

# INTEGRATED DASHBOARDS WITH SOCIAL MEDIA ANALYSIS CAPABILITIES FOR MONITORING QUALITY IN HIGHER EDUCATION INSTITUTIONS

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## Abstract

The nature of Higher Education (HE) systems encompasses different internal and external stakeholders, as well as the substantial budgetary funds allocated by governments in support of Higher Education Institutions (HEIs) operations. This has led to stakeholder demands for assurance that resources are used in the most efficient way, thus, Quality Assurance (QA) plays an essential role in assuring that the organizational mission and objectives are aligned to meet the expectations of stakeholders. This paper discusses an extensive literature review for identifying current architectures for Business Intelligence in Higher Education, and the use of these architectures in the developing of Business Intelligence dashboard. The paper discusses the role of dashboards in monitoring quality in Higher Education Institutions (HEIs) and how reports generated through dashboards can be utilized for the accreditation process in the Kingdom of Saudi Arabia (KSA). The paper also discusses the role of social media which can be used to assess service quality through sentiment analysis. The paper outlines the integration of dashboards and social media for monitoring and supporting decision making processes in Higher Education. The paper contributes in identify the sub elements of an assessment framework and the validation through focused interviews techniques by Quality Assurance professionals to determine its usefulness in assisting decision making. Future work will be to develop the dashboard to use the National Commission for Academic Accreditation and Assessment standards as a reference of information to be included in dashboard design.

Keywords: Dashboards, Higher Education Institutions, Business Intelligence, Monitoring, Accreditation, Social Media, Decision Support, Saudi Arabia.

## 1 INTRODUCTION

Business Intelligence (BI) plays an important role in monitoring performance in Higher Education Institutions (HEIs) as it provides real-time information to assist management decision making [1]. In the context of KSA, Colbran and Al-Ghreimil [2] suggested that BI systems and Quality Assurance (QA) go “hand in hand” as BI reporting allows the provision of summarized reports about learning and teaching quality indicators. These reports which can be generated easily by BI tools can improve learning and teaching outcomes [2] and the reports can be aggregated to provide individual to sector benchmarks. Sorour et.al. [3] proposed a BI architecture in Higher Education (HE) context which addressed the role of different inputs in gathering information about the quality of service provided by HEIs.

Data warehouses were originally developed to store transactional data in conventional BI architecture [4] but there is recognition of the need to extend the data to include feedback and opinions obtained through social media channels [5], [6]. However, sentiment analysis is used in this case to analyse this data from social media and clean it to prepare it to be used in the system [7]. Additionally, the emergence of cloud services like Microsoft Azure, Amazon AWS, Google Cloud, and other cloud services allowed some Business Intelligence providers like Tableau and Microsoft Power Business Intelligence to allow users to connect to cloud services. This will allow users to get the benefits of real-time update of data from Cloud systems and avoid costs of implementing local server for databases. These data and analytics are then represented to decision makers in terms of reports and graphical representation that is known now as Dashboards [8], [9].

Reviewing the current BI architectures indicates that there is a lack of information on essential components such as alignment with National Qualifications Framework (NQF) [10], considering cloud computing services [11], acknowledging the role of Social Media as data input source [5], [12]. Thus, this paper develops a framework for monitoring Quality in Higher Education using Business Intelligence Dashboards with Social Media Analysis capabilities.

## **2 BUSINESS INTELLIGENCE IN HIGHER EDUCATION**

Business Intelligence (BI) plays an important role in decision making in the HE context [13]. Business Intelligence tools support managers in making decisions more effectively and accurately [1]. A data warehouse environment uses data sources from which information is gathered; the information is then integrated into a Data Warehouse (DW), and used to support query and reporting tools, and analytical and monitoring tools [14], [15]. The system supports retrieval and storage to enable analytics which are presented to the user using Business Intelligence visualisations such as reports, graphs, and notifications [9], [16], [17]. Current literature indicates that there are also BI architectures which will allow organizations to benefit from the capabilities of BI analytics while avoiding investing in Data Warehouses (DW), an approach which might be suitable for Small and Medium Sized Enterprises (SMEs) [3], [18]–[20].

### **2.1 Quality Monitoring in Higher Education**

Educational services are intangible and difficult to measure since the outcome is reflected in the improvement in knowledge, characteristics, and behaviour of individuals [21]. This suggests a need to monitor quality in HE, and for doing so, a set of performance indicators are needed to track performance [10], [22]. Key Performance Indicators (KPIs) are used by HEIs to benchmark performance in certain areas. The actual performance is measured and compared to reference KPI in order to determine the level of satisfaction or compliance with the target. As KPIs are directly related to the organizational mission, the achievement level can predict whether or not the HEI is aligned to its mission and strategic objectives. Colbran and Al-Ghreif [2] suggested that, for the purpose of decision-making, good decisions require good information and datasets, metrics and KPIs can be relevant to learning and teaching as well as research.

### **2.2 Role of Social Media in Monitoring Quality in Higher Education**

Social media is increasingly important as a source of data for HE as it provides feedback for quality of services provided by HEIs [5], [12]. There are challenges in working with social media data in Business Intelligence [23]. Hajli and Laroche [23] suggests that there is a need to explore how data coming from social media can be utilized to capture consumer thoughts and insights from social media platforms.

### **2.3 Dashboards and Data Visualisation**

Monitoring performance through the use of BI capabilities and dashboards is seen as an important application for Business Intelligence in HEI [1], [16], [24], [25]. Business Intelligence dashboards are seen as an effective tool for visualising data and communicating HE related real-time performance information to assist decision making [25]–[27]. Data visualization describes the process of presenting data to decision makers [27]–[29]. Noonpakdee et al. [30] considers visualization to be an important part of Business Intelligence which supports the presentation of data after processing and analysis. Dashboards are seen as a crucial tool for communicating information clearly at glance.

In a Higher Education context, there are a number of studies which discuss the importance and the role of data visualization in decision making and monitoring managerial and academic performance of the HEI such as Dyk [31], Chen [32], Qiu et al. [12], Denwattana and Saengsai [27], Qiu et al. [5], Li et al. [33], and Scholtz et al. [26]. Denwattana and Saengsai [27] suggested that dashboards can assist decision making in HEI by monitoring performance activities related to the achievement of the institutional mission. Scholtz et al. [26] discussed the development of dashboards to assist in taking sustainable strategic decisions for HEIs.

## **3 METHODOLOGY**

This study followed the approach used in related studies [34]–[36], by examining existing QA monitoring frameworks through an extensive literature review. From the frameworks identified through the literature review, the researchers developed an Holistic Framework for Monitoring Quality in Higher Education using Business Intelligence dashboards based on current frameworks, as discussed in a previous study [37]. The framework also addressed the role of Social Media in monitoring quality. The researchers then conducted a series of interviews with a focus group of experts in QA in HE concerning Business Intelligence Architectures in Higher Education. The focus group consisted of 10 experts with backgrounds ranging from Vice Chancellor to a lecturer with a range of QA experience from 6 to 30

years in HE. The experts came from KSA, Egypt, UK, USA, India and Australia and a number of the experts either worked in or had previous experience of quality assurance in KSA.

#### **4 PROPOSED BUSINESS INTELLIGENCE DASHBOARDS FRAMEWORK**

For the purpose of building the proposed framework, theoretical frameworks in the field of Information Systems were selected to underpin the concepts used in this research and support coverage of factors that had been identified as missing from the literature review [37]. Reviewing the components identified as missing or not fully covered in the literature, it was found that the framework needs to (1) consider Social Media as a data input source, (2) acknowledge the National Qualifications Framework (NQF) in the development of the curriculum, and (3) use of meaningful Key Performance Indicators (KPIs).

The Technology, Organization, and Environment (TOE) framework, Information System Strategy Triangle (ISST), and Human, Organization, and Technology fitness (HOT-fit) framework have been selected to support this research as these frameworks have been used in other areas such as the development of a Cloud computing adoption framework for healthcare providers [44] and a framework to support decision making for healthcare organizations joining telemedicine networks [45]. TOE has also been used to study the adoption of Cloud computing in the context of higher education [46]. The Unified Theory of Acceptance and Use of Technology (UTAUT) will also be used in the current study to underpin the development of the holistic framework as researchers like Ramayasa [38] have used UTAUT and HOT-fit for development of evaluation model for the success and acceptance of E-Learning.

The review of current literature indicated that there are five main pillars which need to be considered while designing a BI system in HE for monitoring Quality. These pillars are outlined as follows:

##### **1 Technology**

The main purpose of BI-QA monitoring is to deploy BI tools for the purpose of assisting decision makers to take appropriate decisions regarding the continuous development of HE quality. The use of notifications systems and dashboard monitoring that is connected to a real-time database will require investment in the technological infrastructure. As discussed in this paper, the decision makers must decide which BI architecture is suitable for their HEI according to their requirements and capabilities. The HEI may consider presenting the outputs of the BI system through the use of Dashboards, which gives at a glance a view of QA performance, or Balanced Scorecards, or generate specialized reports as needed. Additionally, the HEI may choose to analyse data through Online Analytical Processing (OLAP) techniques, data mining, or even using text mining and sentiment analysis for dealing with Social Media data.

##### **2 Organization**

The HEI, as an organization, needs to consider specific factors to be able to fulfill QA standards and successfully implement the BI system. Among these factors, are deployment of safety standards [39], assuring administrative services quality [21], crafting curriculum structure [21], effective management [20], [40], innovation [41], leadership [20], and deployment of quality culture [20], [40].

##### **3 Environment**

HEIs operating in the context of KSA are obligated to follow the standards and requirements imposed by the Ministry of Education and the National Commission for Academic Accreditation and Assessment (NCAAA) for the purpose of assuring quality [10]. All HEIs are required to develop their curriculums according to the National Qualifications Framework (NQF) and this is the main factor identified by the authors as missing from other models [33]. Interaction with external stakeholders is considered among the main requirements of the QA system, thus, external stakeholders are considered as part of the environment in which HEIs operate.

The challenges that external environment present to the HEI such as globalization [42], economic, political, and socio-cultural aspects [43] as well as fitness of purpose for the programme [39] and the location of the HEI [21] need to be addressed while analyzing the environment for the purpose of crafting the strategy to face these challenges, whether through Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis or any environmental analysis tool.

##### **4 Business**

There are costs associated with the implementation of QA systems. While NCAAA requires HEIs to adopt quality standards, HEIs find these operations to be costly and require additional financial

resources. Quality assurance itself requires institutions to have sound policies for financial monitoring and disbursements. QA activities require all managerial levels in the organization to be working together for the purpose of achieving quality, and QA is considered, from the managerial perspective, as a business process management activity. HEIs are required to measure their performance against a set of KPIs in order to ensure the minimum level of quality. HEIs are operating, from business perspective, in a competitive market where institutions are trying to provide the best programmes and services for students, thereby gaining competitive advantage and support for the achievement of the organizational mission [44]. The academic quality of teaching and learning needs to be considered as part of the HEI business processes together with the management of costs associated to the resources used for the educational process [40], [45], [46].

## 5 Social

It is necessary to distinguish between Social element from the psychological perspective, which includes organizational behavior, leadership, and personal characteristics (individual level) [38] and the Social element from the organizational perspective. From the organizational perspective, the Social element is concerned with the social relationship between the HEI and the environment in which it operates as well as human characteristics including the Social Media aspect [5], [41]. In addition, as HEIs are moving toward being student-centered and community-oriented, social interactions between individuals and community organizations which occur both internally and externally need also to be considered [47]. The Social elements relates to the Human characteristics that affect the acceptance of new systems as well as the social culture of the institution.

The factors associated with each of these five pillars that together make up the framework were identified through an extensive literature review and through the interviews with experts. The factors are outlined in Table 1.

*Table 1. Literature Sources and Interview Factors for Quality and Business Intelligence Implementation in Higher Education.*

<i>HF-HEQ-BI Pillar</i>	<i>Identified Factors from Literature</i>	<i>Literature Source</i>	<i>Identified Factors from Interviews</i>
Technology [40], [44], [46], [48], [49]	Methods (BI Architecture) Technical infrastructure Data management Data quality Data Sources Analysis Methods Notifications	[39] [21], [40] [26] [6], [40] [5], [33] [26] [9], [16]	<u>Special Requirements</u> Technical Infrastructure Data Management Data Quality Data Sources Analysis Methods Notifications
Organization [40], [41], [46], [50]	Safety Administration service Library service Curriculum Structure Facilities Management Innovation Strategic alignment Leadership Culture Partnership Administrative Quality	[39] [21] [21] [21] [21] [6], [20], [26], [40], [46] [41] [26], [51] [20], [51] [20], [40] [39], [51] [52]	Safety Administration Service Library Service Curriculum Structure Facilities <u>Top Management Support</u> Innovation Strategic alignment Leadership Culture Partnership Administrative Quality

Environment [39], [48]–[50], [53]	Fitness Location Career prospects Economy Politics Socio-culture Globalization Competition QA Standards NQF	[39] [21] [21] [43] [43] [43] [42], [54] [42] [27] [27], [55]	Fitness Location Career Prospect Economy Politics Socio-Culture Globalization Competition <u>QA Regulations (Including NQF)</u>
Business [6], [40], [48], [49]	Purpose Requisite resources Financial factors <del>Costs</del> Competitive advantage Process KPIs Academic Quality	[39] [20] [42] [42], [56] [44] [40], [53] [1] [52], [57], [58]	<u>Continuous Improvement</u> <u>Resources</u> <u>Financial factors</u> Competitive Advantage Process KPIs Academic Quality
Social [5], [38], [41]	Motivation Team Academic Staff Human elements Reputation Social Media Stakeholders Interactions <del>Relationship Quality</del>	[39] [39] [21] [59] [57], [58] [5], [41] [26] [52]	Motivation Team Academic Staff Human Elements Reputation Social Media Stakeholders Interactions

## 5 DISCUSSION

For the purpose of evaluating the framework and identifying the factors associated with each pillar, the researchers used a focus group of experts with extensive experience of QA in Higher Education as discussed in section 3. The respondents were presented with the factors outlined in Table 1. The respondents could either confirm the factors, rearrange, or add or delete factors. Ten experts in Quality in HE were interviewed as the expert focus panel as suggested [60]. All the experts confirmed the factors shown in Table 1. However, six of the interviewees suggested merging some factors which they felt were related. These are shown in the right hand column in Table 1. They suggested that BI architecture is related to technical specifications which only Information Technology experts may understand, so they preferred 'Special Requirements' rather than 'Methods'. In the Organization pillar, they suggested the term 'Top Management Support' rather than 'Management' to be more indicative of top management's role in Higher Education Quality. Five of the interviewees agreed that NQF and QA standards related to each other. As the Ministry of Education imposes the QA standards and requires compliance with NQF while designing the curriculum, it was suggested that the name should be changed to 'QA Regulations'. In the business pillar, 5 respondents agreed that 'Costs' factor is related to 'Financial factors' and suggested merging them. In the Social pillar, five of interviewees commented on 'Relationship Quality' and 'Stakeholders Interaction' and indicated that they referred to the same thing and suggested merging to 'Stakeholders Interaction'.

The proposed Holistic Framework for Monitoring Quality in Higher Education using Business Intelligence Dashboards (HF-HEQ-BI) is depicted in Fig.1. This shows that the identified five pillars are the backbone for the development of dashboards for monitoring quality in HE.

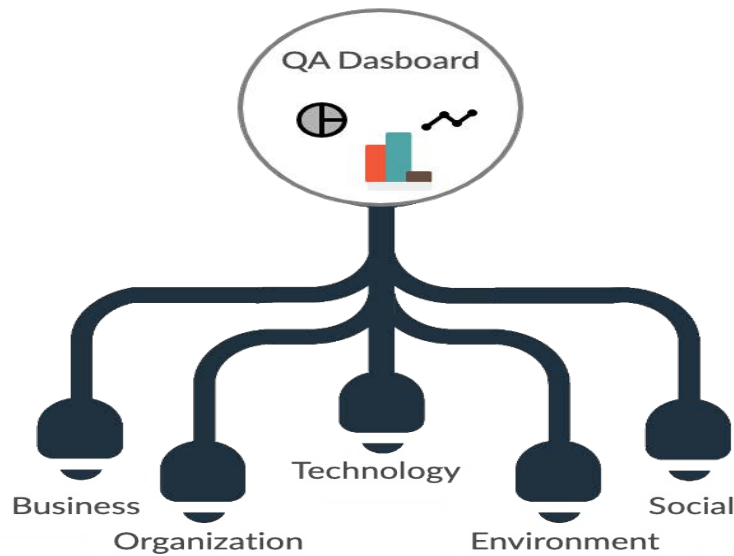


Figure 1. Holistic Framework for Monitoring Quality in Higher Education using Business Intelligence Dashboards (HF-HEQ-BI).

## 6 CONCLUSIONS

This study has found that there are five main pillars to be considered when building BI dashboards for monitoring quality. The motivation for developing this framework arose from the limitations of existing frameworks identified by the authors in a previous study [37]. The developed framework has been built based on underpinning theoretical frameworks in the Information Technology field. The proposed holistic framework takes into consideration all factors to be considered while designing Business Intelligence system and Quality Assurance system. However, the framework will require further evaluation through surveying practitioners to confirm that it supports the aim of developing a Business intelligent Dashboard with social media capability.

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