# THE IMPACT OF BUSINESS INTELLIGENCE SYSTEMS ON PROJECT MANAGEMENT IN HIGHER EDUCATION: AN EMPIRICAL STUDY

**Vikas Rao Naidu[1]*, Huda Al Balushi[2], Lilibeth Reales[3], Suad Al Qassabi[4], Shaima Al Balushi[5], Karan Jesrani[6], Zahra Al Mehdi[7]**

[1]Dr., Middle East College, OMAN, vikas@mec.edu.om
[2]Ms., Diwan of Royal Court, OMAN, email: hmalblushi17@hotmail.com
[3]Ms., Middle East College, OMAN, lilibeth@mec.edu.om
[4]Ms., Middle East College, OMAN, salqassabi@mec.edu.om
[5]Ms., Middle East College, OMAN, email: PG23S2240@mec.edu.om
[6]Mr., Middle East College, OMAN, email: kjesrani@mec.edu.om
[7]Ms., Middle East College, OMAN, email: zahram@mec.edu.om
*Corresponding author

## Abstract

The successful completion of projects depends on effective project management, particularly in the complex and dynamic environment of higher education institutions. Business intelligence (BI) tools can assist identify problems and hazards, facilitate decision-making, and offer insightful information on how projects are performing. The purpose of this study is to examine how BI systems are used for project management in higher education institutions and to suggest a successful project management strategy that incorporates BI systems. To determine the present state-of-the-art in project management and BI systems in higher education, the research technique includes a rigorous literature review of academic and industry sources. An analysis of a case study from a university that has used a BI system for project management is also included in the Study. The study's conclusions imply that BI systems can enhance project management at higher education institutions by supplying precise real-time data on project performance, risks, and problems. By facilitating better decision-making, early issue detection, and prompt problem resolution, the deployment of a BI system has improved project management, according to the case study analysis. The study suggests a successful project management strategy that incorporates BI systems in higher education institutions based on the findings. The following steps make up the suggested strategy: Project objectives and scope definition, project planning, BI system implementation, BI system performance monitoring, project issue and risk identification and mitigation, and continuous improvement are the steps in a project. The suggested framework can assist institutes of higher learning in managing projects successfully by making use of BI tools. The paper also outlines the critical success criteria for BI system deployment in project management in higher education institutions, such as top management support, transparent communication, user training, and efficient data governance.

**Keywords**: Project management, Business intelligence, Higher education, Project performance, Decision-making.

## 1 INTRODUCTION

Due to the growing emphasis on making data-driven decisions and effective project management in recent years, the higher education industry has seen substantial expansion and transformation. Technology integration is now essential as institutions work to fulfil the changing needs of stakeholders, students, and

regulatory agencies. Business intelligence (BI) systems, which are distinguished by their capacity for data collection, analysis, and meaningful presentation, have become effective tools for enhancing project management across a range of sectors, including higher education.

Organizations can use business intelligence tools to turn raw data into useful insights, boosting well-informed decision-making, increasing operational effectiveness, and improving project outcomes. Higher education projects that are successfully completed advance the institution's mission, draw in students, and keep it competitive. Examples of such projects include curriculum development, facility construction, and strategic initiatives. However, project management in higher education is frequently challenging due to the numerous stakeholders, rigid deadlines, and financial restrictions. These issues may be resolved by the integration of BI systems, which would offer priceless information that would improve project planning, monitoring, and evaluation.

The objective of this empirical study is to ascertain how business intelligence systems affect project management in higher education. This study aims to pinpoint the advantages, difficulties, and best practices of adopting such systems by examining the experiences of organizations that have done so. The results of this study will add to the body of knowledge already available on the application of BI systems in project management and offer guidance to higher education institutions looking to improve their project management procedures.

## 2 LITERATURE REVIEW

Previous studies (Chen et al., 2012; Lee et al., 2019; Verma & Patel, 2016) have emphasized the advantages of business intelligence systems across a variety of industries, including healthcare, banking, and manufacturing. However, there is still more research that needs to be done on the use of BI systems specifically in project management in higher education. Few research have particularly evaluated the impact of BI systems on project management procedures in this context, despite some studies (Al-Araibi & Tarhini, 2018; Garrison & Kanuka, 2004) looking at the general usage of technology in higher education.

The potential for BI systems to facilitate better project planning and resource management is one area of focus. Institutions can acquire insights into past project data, stakeholder requirements, and resource availability by integrating data from diverse sources (Borrego et al., 2017; Moilanen et al., 2018). These insights can help institutions design more precise project plans. The real-time monitoring capabilities of BI systems can also help with efficient project tracking by enabling project managers to spot problems early and take immediate action to resolve them, hence reducing delays and cost overruns (Kehoe & Pitrelli, 2019).

Additionally, BI systems can improve decision-making processes by offering visualizations and reports that clearly and simply display project performance metrics. Senior management, project teams, and external regulators can all benefit from this information by using it to make data-driven decisions that will support the success of their projects (Kardos et al., 2021; Popovi et al., 2012). Additionally, BI systems may help organizations undertake in-depth project reviews, evaluate how projects affect key performance indicators, and pinpoint areas that need development for upcoming efforts (Yoon et al., 2015; Zeng et al., 2016).

## 3 BI ARCHITECTURE

A Business Intelligence (BI) architecture in the context of education is made up of a number of crucial parts that work together to make it possible to gather, integrate, analyze, and share data-driven insights. These elements are essential for using data to make decisions and for managing various facets of education. The following are some essential elements of a BI architecture for education (figure 1):

### 3.1 Data Sources and Integration

The various data sources that are accessible in educational institutions serve as the basis of a BI architecture. These sources may include databases from the government or trade publications, learning management systems, financial systems, human resource systems, and student information systems. Effective data analysis and reporting depend on the integration of data from these various sources into a centralized data warehouse or data lake.

### 3.2 Data Warehouse

The foundation of a BI architecture is a central repository, such as a data warehouse or data lake. It maintains data consistency and accessibility for analysis by storing structured, semi-structured, and unstructured data from diverse sources. Data consolidation is made possible by the data warehouse or data lake, which also makes it possible to retrieve data quickly for reporting and analysis needs.

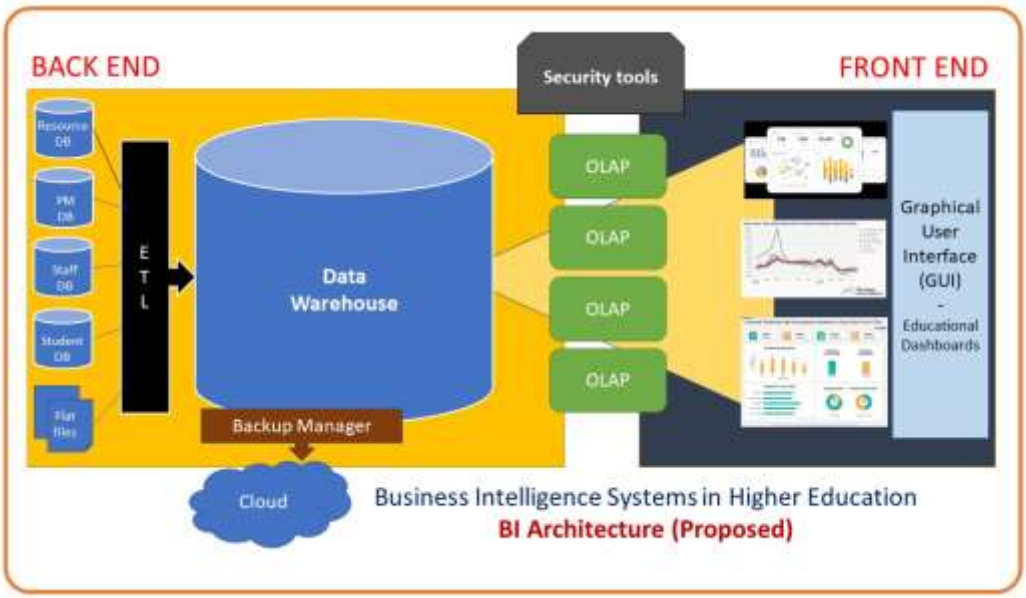


Figure 1. Proposed BI Architecture

## 3.3 ETL Processes

A BI architecture's data integration and transformation depend heavily on extract, transform, and load (ETL) procedures. Data is extracted from source systems via ETL methods, transformed into a standard format, cleaned, and validated before being loaded into a data lake or warehouse. As a result, the data is acceptable for analysis and reporting. These procedures guarantee the quality and integrity of the data.

## 3.4 Data Modelling

Designing the relationships and organizational structure of the data in a data lake or warehouse is known as data modelling. In order to facilitate effective data retrieval and analysis, it also entails the creation of data models like star schemas or snowflake schemas. Complex searches and reporting are made easier by data modelling, which helps establish the connections between various data elements.

## 3.5 Analytics and Reporting Tools

In order to properly query, analyze, display, and report data, BI infrastructures in education rely on analytics and reporting technologies. These tools offer the ability to generate reports, do ad-hoc data exploration, create interactive dashboards, and carry out advanced analytics like data mining or predictive modeling. Tableau, Power BI, QlikView, and IBM Cognos are some of the most well-known products in this field.

## 3.6 Data Governance and Security

Any BI design in education must have both data governance and security as essential components. Data governance guarantees the accessibility, accuracy, and integrity of data as well as adherence to data privacy laws. Establishing data governance frameworks, specifying data ownership and stewardship, putting in place data quality standards, and keeping up with data documentation are all part of the process. Sensitive educational data is protected by security mechanisms such user identification, role-based access limits, and data encryption.

## 3.7 User Interface and Self-Service Capabilities

In order to enable education stakeholders to freely explore and analyze data, user-friendly interfaces and self-service capabilities are crucial. Users with various degrees of technical competence can readily engage with the BI system thanks to intuitive interfaces. Without the assistance of IT staff or data specialists, users can produce their own reports, carry out ad hoc analysis, and draw conclusions from the data using self-service capabilities. These features encourage data literacy and empower stakeholders to make defensible decisions using real-time data.

Educational institutions can harness the power of data to gather insightful information, improve decision-making, increase operational effectiveness, and maximize educational results by merging these elements into a comprehensive BI architecture. This makes it possible for schools to proactively address problems,

find areas for improvement, and provide a more data-driven and successful educational experience.

## 4 BI IMPLEMENTATION IN HEI CONTEXT

Following these steps (Figure 2), educational institutions can successfully implement business intelligence systems and learning analytics to gain useful insights into student performance, instructional effectiveness, and institutional operations, resulting in data-driven decision-making and improved educational outcomes.

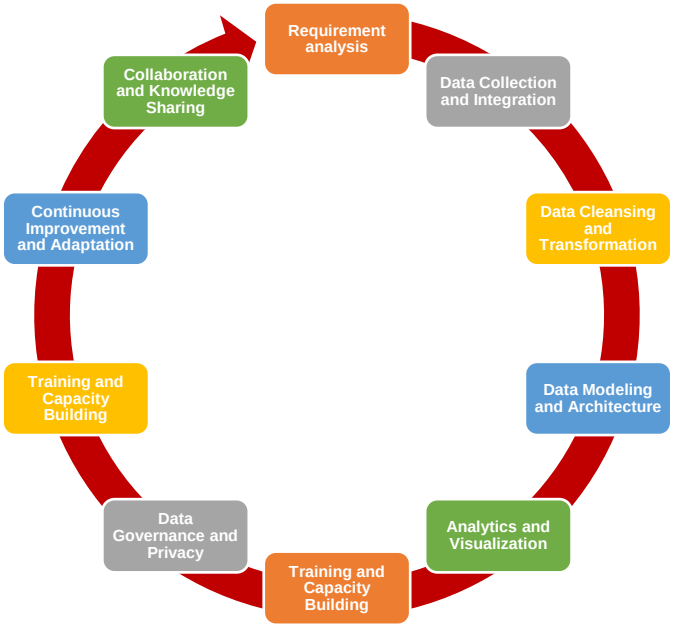


Figure 2. BI Implementation stages

### 4.1 Requirement analysis

To comprehend the precise needs and objectives of the educational institution or business, conduct a thorough requirement study. Determine the main stakeholders, such as administrators, teachers, and students, and solicit their opinions on the objectives and features of the learning analytics and business intelligence systems.

### 4.2 Data Collection and Integration

Determine the educational institution's pertinent data sources, such as the student information systems, learning management systems, assessment platforms, and other pertinent databases. Integrate the data from numerous sources into a centralized data repository after determining the data items that must be collected.

### 4.3 Data Cleansing and Transformation

To guarantee the collected data is accurate, consistent, and comprehensive, clean and preprocess it. Organize the data into a standardized format that makes it simple to examine and interpret it. This could entail data cleansing procedures like deleting duplicate records, resolving discrepancies, and addressing missing data.

### 4.4 Data Modelling and Architecture

Create a data model and architecture that best meets the requirements of the business intelligence system and learning analytics. (Al Hadhrami et. al., 2017) Create a logical and physical data structure that enables effective data storage, retrieval, and analysis. When designing, take into account elements like data granularity, scalability, and security.

### 4.5 Analytics and Visualization

Utilize suitable analytics methods, such as data mining, statistical analysis, and machine learning, to draw out insightful conclusions from the data. To portray the analyzed data in a way that is aesthetically pleasing and simple to grasp, use visualization tools and techniques. Graphical representations, reports, and interactive dashboards may all fall under this category.

## 4.6 Performance Monitoring and Evaluation

To measure the success of the business intelligence system and learning analytics, establish key performance indicators (KPIs) and metrics. To make sure the system is operating in accordance with the institution's aims and objectives, it should be continuously tracked and evaluated against the stated KPIs. Based on the knowledge gleaned from the monitoring process, make corrections and enhancements.

## 4.7 Data Governance and Privacy

To assure data integrity, security, and privacy, establish data governance policies and processes. To protect student and institutional data, define data access and usage policies, put in place suitable data protection measures, and adhere to applicable laws.

## 4.8 Training and Capacity Building

Users, including administrators, teachers, and other stakeholders, should get training and capacity-building programs to improve their knowledge of and use of the business intelligence system and learning analytics. Promote data literacy and analytical abilities among the users while fostering a data-driven culture within the organization.

## 4.9 Continuous Improvement and Adaptation

Based on user feedback, new technologies, and evolving educational demands, continuously assess and improve the business intelligence system and learning analytics. To guarantee that the system remains relevant, keep up with the most recent developments and trends in business intelligence and learning analytics.

## 4.10 Collaboration and Knowledge Sharing

In order to share best practices, lessons learned, and insights on business intelligence systems and learning analytics, institutions and companies should collaborate and share knowledge. Participate in pertinent conferences, workshops, and forums to get knowledge from others and enhance your industry.

# 5 ADVANTAGES AND CHALLEGES

## 5.1 Advantages

### *5.1.1 Enhanced Decision Making*

Higher education institutions can make well-informed project management decisions thanks to business intelligence (BI) solutions' extensive and fast data insights. The ability to make data-driven decisions that can improve project outcomes is given to project managers and stakeholders by access to real-time data on project progress, resource allocation, and performance measures.

### *5.1.2 Improved Resource Allocation*

BI systems aid in the efficient use of resources in initiatives for higher education. Institutions can more efficiently distribute resources, ensuring that projects are personnel, supplied, and funded in an adequate manner, by analyzing historical data and present resource availability. These results in improved resource utilization, cost reductions, and reduced project risks.

### *5.1.3 Effective Project Monitoring*

By enabling real-time project monitoring, BI systems give stakeholders access to the most recent data on project status, milestones, and potential dangers. This makes it easier for prompt decision-making and proactive intervention to handle problems and keep projects on schedule. In order to increase project performance, project managers can spot bottlenecks, foresee dangers, and deploy resources appropriately.

### *5.1.4 Data-Driven Insights*

Higher education organizations can extract valuable insights from project data using the robust analytics and reporting capabilities provided by BI systems. Using visualizations and reports, stakeholders may spot trends, patterns, and areas for improvement by viewing complex project data in an easily digestible format. These revelations aid in better strategic planning, risk reduction, and decision-making.

### *5.1.5 Continuous Improvement*

Institutions can analyze project success, pinpoint areas for development, and draw lessons from the past

thanks to BI systems' facilitation of project evaluation and post-implementation analysis. Continuous development in project management techniques is made possible by the capacity to monitor key performance indicators and contrast actual outcomes with project objectives.

## 5.2 Challenges

### *5.2.1 Data Integration Complexity*

Due to different systems, data silos, and different data formats, integrating data from numerous sources is necessary for the implementation of BI systems in higher education. For a successful implementation, it is imperative to handle the substantial problems that come with ensuring seamless data integration and maintaining data quality.

### *5.2.2 Change Management*

Changes to organizations' structures and cultures are required to implement BI systems in project management. Successful adoption might be hampered by reluctance to change, a lack of a culture of data-driven decision-making, and talent gaps. To overcome resistance and promote a culture of data-driven decision making, institutions must invest in change management initiatives, such as training courses, stakeholder involvement, and leadership support.

Higher education institutions can use BI systems to boost decision-making, drive project success, and optimize resource allocation by taking advantage of the benefits and addressing the drawbacks, and in the end, improve their entire project management procedures.

# 6 CONCLUSION

The empirical study identified a number of important benefits of BI system use in project management. First, by offering real-time data insights, BI systems facilitate informed decision making, enhancing project outcomes. Making data-driven decisions, which optimize resource allocation and improve overall project performance, is made possible by the availability of accurate and timely information for project managers and stakeholders. By analyzing data from numerous sources, BI systems also make it possible for organizations to optimize staffing, funding, and supply chain management. This leads to increased resource efficiency, cost reductions, and decreased project risks.

BI systems also provide real-time project progress updates, milestone tracking, and risk identification in addition to effective project monitoring features. This makes it possible for prompt decision-making, proactive intervention, and resource reallocation to keep projects on schedule. Additionally, the data-driven insights produced by BI systems aid in the ongoing development of project management techniques. Institutions can better prepare, reduce risk, and make strategic decisions by analyzing project data to find trends, patterns, and areas for improvement.

A lot of data on students must be handled by educational institutions, just as companies must handle a lot of data about their clients, partners, employees, and finances. Thousands of students enroll in a variety of courses at various institutions each year, generating enormous volumes of data. The student data includes the details of the course, the year of enrolment, the student ID, the results of the exams, and the grades obtained in each topic. Analysis of this data can be very beneficial for their professional progress. (Al Yousufi et. al., 2023)

The importance of BI systems in project management within higher education is highlighted by this research paper's conclusion. The empirical study offers insightful information about the benefits of BI systems, such as better resource allocation, efficient project monitoring, and data-driven insights for continuous improvement. For successful deployment, however, hurdles like sophisticated data integration and change management must be surmounted. Higher education institutions can improve project management procedures, maximize project results, and ultimately boost institutional performance by addressing these issues and taking advantage of the opportunities.

# REFERENCE LIST

Al Yousufi, A., Naidu, V. R., Jesrani, K., & Dattana, V. (2023). *Tracking Students' Progress using Big Data Analytics to enhance student's Employability: A Review.* SHS Web of Conferences (Vol. 156, p. 07001). EDP Sciences.

Al-Araibi, S. N., & Tarhini, A. (2018). *Factors affecting the adoption of e-learning systems in Qatar and USA:*

*Extending the unified theory of acceptance and use of technology 2 (UTAUT2).* Education and Information Technologies, 23(6), 2733-2759.

Agarwal, A., Naidu, V. R., & Al Mamari, R. (2019). *A Framework To Enhance Learning Experience in Flipped Classroom Based on Student Accountability Towards Active Participation.* EDULEARN19 Proceedings, 1(July), 1569–1577. https://doi.org/10.21125/edulearn.2019.0464

Agarwal, A., Saqib, M., Hasan, R., Srinivas, S., Rao Naidu, V., & Jesrani, K. (2021). *Educational Association Mining on the Use of Media Platforms for e-Learning.* 2021 2nd International Conference on Computation, Automation and Knowledge Management (ICCAKM). https://doi.org/10.1109/ICCAKM50778.2021.9357727

Al Mahdi, Z., Rao Naidu, V., & Kurian, P. (2019). *Analyzing the Role of Human Computer Interaction Principles for E-Learning Solution Design* (pp. 41–44). Springer, Cham. https://doi.org/10.1007/978-3-030-01659-3_6

Borrego, Á., Arrieta-Salinas, I., & Arquero, J. L. (2017). *The role of business intelligence in project management*. Procedia Computer Science, 121, 649-657.

Chen, N., Niu, J., Shao, B., & Yu, H. (2012). *Research on business intelligence system based on data mining.* 2012 8th International Conference on Wireless Communications, Networking and Mobile Computing (pp. 1-4). IEEE.

Garrison, D. R., & Kanuka, H. (2004*). Blended learning: Uncovering its transformative potential in higher education.* The Internet and Higher Education, 7(2), 95-105.

Kardos, M., Kavecky, M., & Korakova, D. (2021). *Data visualization in business intelligence*. Procedia Computer Science, 182, 1080-1087.

Kehoe, D. F., & Pitrelli, N. (2019). *Project management business intelligence (PMBI): A new framework for integrated project reporting and analytics*. Procedia Computer Science, 164, 419-428.

Lee, D. M. S., Ahn, S. H., Yoo, H. S., & Woo, Y. S. (2019). *The effect of business intelligence on supply chain integration: An empirical analysis of Korean manufacturers*. Sustainability, 11(4), 1073.

Moilanen, P., Salo, M., & Äyväri, A. (2018*). Business intelligence system in project-based company*. Procedia Manufacturing, 21, 372-379.

Popovič, A., Hackney, R., Tassabehji, R., Castelli, M., & Mayr, H. C. (2012). *Data visualization for business intelligence: State-of-the-art and research directions*. Proceedings of the International Conference on Information Systems (pp. 1-16).

Verma, R., & Patel, M. (2016). *Business intelligence system: A managerial perspective*. Journal of Industrial Engineering and Management, 9(5), 1311-1337.

Yoon, J., Chung, S., & Choi, S. (2015). *Building the business intelligence system for ERP data using big data technology*. The Journal of Supercomputing, 71(5), 1928-1941.

Zeng, Z., Zhou, Z., Li, Y., & Wang, Y. (2016). *Integrating big data into business intelligence architectures*. 2016 IEEE International Conference on Big Data (pp. 1428-1433). IEEE.