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Automate Quality Assurance Processes based on BPM over Google Cloud Platform

Sarah Al-Habashi
Information Technology Dept
School of Engineering
Tripoli, Libya
sarah.elhebshi@academy.edu.ly

Ahmed Alkilany
Information System Dept
Faculty of Information Technology
Tripoli, Libya
a.alkilany@uot.edu.ly

***Abstract*— The administration of the Libyan Academy(LA) is working to develop an integrated system that to help the Academy provide and manage a variety of services, such as quality assurance, Teaching Staff, students, educational materials management, human resources management, and other systems.**

The absence of an internal institutional electronic system for performance appraisal to keep it on the quality assurance tracking. This might cause numerous complications in the calculation of quality measures this include the distribution of paper forms, errors modification, communication with interested parties, and difficulty dealing with indicators. In order to meet the required standards, handling, understanding the system, and required platform operations.

This paper will focus on the automation of Academicals Institutions Quality Assurance workflow. However, the processes have to be analysed first and then modelled perfectly in the correct sequence. Where the Processes modelled with (BPMN) Trough BPM engines.

Keywords*— Google Cloud Platform (GCP), Business Process Management (BPM), Business Process Model and Notation (BPMN), Quality Assurance System (QAS)*

I. INTRODUCTION

As it appears to the observer, the academic arenas are changing with unprecedented effects. As Communication and Information technology; becomes more critical of learning and teaching. The explosive growth of the World Wide Web allows educational institutions to become virtual and global. The huge production of teaching material each year [1]. The process of developing education received great attention in a wide spectrum of countries of the world. Moreover, the locomotive of development for societies is precise, to be vigilant to the quality of learning as well as applying the quality standards firmly that have become a feature of this era. About that, the Center for Quality Assurance and Accreditation of educational and training institutions are established to facilitate the management and development of higher education institutions to keep supplying the local job market with qualified graduates equivalent to the level of International Institutions.

The quality of education is defined as a continuous management development strategy followed by the educational institution, that is based on a set of principles including Ensuring the quality of educational curricula - the staff cadre - the quality of equipment and other system requirements. To graduate its main entrance and which is the student, at the highest level of quality in all mental and psychological aspects Social and ethical. Development, to satisfy it as required after graduating in the labour market [2]. Currently, educational institutions need to automate all of their activities to make them run faster and more efficiently, preferably at lower cost and with better quality. Therefore, organizations must continue to use the best management principles, methods and techniques available. Nevertheless, Business Process Management (BPM) is the best management principle [3].

The analysis for constructing such a system has been previously explained. The main modules of the system and the relationships between them in the quality system were identified. Whereas, the QAMS system is built in such a way that the quality assessor can assess the quality of the organization and prepare the final quality report without having to do more work. UML diagrams such as use case diagrams, data flow diagrams, flowcharts, and activity diagrams, expresses the modelling approach [4]. On other hand, in [5] the author explored how different quality assessments to be used as Meaningful and synergistic of higher education. The results of this approach suggest that a systematic evaluation process, starting at the enterprise level, can help build evaluations on each other and drive continued development. The theoretical contribution of this study adds to the conversation about assessing quality and excellence and integrating management activities into higher education.

However, the author of [6] has presented his proposal on modelling organizations in a previous study in the context of Business Process Modelling and Coding (BPMN) to serve the academic setting. Based on a comparative survey of some representative universities in the United States and Central Europe. UML diagrams show the actors involved in each activity, while the BPMN method reveals the sub-processes and components of the flows. This method also helps identify process dependencies. Where the operations repeatedly can be performed using BPMN. A previous article also provided a new perspective on modelling organizations in the context of Business Process Modelling and Coding (BPMN) and an academic setting. Based on a comparative survey of some representative universities in the United States and Central Europe, the article presented a specific approach to BPMN in

the context of university information systems. UML diagrams show the actors involved in each activity, while the BPMN method reveals the sub-processes and components of the flows. This method also helps identify process dependencies. Operations can be repeated and performed using BPM notation [7].

As there are several notations for business process modelling, such as UML and BPMN. However, UML is primarily oriented to people who model and build software systems like web applications and cloud environments that enable the documentation of a design implemented in a variety of programming languages. Whereas BPMN is focused on designing 'as-is' and 'to-be' process models and is used by business analysts, IT developers and business people alike that are only used for designing and improving new systems, it allows improving manual processes. The significant role for (BPMN) is to empower business owners to contribute during the whole QAS project development lifetime. BPMN is a valuable technique, though; we have chosen BPMN to automate the proposed system processes. This paper aims to digitize the quality and accreditation processes for the Libyan Academy (LA) to raise the efficiency of the system.

II. Quality Assurance in Higher Education

Quality assurance in educational institutions has become a matter of life and death. Without quality assurance within the educational institution, there is no education, therefore no recognition of the institution and its graduates. In all of its components, the necessity of quality assurance in higher education has become one of the societal necessities that have evolved in all policy levels to develop higher qualifications to keep up with the needs of the labour market to align with all that's, a new methodology that has recently appeared. Such as Quality Assurance and Quality Correction, which refer to the use of the assessment and correction process as one of the evidence of achievement by the establishment of the quality of education that encourages many advanced countries in the field of higher education to prepare evidence of the limits of the processing of student evaluations in their institutions as shown in figure 1 [8].

Figure 1: Enhancement-led Institutional Review in Higher Education [9]

Quality Assurance is a management methodology and evaluation procedure adopted by higher education institutions and systems to monitor performance against objectives and ensure quality results and quality improvement [10]. In general, Quality Assurance refers to the defined process to meet a set of quality standards consistently and continuously, to satisfy all consumers, producers and other stakeholders. Where Higher Education Quality Assurance refers to the procedures, processes and systems used by Higher Education Institutions to manage and improve the quality of their education and other activities [11]. Where Figure 2 shows the evaluation steps of the Quality and Accreditation operations.

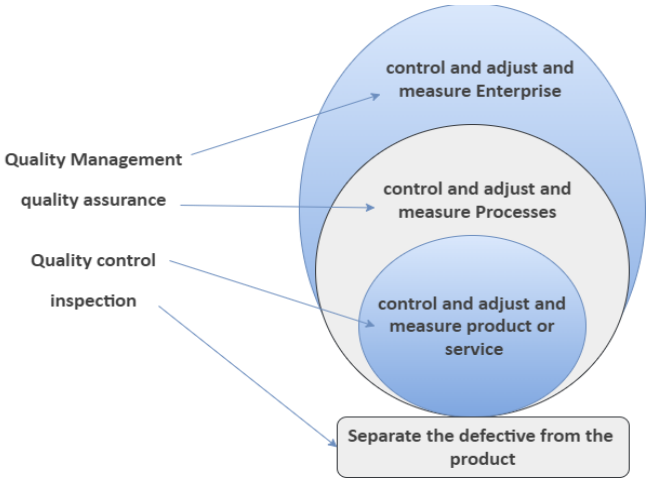


Figure 2: Evaluation steps of the Quality and Accreditation operations

Quality processes are evaluated for academic accreditation through two stages as shown in figure 3.

- Self-assessment
- External evaluation

Self-evaluation: the institution's assessment of itself according to the accreditation criteria contained in the accreditation criteria manual issued by the centre. The self-evaluation of university education institutions aims to determine:

- The degree of compatibility between the prevailing practices in the institution and the standards in its various fields.
- Strengths and weaknesses of performance; To meet the requirements of access to quality and accreditation standards.
- The extent to which the institution achieves the targeted learning outcomes.
- The starting point in building and implementing continuous improvement plans; To meet the requirements of achieving standards.

The evaluation process is carried out through the Quality Department, which forms a technical team to evaluate each accreditation standard, where the internal auditor, a person from the institution, with experience in the field of

specialization, evaluates the extent to which quality standards have been achieved in the institution or program. By reviewing and collecting all the evidence and evidence that proves the achievement of the necessary standards and preparing the necessary report.

External evaluation: It is the evaluation process by a work team from the accredited National Centre for Quality Assurance with experience in this field. It examines all the evidence and evidence that meets the standards, and a report is prepared accordingly, on the basis of which attention is given to the institution or the rejection.

The built system contributes to facilitating these operations in terms of easy access to the necessary data and evidence in a smooth, accurate and fast manner, saving time and effort.

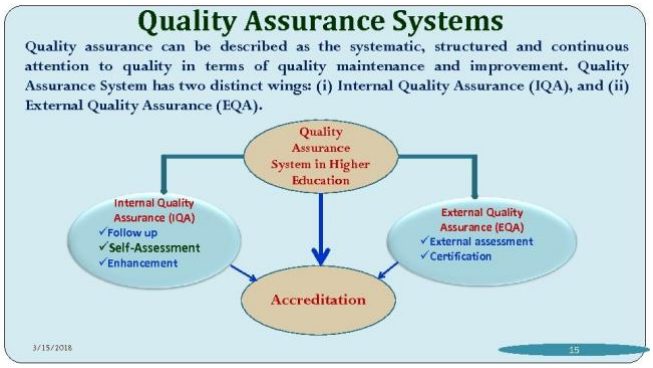


Figure 3. Categories of assessment in quality assurance [12]

III. LIBYAN APPROACH OF QUALITY ACCREDITATION STANDARDS FOR HIGHER EDUCATION

Quality assurance depends on the external auditors of the National Center for Quality Assurance and Accreditation of Educational and Training, who enter the institution to assess the quality of its performance, according to criteria determined by the National Center[13].

Quality standards in performance are based on international standards and specifications, and these standards are the basis for differentiation and excellence, so quality is achieved through adherence to these standards [13]. The question that needs to answer is whether the standards or references determine the quality of the education system and educational services in Libya.

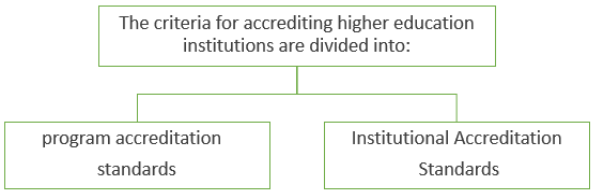


Figure 4: The Higher Education Institutions Quality Accreditation criteria

As shown in Figure 4, the role of accreditation, both institutional and programmatic designed to keep pace with comprehensive reforms of the education and training sector locally and globally. To improve the quality of educational outcomes. That will help to provide education and training opportunities for every citizen in relation to his individual needs, ambitions and capabilities. That will lead to meeting the demands of the state and the prosperity of its economy.

Academic accreditation known as the global academic community is the main policy tool that aims to scale up the education level of the institutions with continuous development and improvement of the education and training sector. It also ensures the achievement of minimum standards for students, parents, employers and other countries. Confidence in having a strong accreditation system achieves Stakeholder needs [13].

A. Institutional Accreditation Standards (IAS)

As shown in Table (1) IAS's are divided into nine criteria, which include planning, leadership and governance, educational and training programs, teaching staff, support staff, student affairs, educational facilities and support services, research, community, environmental services for the QA and continuous improvement. The IAS's divided to 168 indicators as mentioned in [14].

Table 1: Institutional Accreditation Standards (IAS)

Nº	**Standard**	**Indicators Count**
1	Planning.	11
2	Leadership and Governance.	30
3	Educational and training programs	19
4	Teaching staff and support staff	14
5	Student Affairs	21
6	Educational facilities and support services Research.	29
7	Community and environmental services.	18
8	Research	10
9	*QA* and continuous improvement	16

B. Programs Accrediting Standards (PAS)

As shown in Table (2) PAS's are divided into eight criteria, which include Administrative planning and organization; education programs; faculty and support staff; student affairs; educational facilities and support services; Research; community and environmental service, QA and continuous improvement, and it consists of 114 indicators as stated in [14].

Table 2: Programs Accrediting Standards (APS)

Nº	**Standard**	**Indicators Nº**
1	Administrative planning and organization	14
2	Education programs	22
3	Teaching staff and support staff	13
4	Student Affairs	10
5	Educational facilities and support services	17
6	Research	13

7	Community and environment service	10
8	Quality assurance and continuous improvement	15

IV. Quality Assurance Process Modelling

BPM is a collaborative strategy that blends information technology and management science ideas, as well as their applicability to an organizational approach to business operations. BPM focuses on organizing, integrating, optimizing, implementing, controlling, and managing operations at scale. As customer needs and competition interactions grow, corporate processes are becoming more complicated, relying largely on information technology and spanning a wide range of industries [15].

The Business Process Management Initiative created the Business Process Modelling Notation (BPMN) as a process modelling standard (BPMI). The BPMN is made-up of a diagram, specifically a Business Process Diagram (BPD), which is used to understand and model business processes. The BPMN diagram is made up of various parts. Flow objects, connection objects, swimming lanes, and properties are the four categories in which they are separated. BPMN strives to give a notation that is easily understood by all users, from business analysts who generate the first drafts of processes to programmers who construct the technology that will conduct those processes to business owners who will manage and monitor them. As a result, BPMN provides a standardized link between business process design and process implementation. Furthermore, the BPM engine's platform is used to create these processes [16].

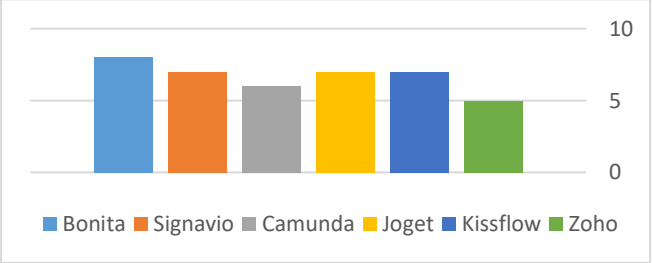
V. BPM Engines

Broadly, a BPM Engine named with BPM suite, in other words, known as a Process Execution Engine for processes expressed in BPMN. Which allowed the engines to interpret the definition of a business process expressed in BPMN to execute the symbols of that standard. There are several BPM engines in the market. Which impose difficulty upon choosing the appropriate engines due to the large number. In order to select the most appropriate engine, we have reviewed a group of engines. In order to ensure that the chosen BPM engine meets all the requirements on which the system depends in terms of Integration and Automation. We have reviewed the information from documents, websites and references of those engines as well as we tested the select engines cross set of features to determine which BPM engines can be used to automate the proposed system. The evaluation detailed in Table 3:

Table 3: the Chosen BPM Engines Assessment

		BPM suites					
		Bonita	Signavio	Camunda	Joget	Kissflow	Zoho
BPM Features	BPMN Modelling	1	1	1	1	1	0
	Processes Execution	1	1	1	1	1	1
	Integration	1	1	1	1	1	1
	Automation	1	1	1	1	1	1
User-Friendly Interface		1	1	0	0	1	1
Cost		1	1	1	1	0	0
Accumulated Points		6	6	5	5	5	4

Whereas for comparison, the digital evaluation methodology was adopted to evaluate BPM suites. We assume that are equally likely; to measure the effectiveness of specifications through evaluating its sub-specs, its value either equals 0 or 1 to express whether the service, feature or component are effective as its availability. As presented in Table 3, we have chosen a set of comparison criteria to evaluate a set of BPM suites. As presented in Graph 1, we found that Bonita has the upper result of the accumulated points; because it is easy to use well known to some extent, easy to operate and expandable. Because of all that, Bonita will be the core-modelling engine for the proposed solution.



Graph 1: the preferred BPM Engine

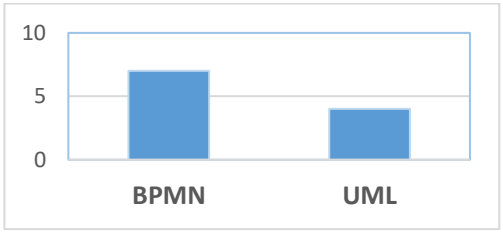
VI. BPMN and UML Comparisons

In the software world, the term "process" has several meanings. A process is a set of actions or activities that are performed over a period of time to achieve a goal in process modeling. There are many different modeling methodologies but the best known are UML, BPMN. Unified Modeling Language (UML) is a custom modeling method for precision object-oriented software systems. Whereas BPMN is used to model entire business processes. [17].

Table 4. Comparison between *BPMN* and *UML*

Criterion	BPMN	UML
Expressiveness	1	0
Readability	1	1
Usability	1	1
Formality	1	1
Tools Support	1	0
Flexibility	1	0

Ease of Learning	0	1
Enabling Business Owners	1	0
Accumulated Points	**7**	4



Graph 1: Consequences *BPMN* and *UML* Evaluation

Whereas for comparison, the numerical assessment methodology has been adopted for evaluating BPMN and UML. Its value is either 0 or 1 to express whether the service, feature, or component is as effective as its availability. As shown in Table (4), we chose a set of comparison criteria for the evaluation process. As shown in Graph 2 we found that BPMN has the highest score for accumulated points; Because of its advantages that help in developing the system and enabling employers to control it easily without referring to an expert person, it is expandable and flexible and supports many effective tools and other features. Because of all of that, BPMN was the technology used for the solution.

VII. QUALITY ASSURANCE SYSTEM DESIGN (QAS)

As shown in Figure 5, the QAS framework illustrated the Managing platform As a Service. This Platform called Computing Engine on GCP provides scalable and secure services. In order to implement the QAS process, where the integration of a set of components Cloud SQL and the BPM engine to fulfil the requested Tasks.

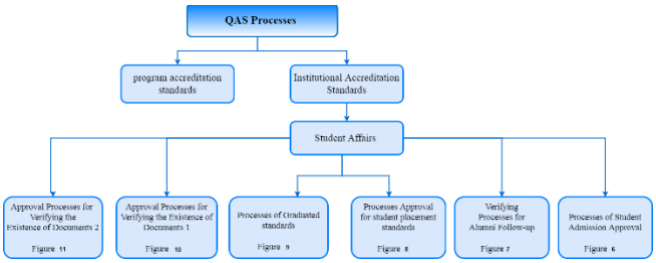


Figure 5: QAS Processes

In this research, we focus on the automated part of accreditation standards namely, the Student Affairs section from Institutions accreditation standards as illustrated in Figure 5. Whereas each sub-processes been modelled listed in Table 5 as follows:

Table 5: Student Affairs BPMN Notation Figures

Nº	**Declared Processes**	**Attached are BPMN Notation Figures**
1	Processes of Student Admissions	Figure 6
2	Verifying Processes for Alumni Flou-up	Figure 7
3	Process Approval for Student Placement	Figure 8
4	Processes Graduated Standards	Figure 9
6	Approval Processes for Verifying Document 1	Figure 10
7	Approval Processes for Verifying Document 2	Figure 11

The Modelled processes of QAS will operate and manage Quality Assurance and accreditation equivalent to the assigned procedure over cloud platform as following functions but not limited to:

- Orcastrate the workflow to completed appropriate tasks on time according to the specified sequence.
- Collection of the obtained data in an organized manner for Data analysis or later use for possible reference.
- Allow users to perform a set of tasks on data upon granted privilege.

QAS Should move through several stages to study and understand the system from the analysis and design stage, and here a set of operations will be modelled (using Bonita Soft) on GCP with Cloud SQL database that meets one of the institutional accreditation standards, which is the fifth standard (Student Affairs Standard) which contains 21 indicators. The indicators were divided into six groups based on their relationship to each other as follows, shown in figures (6-11).

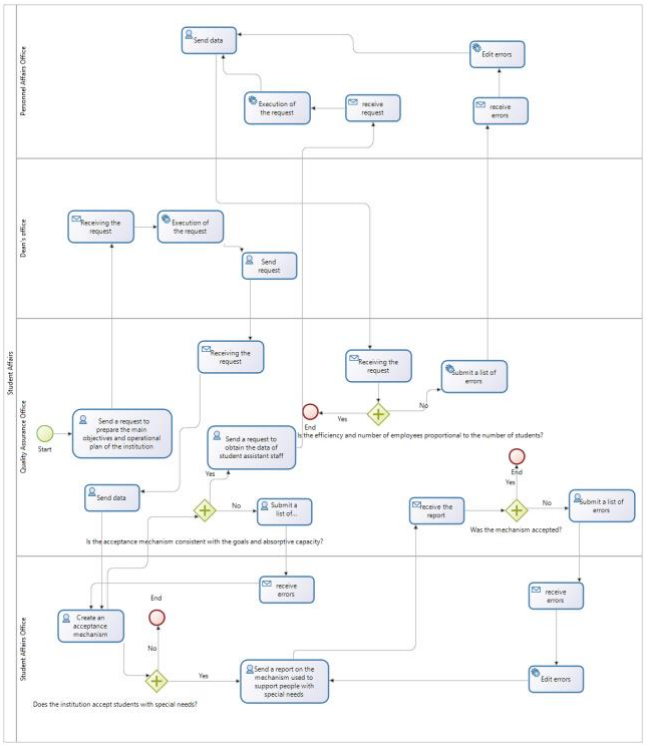


Figure 6. Processes of Student Admission Approval

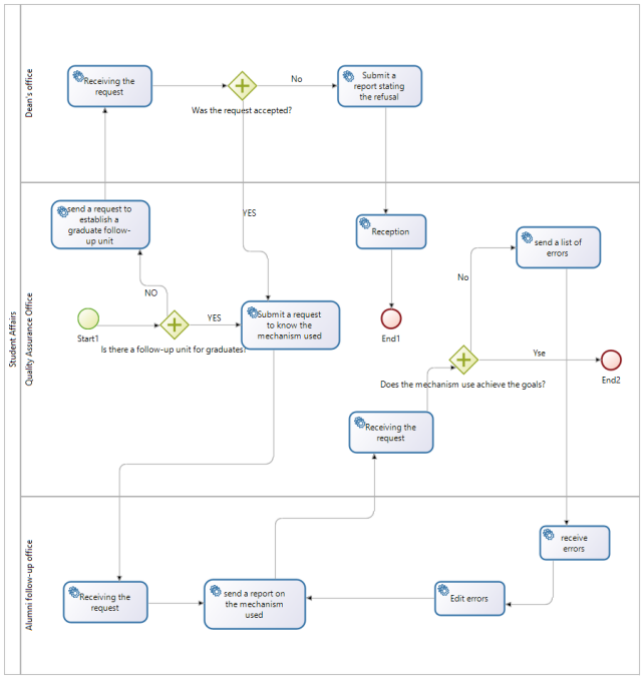


Figure 7. Verifying Processes for Alumni Follow-up

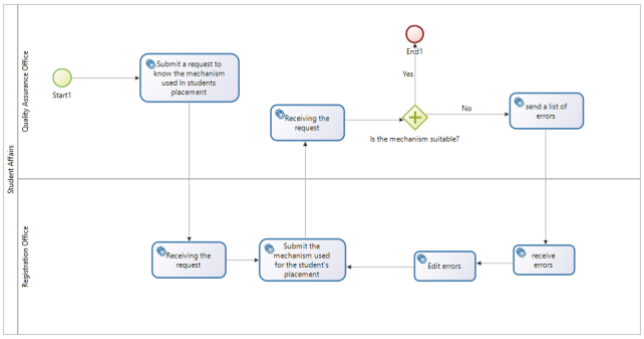


Figure 8. Processes Approval for student placement standards

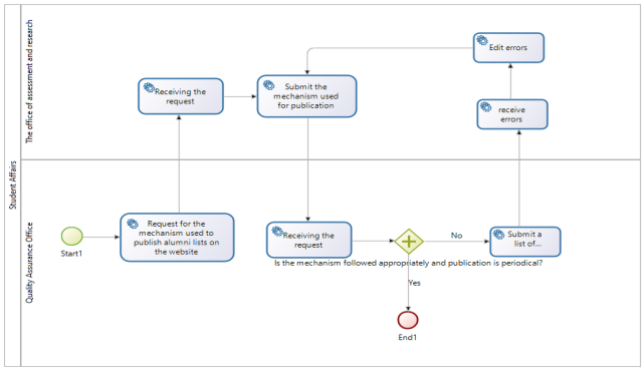


Figure 9. Processes of Graduated standards

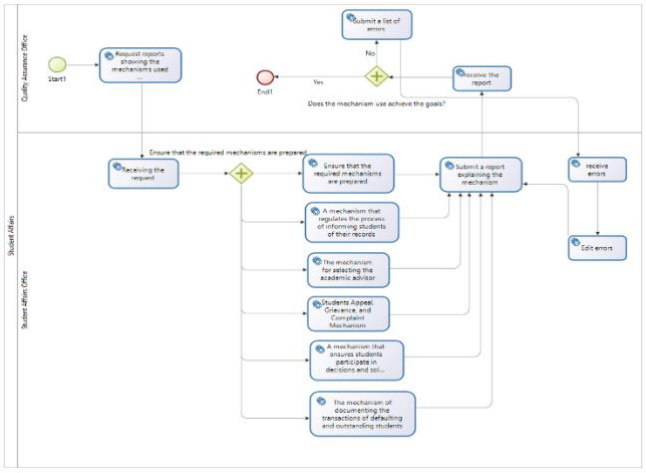


Figure 10. Approval Processes for Verifying the Existence of Documents 1

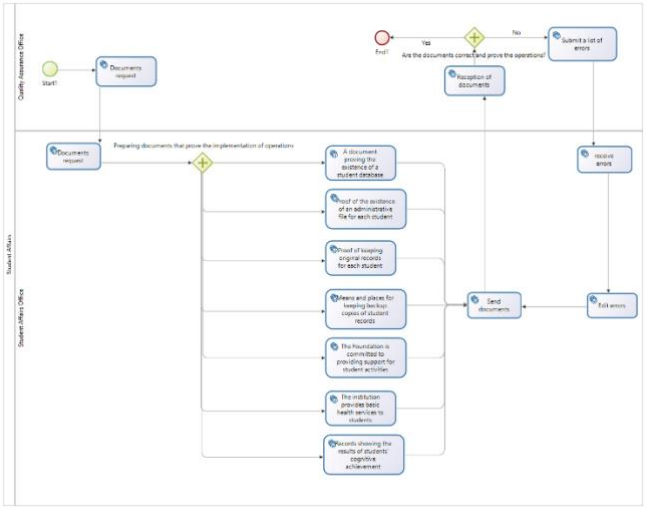


Figure 11. Approval Processes for Verifying the Existence of Documents to students 2

VIII. CONCLUSION

QA patterns are an extraordinary phenomenon that shapes the way to deliver proper HE globally. In order to survive in the competitive world of globalization, all HE institutions have to pay a close attention to the quality of handling of its operations.

In recent years, the interest Libya has grown toward ensuring the quality of education. Where the National Center for QA has imposed set of procedures and capacity-building courses, aiming to prepare individuals all-round the state with equated resource oriented for HE quality.

A wide range of businesses hope to be able to model their operations more professionally and achieve long-term success in attaining their objectives and reaching a more successful position in their respective fields and building a strong, secure, and easy-to-extend interconnected system. Through this study and evaluation results, it has been demonstrated that quality assurance systems and the overall performance of organizations can be supported by BPM systems, due to their capabilities to simplify operations, integrate with other tools

and achieve continuous automation. Therefore, BPMN from BPM was used to standardize quality system processes in an automated manner, allowing the system owner to develop processes without the intervention of the programmer.

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