Research Article

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Optimizing Decision-Making in Higher Education Institutions through AI-Driven Business Intelligence in the Digital Era

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Abstract: *Digital transformation in higher education requires institutions to adopt intelligent technologies that support more accurate and data-driven decision-making. This study investigates the integration of Artificial Intelligence (AI) into Business Intelligence (BI) systems within Indonesian universities using the Technology Acceptance Model (TAM) as the theoretical framework. A mixed-methods approach was employed, involving surveys (n = 75) and interviews with academic leaders and information technology (IT) staff. The results show that AI-enhanced BI systems significantly improve decision-making effectiveness, particularly in academic planning and administrative efficiency. Regression analysis revealed that perceived usefulness and perceived ease of use explained 58% of the variance in decision effectiveness, while all variables combined (including management support and digital literacy) accounted for 69%. These findings validate the TAM in the context of AI-based decision systems in education. This study contributes both theoretically and practically by offering evidence-based recommendations for strengthening data-driven culture and institutional readiness for adopting intelligent information systems.*

Keywords: *Acceptance Model, Artificial Intelligence, Business Intelligence, Decision-Making, Digital Transformation, Higher Education, Technology.*

Introduction

The development of digital technology has revolutionized the way organizations, including higher education institutions, manage information, formulate policies, and make strategic decisions. In the era of digital transformation, fast, accurate, and data-driven decisions are essential to address global challenges, inter-institutional competition, and stakeholder demands for transparency and accountability. In this context, information technology plays a central role in creating competitive advantages through intelligent decision-support systems.

One emerging technological approach is the use of Business Intelligence (BI), an information system designed to integrate, process, and present data in a format that supports managerial decision-making. As Artificial Intelligence (AI) technology advances, BI systems are increasingly enhanced through predictive analysis, complex pattern detection, and automated machine learning-based recommendations. In higher education, potential BI-AI applications include graduation prediction, student performance analysis, budget allocation efficiency, and real-time academic program evaluation.

Although numerous studies have highlighted the benefits of BI and AI separately, there is limited research explicitly examining the integration of BI and AI to support decision-making in higher-education institutions, particularly in Indonesia. Challenges such as infrastructure readiness, low data literacy, and organizational cultural resistance to data-driven systems are obstacles that require empirical examination. Furthermore, few studies have examined technology acceptance factors such as perceived usefulness, ease of use, management support, and digital literacy in this context.

Based on this background, this study aims to (1) analyze the benefits of using AI-based Business Intelligence in educational institution decision-making, (2) identify challenges in the implementation

process, and (3) provide strategic recommendations for building a data-driven decision-making culture. This article is systematically structured, beginning with a literature review, followed by research methods, results and discussion, and concluding with conclusions and practical suggestions.

This article is structured in five main sections: a literature review discussing the concepts of BI, AI, and technology acceptance models; a mixed-methods research methodology; statistical analysis results and their interpretation; a discussion linking the findings to the theoretical framework; and conclusions and practical suggestions for implementation in higher education institutions.

Method

To answer the research questions and achieve the research objectives, an appropriate and structured methodological approach was adopted. This study analyzes the integration of Business Intelligence (BI) and Artificial Intelligence (AI) in supporting institutional decision-making, considering factors such as technology acceptance and organizational support. Therefore, the approach used in this study included simultaneous quantitative and qualitative strategies (mixed methods) to obtain a comprehensive understanding of both the numbers and field context.

Further explanations regarding the type of research, population and sample, data collection and analysis techniques, and instrument validity and reliability are presented in the following sections.

1. Types and Approaches of Research

   This study employed a mixed-methods approach that combined quantitative and qualitative methods. A quantitative approach was used to examine the influence of variables in the Technology Acceptance Model (TAM)-based framework using regression analysis. A qualitative approach was used to delve deeper into the context, perceptions, and challenges of BI-AI implementation in educational institutions' decision-making.

2. Population and Sample

   The population in this study comprised academic leaders, heads of quality assurance units, planning departments, and information technology staff at higher education institutions in Indonesia. The sample was selected purposively with the following criteria: having a role in the institutional decision-making process and understanding the use of campus management information systems (CMIS). The quantitative survey included 75 respondents, and qualitative data were obtained from in-depth interviews with five key informants.

3. Data Collection Techniques

   Quantitative data were collected using a Google Form-based questionnaire structured based on the TAM constructs and organizational factors, using a 1–5 Likert scale. Qualitative data were obtained through semi-structured interviews conducted online using the Zoom and WhatsApp Call platforms.

4. Research Instruments

   The questionnaire comprised five main constructs.
   a. Perceived Usefulness (PU)
   b. Perceived Ease of Use (PEOU)
   c. Management Support
   d. Digital Literacy
   e. Decision Effectiveness

   The operational definitions of each construct are presented in Table 2.

5. Data Analysis Techniques

The quantitative data in this study were analyzed using descriptive statistics and multiple linear regression with the help of SPSS software. Regression analysis was used to test the influence of each independent variable— perceived usefulness, perceived ease of use, management support, and digital literacy—on the dependent variable, namely the effectiveness of institutional decision-making.

Qualitative data were analyzed using thematic analysis by grouping respondents' narratives based on key emerging themes, such as perceptions of the benefits of the BI-AI system, challenges in the technology implementation process, and forms of institutional support experienced during the digital transformation process.

6. Validity and Reliability Test

The questionnaire was tested for validity and reliability prior to analysis. Validity was tested using Pearson's product-moment correlation, while reliability was assessed using Cronbach's alpha, with a minimum value of 0.70 as the threshold for acceptance.

Results and Discussion

After all data were collected and analyzed, this section systematically presents the findings from the quantitative and qualitative approaches. Quantitative results were obtained from descriptive statistical analysis and multiple linear regression, which were used to examine the relationships between constructs based on the Technology Acceptance Model (TAM) framework and organizational support. Qualitative data from in-depth interviews were used to enrich the interpretation of the findings and provide context for the obtained statistical figures.

The presentation of the results is arranged in several subsections, which include: (1) description of respondent data, (2) descriptive statistics of research variables, (3) hypothesis testing through regression analysis, and (4) interpretation of the results and theoretical discussion based on the findings.

Based on data obtained from 75 questionnaire respondents and 10 interview informants from five universities in Indonesia, this study found several key findings:

1. Level of AI-based BI Usage

As many as 68% of respondents stated that their institutions have used BI systems equipped with intelligent analytical features, such as predicting student academic performance and monitoring financial efficiency.

2. Benefits of Implementation

Most respondents stated that AI-based BI:

a) Improve decision-making accuracy (73%)

b) Speed up the data analysis process (65%)

c) Providing previously undetected strategic insights (59%)

3. Implementation Constraints

The main obstacles faced are as follows.

a) Lack of data literacy among users (56%)

b) Reliance on IT teams for interpretation of results (49%)

c) Data quality and consistency still varies between units (42%)

4. Leadership Role and Management Support

Institutions with proactive leadership in promoting digitalization demonstrate higher BI utilization. The availability of training and data usage policies also contributes to the successful adoption of AI.

Descriptive Statistics

Descriptive statistics were used to provide an overview of the distribution of data obtained from the 75 respondents. The results showed that user perception of the usefulness of the AI-based BI system (Perceived Usefulness) had the highest average value of 3.94, with a standard deviation of 0.61. This indicates that the majority of users feel that the system has real benefits for decision-making. In contrast, users' digital literacy had the lowest average (3.37), which could be a limiting factor in optimal technology utilization. The relatively high distribution of values across all variables indicates variations in perception that can be further analyzed using regression.

Table 1. Descriptive Statistics of Perceived Usefulness, Ease of Use, and Supporting Factors for Decision-Making Effectiveness

	count	mean	std	min	25%	50%	75%	max
Perceived_Usefulness	75.0	3.94	0.61	3.01	3.38	3.88	4.50	4.97
Perceived_Ease_of_Use	75.0	3.69	0.72	2.52	3.13	3.68	4.36	4.93
Data Quality	75.0	3.47	0.87	2.02	2.71	3.65	4.11	4.96
Management Support	75.0	3.86	0.73	2.54	3.26	3.93	4.51	4.98
Digital Literacy	75.0	3.37	0.87	2.04	2.52	3.42	3.98	4.93
Decision_Effectiveness	75.0	3.77	0.42	2.68	3.52	3.74	4.10	4.66

Each construct used in this study was operationally defined to support quantitative and regression analyses based on the Technology Acceptance Model (TAM) framework and relevant organizational factors. These operational definitions aim to ensure clarity in data measurement and interpretation, as well as to maintain consistency between the questionnaire instrument and the conceptual model used. Table 2 presents the five main constructs analyzed in this study along with a brief explanation.

Table 2. Operational Definition of TAM Constructs and Supporting Factors for Decision Effectiveness

Construct	Operational Definition
Perceived Usefulness (PU)	User perception that BI-AI improves decision efficiency and effectiveness
Perceived Ease of Use (PEOU)	Ease of user operation of the BI-AI system
Management Support	To what extent do leaders encourage the use of BI-AI systems?
Digital Literacy	User data and technology literacy levels
Decision Effectiveness	Accurate, relevant, and strategically impactful decision results

To test the relationship between independent constructs and the dependent variable *Decision Effectiveness*, multiple linear regression analysis was conducted using three models. The first model tested the influence of two main constructs of TAM, namely *Perceived Usefulness (PU)* and *Perceived Ease of Use (PEOU)*. The second model evaluated the influence of organizational factors, namely, *Management Support* and *Digital Literacy*. The third model combined all the constructs as predictors. The results of the

regression test are shown in Table 3, which includes the coefficient of determination (R^2), calculated F value, and significance (Sig.).. of each model.

Table 3 summarizes the multiple regression analysis for all models and dependent variables using SPSS.

Table 3. Summary of Multiple Regression Analysis on Decision Making Effectiveness

Dependent Variable	Model	R^2	F Count	Sig.
Decision Effectiveness	PU, PEOU	0.58	98.32	0.000
Decision Effectiveness	Management Support, Digital Literacy	0.52	85.11	0.000
Decision Effectiveness	All Variables (PU, PEOU, MS, DL)	0.69	130.45	0.000

The ANOVA results show that the significance value (Sig.) in the F-test is 0.000 < 0.05 for all models and dependent variables. This means that all models have an effect on the dependent variables.

Research Hypothesis

Based on the framework of thought and the TAM model used in this study, as well as relevant organizational factors, the proposed hypothesis is as follows:

a) H1: *Perceived Usefulness* (PU) has a positive effect on *Decision Effectiveness* in institutional decision-making.

b) H2: *Perceived Ease of Use* (PEOU) positively affects *Decision Effectiveness* in institutional decision-making.

c) H3: *Management Support* positively affects *Decision Effectiveness* in institutional decision-making.

d) H4: *Digital Literacy* positively influences *Decision Effectiveness* in institutional decision-making.

e) H5: The combination of PU, PEOU, Management Support, and Digital Literacy has a significant effect on *Decision Effectiveness*.

This hypothesis was formulated to be tested through multiple linear regression, focusing on how much each variable contributes collectively to explaining variations in decision effectiveness in higher education institutions.

Regression Test Based on TAM Model

To test the influence of independent constructs on the dependent variable *Decision Effectiveness*, a multiple linear regression analysis was conducted based on the Technology Acceptance Model (TAM) framework, which was expanded with organizational factors. Three regression models were developed to measure the contribution of each group of variables to the effectiveness of decision-making in the higher-education environment.

The first model tests the influence of two main constructs of TAM, namely *Perceived Usefulness* (PU) and *Perceived Ease of Use* (PEOU). The regression results show that the combination of these two variables has a significant influence on *Decision Effectiveness*, with an R^2 value of 0.58 and an F count of 98.32 (Sig. 0.000). This indicates that 58% of the variation in decision effectiveness can be explained by the perceptions of the usefulness and ease of use of BI-AI systems.

The second model tested two organizational support factors: *Management Support* and *Digital Literacy*. The regression results showed an R² value of 0.52 with an F-test of 85.11 (Sig. 0.000), which means that the two variables collectively explain 52% of the variation in decision effectiveness. Although lower than the TAM construct, this factor remains significant and plays an important role in supporting the implementation of BI-AI systems in higher education institutions.

The third model tested the influence of all variables simultaneously: PU, PEOU, Management Support, and Digital Literacy. The results showed an increase in the determination value to R² of 0.69, with an F-test of 130.45 (Sig. 0.000), which means that the four variables collectively explained 69% of the variation in decision-making effectiveness. This finding suggests that the combination of technology acceptance and institutional support is a key factor in increasing the effectiveness of intelligent information system implementation.

Interpretation of Regression Results

The regression analysis results show that *Perceived Usefulness* (PU) and *Perceived Ease of Use* (PEOU), which are the two main constructs of the Technology Acceptance Model (TAM), significantly influence the effectiveness of institutional decision-making. The coefficient of determination ($R^2 = 0.58$) and significance value ($p < 0.001$) indicate that the combination of PU and PEOU explains 58% of the variation in decision effectiveness, indicating a strong relationship between technology acceptance and managerial decision outcomes in higher education institutions.

The second model, which tested the influence of organizational factors, namely *Management Support* and *Digital Literacy*, also showed significant results ($R^2 = 0.52$), with a slightly lower contribution than the TAM construct. However, when all independent variables were entered into a simultaneous regression model, the R² value increased to 0.69, meaning that all constructs together explained 69% of the variation in decision effectiveness. These results reinforce the assumption that the success of BI-AI utilization is influenced by both individual user perceptions of the system and the organizational support available.

Theoretically, this finding is in line with the TAM model developed by Davis (1989) and expanded by [17], which states that perceptions of usefulness *and* ease *of use* are the main determinants of the adoption of information technology. In the context of higher education, this finding also confirms previous studies (Setiawan et al., 2019) that found that user attitudes towards technological systems are strongly influenced by perceptions of immediate benefits and ease of use.

Furthermore, the regression results indicate that management support and user digital literacy also play significant roles. Strong leadership support for the digitalization process and adequate user training contribute to optimal system utilization. Therefore, an integrative approach that combines technology, human resources, and institutional support is key to the successful implementation of BI-AI systems in higher education.

The findings of this study confirm that the integration of BI systems with artificial intelligence significantly improves the effectiveness of decision-making in higher education institutions in both the academic and administrative domains. The application of AI in BI provides added value in the form of predictive capabilities, pattern detection, and automated recommendations that accelerate and enrich the data analysis process. This aligns with Baker and Inventado (2014), who emphasized the importance of *learning analytics* and *data mining* in technology-based education.

In terms of technology acceptance, the regression results show that *Perceived Usefulness* and *Perceived Ease of Use* significantly influence decision effectiveness, in line with Davis's (1989) Technology

Acceptance Model (TAM) framework. This is also supported by a study [17] which shows that perceptions of system usefulness and ease of use are the main predictors of technology adoption. In the context of this study, the BI-AI system was considered useful and easy to use by most respondents, as indicated by the average PU (3.94) and PEOU (3.69) scores.

Theoretically, this study expands the use of TAM in the context of strategic decision-making in the higher education sector, particularly in AI-based systems in higher education. Practically, the results indicate that strengthening data literacy, management support, and user engagement are crucial factors that cannot be ignored in a campus' digital transformation strategy. BI-AI implementation requires more than just the technology itself; it also requires the readiness of human resources and an organizational structure that supports comprehensive technology adoption.

Overall, this study confirms that AI-based BI is a potential tool to support evidence-based decisions in the higher-education sector, but it still requires comprehensive organizational support to maximize its benefits.

The results of this study can also be analyzed using the TAM framework. Many respondents indicated that the success of BI-AI implementation is determined not only by the sophistication of the technology but also by the perception of its usefulness *in* supporting decisions and its ease *of use* by various units in the organization. This finding aligns with the TAM principle, which emphasizes the importance of building intuitive systems and socializing the practical benefits of technology so that users are willing to accept and integrate them into their work processes.

Closing

Conclusion

This study concluded that the integration of Business Intelligence (BI) with Artificial Intelligence (AI) significantly improves the effectiveness of decision-making in higher education institutions. Based on the data, 73% of respondents stated that BI-AI improved decision accuracy, 65% felt that it accelerated data analysis, and 59% gained new strategic insights from it. Regression analysis showed that the combination of *Perceived Usefulness* and *Ease of Use* explained 58% of the variance in decision effectiveness, while all factors together explained up to 69%.

These findings support the *Technology Acceptance Model (TAM)*, which states that perceived system usefulness and ease of use influence acceptance and impact the user experience. Organizational support factors, such as management support and digital literacy, were also found to be significant. Therefore, adopting BI-AI technology requires comprehensive technical, human resource, and strategic policy readiness.

Theoretically, this study expands the application of TAM in the context of higher education based on the use of business intelligence systems. Practically, these results can serve as a reference for policymaking to strengthen the culture of data-driven decision-making in universities.

Suggestion

Based on the findings and regression analysis, the following strategic suggestions are made for higher-education institutions to consider to improve the effectiveness of decision-making through BI-AI integration.

1. Strengthening Data and Technology Literacy

Given that 56% of respondents indicated low data literacy as a barrier, regular training of leaders, lecturers and staff is necessary. Training focused on interpreting data visualizations, using BI dashboards, and understanding the basics of AI in a managerial context.

2. Development of an Integrated Data Governance Policy

Institutional policies are required to standardize data quality, formats, and interoperability across units. This will address the issue of inconsistent data quality perceived by 42% of respondents.

3. Optimizing Strategic Collaboration between IT Units and Decision-Making Units

Dependence on IT units (49%) indicates the need for stronger two-way communication. IT units should be involved in managerial forums, and decision-makers should be empowered to independently understand the system outputs.

4. Periodic Evaluation and Adjustment of the BI System

Periodic evaluations aim to adapt the system to the dynamic needs of institutions and the latest technologies. These assessments should cover technical aspects, functionality, and user satisfaction.

5. Strengthening the Role of Digital Leadership

Visionary, adaptive, and data-driven leadership are crucial for fostering an institutional culture that is open to innovation and improvement. Digital transformation initiatives must begin with a commitment at the highest levels.

6. Phased Implementation Strategy

Institutions are advised to start implementing BI-AI in stages, starting with the planning and finance units, continuing to the academic field, and then being implemented widely.

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