since it can adjust to the needs of its environment or the area where it will be used. The document flow module can also be used in processing documents for routing which can solve the issues of the campus in terms of misplaced documents for signing, hard-to-read handwritten revisions, lack of resources and inconvenience. Managing of accreditation-related documents can also be made using the accreditation requirements module. This can minimize the problems identified during an entire accreditation process. The report module can be used to generate various reports such as self-assessment report, progress report, non-conformance report, risk analysis report, non-compliance impact analysis report and prediction report.

Lastly, all of the specified system modules such as content management module, document flow module, accreditation requirements module, and report module were included and are working accurately according to the previously set functions. The response and processing times met the required standard but vary greatly on the specifications of the device where the system is accessed. The system can be accessed in the most common and current browsers existing which offers convenience in all aspects of system usage.

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