Developing a Quality Automation Framework to Assess Specifications for Academic Accreditation in Saudi Arabian Universities

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Abstract – Saudi Arabia's higher educational standards are gradually evolving to match the country's vision 2030. The importance of education and a strong emphasis on educational quality are the determinants to realize this vision. Recent studies reveal that the faculty members spend a lot of time preparing documents for the accreditation program and eventually may lose interest in the process. There is a lack of an automated system to prepare documents for accreditation and the need for one is strongly felt. Educational institutions entail multiple accreditations to ensure their quality. In addition, accreditation enables educational institutions to attract student communities. The study intends to develop an integrated framework to prepare documents and maintain quality practices for multiple academic accreditations. The proposed system employs application-programming interfaces for publishing data from the database that facilitates an added security to the primary data. Moreover, it automates the overall accreditation process and minimizes manual interaction. Researchers employed the database of the AlMaarefa University and used it as a testbed for implementing the framework.

The initial set of results are promising and support educational institutions to improve their quality of service.

1. Introduction

Accreditation is a quality assurance procedure that universities, colleges and educational institutions or programs undergo to confirm compliance with strict and recognized levels of service and functioning [1],[2],[3]. It is evaluated by independent, non-governmental accrediting organizations explicitly established for examination of educational institutions and programs. The importance of accreditation is to provide a set of quality criteria for all educational institutions or services, to provide access to federal and national funds, to preserve trust in the private sector, and to facilitate the transfer of credits. In addition, the objective of accreditation is to ensure the responsibilities of schools and degree programs. The accreditation also aims at making universities and graduate programs responsible, thereby fostering public faith and confidence [4],[5],[6],[7]. In a properly approved institution or program, the students can determine the overall standard without having to perform a rigorous review individually.

The Ministry of Education (MOE) has maintained its strategic plan since the Saudi Arabia Vision 2030 was announced, which seeks to align the vision and the goals of this nation, recognizing the relevance of education for the long-term growth of this country [8],[9]. The education sector plays an important role in enhancing the social system that is connected with the demands of the economy; community education produces innovative minds, qualified human resources and ultimately a successful economy. In implementing Vision 2030, the public recognizes the education system as a stable and effective partner [1].

Moreover, one of the goals is to match education results with labor markets so that Saudi universities satisfy business standards. This makes National Academic Accreditation & Assessment Commission (NCAAA), a crucial resource for improving the standard of academic curricula in both private and government universities in Saudi Arabia [7].

The accreditation process is not simple, as it is misunderstood that it is a time-consuming and unnecessary process for many faculty members [10],[11],[12],[13]. There are complexities such as collecting, aggregating, analyzing data, and gathering information to produce appropriate corrections and plans. The NCAAA standards generally encompass strategic planning, corporate processes, teaching and learning, student records, faculty and staff documents, institutional resource management, research and development and collaboration within the community [14],[15],[16],[17].

Accreditation of the program covers the standard of education and makes sure that certain set of protocols are followed to achieve the same. However, according to the study [15] the quality assurance of a curriculum cannot be accomplished when the teaching and learning process fails to comply with the quality standards.

The study aims to minimize the efforts in preparing documents and assessing of standards for academic accreditation in the universities of Saudi Arabia. Therefore, it proposes a Business Intelligence (BI) based integrated framework that contains a dashboard for universities for monitoring activities for accreditation including the NCAAA, the Accreditation Agency for Study Programs in Engineering, Informatics, Natural Sciences and Mathematics (ASIIN), and the International Organization for Standardization (ISO) [18],[19],[20],[21],[22]. It reviews the existing frameworks for academic and administrative processes in the university setting. In addition, it provides an automated Key Performance Indicators (KPI) for management to make effective decision [23],[24],[25],[26].

The study is organized as follows: Section 1 introduces the proposed concept of integrated framework for assessing the quality standards of universities. Section 2 presents the background of the research with existing literature. The methodology of the research is proposed in section 3. Section 4 includes the results and discussion. Finally, section 5 concludes the research.

2. Research Background and Related Works

In recent times, governments in different parts of the world have shifted their focus on the higher educational institutions to pay more attention for maintaining the quality of education, enhancing learning outcomes, establishing and encouraging the development of social and economic competences within the country [1],[2],[3],[4]. In general, quality in higher education is an ongoing growth process focused on quality policies, institutional mission practices, principles and the demands and aspirations of the stakeholders. Accreditation is described as "a process by which the officially designed external regulatory agencies, responsible at the government level assess existing qualifications, standards and procedures for educational institutions" [6].

Several steps and accreditation standards are in place at institutional and program levels for universities in Saudi Arabia [8]. In collaboration with the agencies, the Commission develops a schedule of assessments, providing adequate time for the adoption and implementation of quality assurance and the completion of quality self-studies. At least once in every five years, each organization will have to undergo a systematic self-study, examining the efficiency of its operations in all respects, including its programs, facilities, and administrative arrangements. As a basis for the self-studies, self-appraisal scales as models given by the NCAAA are used. A self-study report accompanied by documentary evidence for the assertions made is then submitted to the NCAAA. Independent external peer reviews serve to check the results of the SSR, particularly in relation to international standards and objectives. The Commission then reviews all findings, including those from external independent sources.

A study [6] indicated that the quality of the academic material is directly influenced by academic accreditation and improved quality assurance procedures in the program [2]. In terms of the qualitative contribution of academic accreditation, previous research carried out by author [1] has played a major role for improving the teaching and learning process through accreditation. Author [8] proposed a conceptual framework that contains an Enterprise Resource Planning (ERP) model. The implementation of this model requires more resources. In addition, data security is one of the challenges faced by the users of this model. In another study [9], a BI based technique was used for accreditation assessment. In this study [11], the authors addressed the challenges in the implementation of a dedicated interface for addressing multiple accreditation programs.

All the universities and academic programs in Saudi Arabia should obtain academic certification by the NCAAA [21] through well-defined procedures based on quality standards and collection of KPIs. . Higher education institutions in Saudi Arabia should set up internal quality assurance mechanisms that

ensure high quality levels in eight institutional and six academic standards. One of the major challenges faced by universities is to develop a framework of internal quality for higher education in the Kingdom of Saudi Arabia.

2.1. The NCAAA

In the Kingdom of Saudi Arabia, the NCAAA has been created, which will set standards and requirements for accreditation and evaluation of academic institutions and their programs [7]. The Commission has committed itself to a plan to encourage, endorse and evaluate post-secondary institutions' quality management systems to ensure that their quality of learning and management is equal to the highest international standards. The NCAAA seeks through academic assessment and accreditation to contribute to the enhancement of quality and excellent work in higher education institutions and programs. One of the strategic initiatives under the accreditation responsibility is to improve and streamline the process of accreditation, including recognition and simplification of review and procedures to ensure that the accreditation process and procedures will become practical and efficient [7].

A panel visit on site reviews, observes the results of the self-assessment, and presents a report outlining their academicals quality assessment in relation to the criteria. The NCAAA decides on the accreditation after taking into account the recommendations of the review panel [17]. The institution or program can encertain, before the NCAAA accreditation process, that it will satisfy the core elements of all 11 standards and comply with the terms and conditions of the Ministry of Education's official approval. These key elements include the extent or range of program, the standard of offering of the programming, its official title, name, quality assurance processes and any special standards stated under its approval. The Board of Directors should agree to its vision, its strategy for mission fulfillment and its key quality assurance goals.

2.2. The ASIIN

In accordance with the German law, the ASIIN is organized in the form of a non-profit affiliation. It is an alliance of colleges, universities of applied sciences, chambers of engineering, technical and scientific societies, professional organizations, specialists and companies and organizational groups of the social partners [8]. It was established in 1999. The ASIIN is financed exclusively by membership fees and accreditation fees.

All activities of the ASIIN are aimed at safeguarding and extending high standards and higher quality education - at home and abroad. The ASIIN is based in Germany and registered as an entity under respective national public law and operates internationally on a private-law basis. The ASIIN is certified to grant European Engineering Standard Labels (EUR-ACE®), IT (Euro-Inf®) and Chemistry Labels (Eurobachelor®/Euromaster®) [14].

The quality specification of a study program is specified in relation to the content within the goals formulated by the institutions of higher education itself. Moreover, the political, legal and socio-economic environment, in which the degree program is developed and carried out, makes provision for external standards [12].

The amount of achievement achieved by graduates in their career often demonstrates the efficiency of the study program. It depends on the involvement of all parties involved in and outside the university. We, therefore, consider it as essential for relevant stakeholders in the institution to participate in the preparation, management and implementation of this process [17]. The ASIIN accreditation procedure examines the program's rationale and efficacy within the study program. The efficient achievement of the goals set by the organization itself is central to the overall evaluation.

The ASIIN specializes in the examination of engineering, computer technology, and mathematics and natural science programs in program accreditation and of all cross-disciplinary combinations of these subjects. It conducts quality-management system inspections of higher education institutions on an institutional basis. The specialist areas can be seen in the structure of their boards and commissions, consisting of specialists from both the national and international sectors [21].

2.3. The ISO

The ISO is an International Organization for Standards that uses an alternate order of terminology to accommodate the Greek term 'isos' (meaning 'equal') to several interpretations. The ISO is headquartered in Geneva, Switzerland, with the goal of promoting "the international cooperation and integration of Industrial Standards" and began its operations in London in 1947. The Organization is a non-governmental standard setting agency with representatives in 165 countries and 3,368 technical institutions to take care of its 19,500 production standards, providing outstanding product, service, and system standards to ensure quality, protection, and performance [25].

ISO 21001 offers a standard tool for managing the standards and aspirations of learners and other clients for organizations that provide educational goods, solutions, and services. The management system standard is stand-alone and aligns with other standard ISO management systems (such as ISO 9001, ISO 14001, etc.) with the application of a high-level framework [12]. ISO 21001 focuses on the specific engagement between educational organizations, learning institutions, consumers, and other related stakeholders. In order to enhance their capability, education organizations have a crucial and ongoing desire to determine how they satisfy the demands of learners and other stakeholders. The emphasis of ISO 21001 is on the basic relationship between a training institution, the student, and other clients [18].

Current educational processes increasingly concentrate on co-creation as the conventional relationship between the consumer and the supplier is refined into a collaboration. This standard will provide guidelines on how quality can be delivered in this new and difficult world [19]. Education varies from many other areas in that a good education process maximizes a student's probability of success; however, that cannot be guaranteed. In order to make the educational process a success, the commitment and capability of both the learner and the educational organization is vital [21].

The educational organization fosters this integration and provides it with the framework, insight, processes and learning tools. However, the effectiveness of the educational process ultimately depends on the commitment and capacity of the learner.

Educational institutions that will benefit from the standards include pre-schooling, intermediate, primary and secondary schools, colleges, universities, adult education centers, special educational schools, vocational education and training, centers for tutoring and coaching, training organizations, agencies for education/training, consultants and non-formal providers of educational services [23]. This is valid regardless of the source of funds, which may be private (commercial), public (subsidized), self-sustaining (internal revenues) or not for profit type (sponsored).

2.4. Research Questions

Based on the objective of the research and the research gap in the literature, the following research questions (RQ) are framed:

RQ1 – How to develop an integrated framework to address the multiple accreditation processes?

RQ2 – How to automate the KPIs for assessing the standards?

3. Materials and Methods

The study intends to minimize the efforts in preparing documentation and implementing the KPI for academic accreditation. In the present academic environment, faculties spend a lot of time for submitting documents for obtaining accreditation for institutions and programs. The proposed system attempts to integrate the accreditation process into a single system. The author [11] proposed an ERP system for the process of accreditation. However, some limitations such as security, data storage and retrieval, and data analysis should be taken stock of. Accreditation process primarily focuses on the functional and non – functional standards of higher educational institutions.

To address these limitations, the authors propose a method as shown in Figure 1. Figure 1. illustrates an integrated framework for accreditation for institutions and programs. In this study, researchers simulated a database structure of the AlMaarefa University and generated a synthetic dataset. They utilized the university data as a testbed for implementing the framework. ORACLE 12 G is employed for storing data in the form of tables. ORACLE Representational State Transfer (REST) Application Programming Interface (API) data services are used to publish data in JavaScript Object Notation (JSON) format. PHP language is used to develop a web interface for the integrated framework. To store and retrieve data, SQL queries are used.

The following steps are followed for implementing the proposed integrated framework.

1. Generate dataset from the data source.
2. Pre – process the dataset.
3. Transformation of data to ORACLE 12 G database.
4. Configure RESTful API.
5. Generate data in JSON format.
6. Develop services to extract data for the integrated framework.
7. Create categories such as NCAAA, ASIIN, ISO, and KPI.
8. Present documents as per the standards for the relevant accreditation.

The integrated framework enables an automatic retrieval of data using RESTful API. For instance, Table 1. shows the template to display the previous 3 years of data of programs with number of students. It reflects a template that extracts data from the database of a specific program. For instance, "n" represents the year 2021.
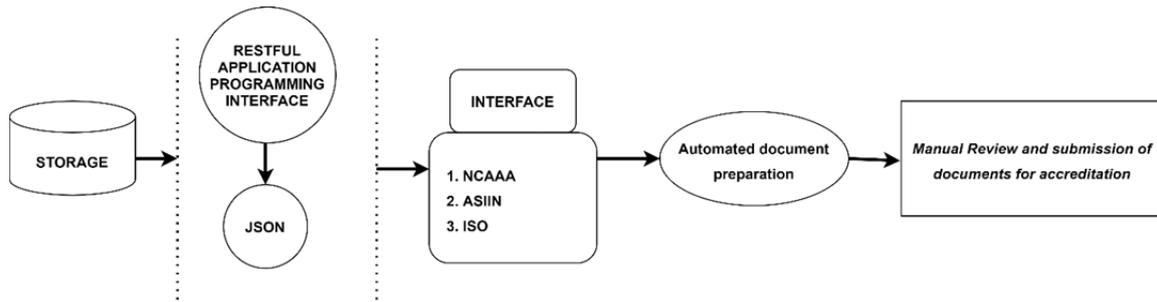
Figure 1. Integrated environment for accreditation

Subsequently, data of the previous years 2020 and 2019 will be extracted using the API of the database. Table 2., Table 3., and Table 4. outline the standards for the ISO, the ASIIN, and the NCAAA accreditation. Furthermore, each program in the institution needs a dedicated accreditation of the ASIIN and the NCAAA. Figure 1. shows the framework for accreditation.

Table 1. Automated data of a course

B.Sc.(Computer) / Year	n-2	n-1	n
Students	Data(n-2)	Data(n-1)	Data(n)
Percentage of Graduated students	Data(n-2)	Data(n-1)	Data(n)

Table 2. Standards for ISO Certification

S.No.	Standards
1	Establishment
2	strategy
3	Progress
4	Policy
5	Identification Guide
6	Program Specification
7	Course Specification
8	Quality Assurance
9	Student Records
10	Research Plan
11	Community Partnership

Table 3. Standards for ASIIN Institutional Accreditation

S.No.	Standards
1	Context of an organization
2	Leadership and commitment
3	Action plan
4	Competence and training
5	Awareness and communication
6	Operations and controls
7	Performance evaluation
8	Improvement

Table 4. Standards for NCAAA Institutional Accreditation

S. No.	Standards
1	Overview of program
2	Content, concept, and Implementation
3	Structures, method, and Implementation
4	Exams: System, concept, and Organization
5	Staff development
6	Student administration and support services
7	Learning resources
8	Documentation and transparency
9	Quality management and further development
10	Assessments management

4. Results and Discussion

To address the RQ1, the authors proposed a conceptual framework for multiple accreditation activities. It enables users to govern academic and administrative processes in universities. Figure 2. represents the conceptual framework for the NCAAA, the ASIIN, and the ISO. It follows the framework proposed in the study [11]; however, it differs in extracting and visualizing data. Furthermore, it contains a dedicated portal for the KPI to evaluate the standards for the institution. It supports management to make decisions and enhance its activities to gain the accreditation. Figure 3. shows the interface of the framework. The development of the framework is the on-going process.
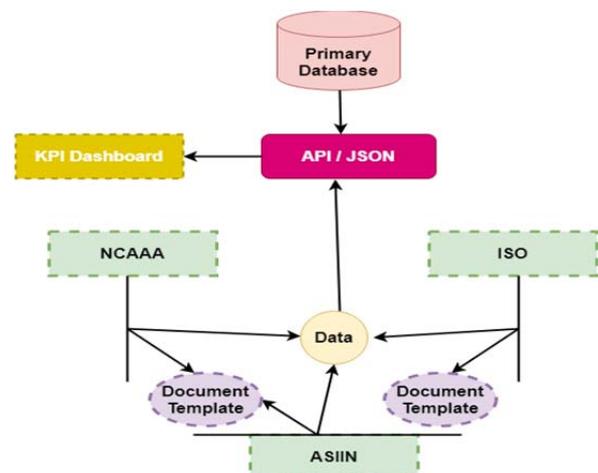

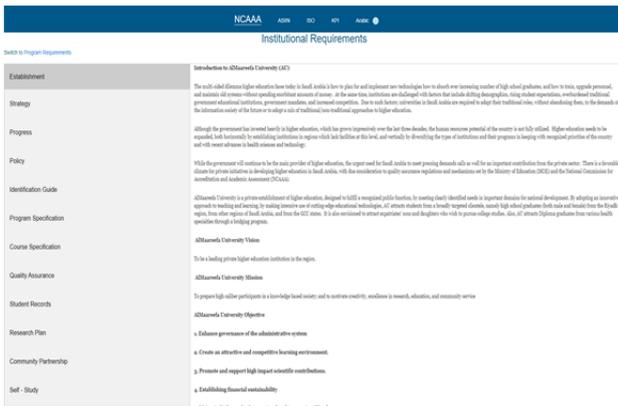*Figure 2. Conceptual framework for accreditation*

Figure 3. Interface of the proposed framework

Figure 4. reflects the structure of the proposed KPI dashboard. The dashboard is designed in order to cover the overall departments / units of the institution. It supports decision makers to monitor each department. Figure 5. shows the interface of the proposed KPI dashboard.
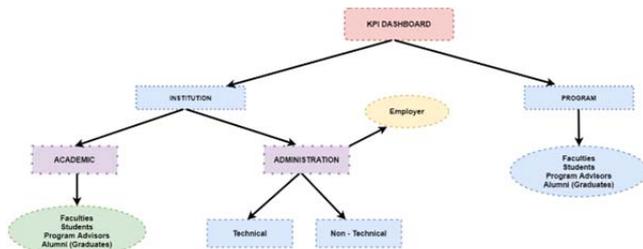

Figure 4. KPI modules for program and institution accreditation

The authors considered the standards for the NCAAA, the ASIIN, and the ISO as prime factors and the KPI as a supplemental factor for maintaining the standards of the university. The authors employed a standalone database for visualizing data and embedded it with the document. They applied an automated approach that extracts data in JSON format.
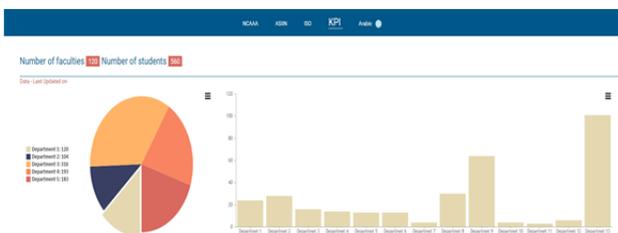

Figure 5. KPI Dashboard

These processes are used to leverage the load on the primary database. For instance, JSON data are not interconnected with the primary database. Moreover, the three-layered approach supports the framework to update data, frequently. For context, users can program the data extraction for a specific day and time in an order to update data in the dashboard. It supports management to make decision to improve its standard.

RQ2 states that there is a demand for a BI based interactive visualization technique to visualize data. The introduction of the AI based approaches in the field of statistical analysis have influenced the developers around the globe to focus on BI. In this study, the KPI is developed using BI tools. Fig. 5. displays the interactive graphs that reflects the institution and program data. However, these data are artificially developed for the purpose of this study. It does not reflect the performance of any institution.

4.1. Discussion

Based on the outcome of the proposed study, the application of the BI for making decisions and visualizing the crucial data is useful for the educational world [14]. A number of suitable metrics should be enabled to use the BI. For university administration, the identification and evaluation of main performance indicators is important. The performance metrics should be extracted according to the university strategies and primary business processes to achieve these strategies. This performance information should be presented in an intuitive format to the academic supervisor to facilitate university administration proceedings [15],[16],[17].

The fundamental role of performance measurement is to determine exactly how well a particular university or department/ faculty has accomplished the respective objectives. For each key business operation, KPIs should be defined. In an era of globalization, the BI is used by many universities to enhance internal management performance (cost reduction and optimization of processes) and improve teaching quality [7]. Several universities already use BI principles to improve internal processes of management [8]. The BI is a data analysis and executable information technology-based process that helps managers and corporate end users make informed business decisions. The BI includes various methods, software and methodologies for the collection, creation and operation of queries on internal systems and external resources, reporting, display panels, and data visualization in order to provide businesses, decision makers as well as managers with analytical results.

KPIs' function in the organizational framework is to provide users/customers with customized and easily accessible measurement in order to improve the quality and efficiency of their operations. The efficiency of using KPIs depends on how efficiently they promote the organizational effectiveness. For instance, a government agency like a higher

education institution or a hospital will have financial KPIs that are different from a publicly traded business. Each KPI should follow the mission and goals of the organization. KPIs are essential for monitoring and reporting progress. Report formats can be personalized according to the perception of a decision maker [17]. The mixture of dashboards, scorecards, insightful reports, and ad-hoc analysis tools should be taken into account. The KPI results allow policymakers to decide where the focus should be placed to increase the productivity of an individual unit / organization. To create structured real-time dashboards, time and efforts are required to efficiently apply data. Things based on KPI will be notified to individuals, possible solutions will be identified and support to develop innovative ideas.

5. Conclusion

In the competitive environment, Saudi Arabian universities are improving their standards through multiple accreditation programs in order to assure that they are doing a quality role in higher education practices. Also, it attracts more number of local and international talented students. Recent studies reveal that the faculties face challenges in assessing the standards and spent considerable amount of time in the document preparation process. In addition, there is a demand for the BI tool to automate the data analysis process. This study intended to develop a framework that integrates multiple accreditation program and applied the BI based technology for automating the statistical analysis. The framework development is an on-going process. However, the initial set of results highlights the importance of the proposed framework in educational institutions. Moreover, the integrated framework provides enhanced security to data in comparison to the existing frameworks. The study supports management to make effective decision through the KPI dashboard. The automated extraction of data from the primary database is minimizing the human intervention. In the future, machine-learning techniques can be employed to improve the overall efficiency of the framework.

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