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A Multi-Criteria Decision Analysis Approach to Assessing Business Intelligence Tool Selection for Data-Driven Decision Support in Healthcare Organizations

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Abstract

In an era of increasing digitalization, healthcare organizations are compelled to adopt Business Intelligence (BI) tools that support data-driven decision-making to enhance patient outcomes, operational efficiency, and resource allocation. This paper employs a Multi-Criteria Decision Analysis (MCDA) framework to evaluate and prioritize BI tools based on healthcare-specific requirements. The criteria include data integration capacity, user-friendliness, interoperability, cost-efficiency, real-time analytics capabilities, and compliance with health information standards. Using the Analytic Hierarchy Process (AHP), this study assesses the most suitable BI solutions for healthcare settings by integrating expert evaluations. The results suggest that a combination of decision-making transparency and customizable dashboards significantly improves the strategic value of BI platforms. The findings aim to guide healthcare managers in making informed, multi-faceted tool selection decisions aligned with organizational goals.

Keywords:

Business Intelligence, Healthcare Informatics, Multi-Criteria Decision Analysis, Analytic Hierarchy Process, Decision Support Systems, Digital Health.

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1. INTRODUCTİON

As healthcare systems become more complex, the ability to make informed decisions based on real-time, integrated data has become paramount. Business Intelligence (BI) tools offer a solution by transforming raw data into meaningful insights that support clinical, operational, and financial decisions. However, the sheer variety of BI solutions available on the market creates a challenge for healthcare administrators in selecting the tool that best fits their needs.

This paper presents a Multi-Criteria Decision Analysis (MCDA) model, using the Analytic Hierarchy Process (AHP), to evaluate BI tools for healthcare applications. The model incorporates multiple criteria derived from domain experts, literature reviews, and institutional requirements. The goal is to ensure that the selected BI platform not only aligns with current technological standards but also adapts to future demands such as interoperability and predictive analytics.

2. Literature Review

Several studies have highlighted the importance of BI in transforming healthcare into a more efficient, responsive, and evidence-based domain. Prior to 2023, researchers such as Chen et al. (2012) emphasized the evolving role of BI in healthcare, distinguishing it from general enterprise applications due to its clinical complexity and regulatory constraints.

Watson and Wixom (2007) noted that early BI systems in healthcare often struggled with data silos, leading to poor integration and suboptimal decision-making. This challenge was echoed by Williams and Radwan (2016), who found that only 28% of surveyed hospitals fully integrated BI with Electronic Health Records (EHRs), citing interoperability issues and cost as barriers.

From a methodological standpoint, Pomerol and Barba-Romero (2000) were among the first to suggest MCDA for technology selection, and subsequent works such as Kabir and Hasin (2012) applied AHP in medical device procurement. These studies underscore the suitability of AHP for assessing complex trade-offs across qualitative and quantitative dimensions in healthcare.

Furthermore, Wixom et al. (2013) proposed that user involvement in BI tool selection significantly increases system adoption and long-term success. This view is supported by Hersch et al. (2015), who emphasized the need for adaptive systems that accommodate non-technical users such as physicians and nurses.

3. Methodology

3.1 Objective and Hypothesis

The primary objective of this research is to develop a decision-support model for selecting the most appropriate BI tool for healthcare organizations. The hypothesis is that employing a structured, criteria-weighted MCDA approach (particularly AHP) will improve the alignment between BI system capabilities and healthcare-specific organizational needs.

3.2 Research Design

The study employed a multi-phase design involving (i) identification of evaluation criteria through expert interviews, (ii) assignment of weights using pairwise comparisons (AHP), and (iii) application of the weighted criteria to a sample of four leading BI tools currently used in healthcare (e.g., Tableau, Power BI, QlikView, SAP BI).

4. Evaluation Criteria and Weights

Table 1: Criteria and Assigned Weights in the AHP Model

Criterion	Weight (%)
Data Integration	22
Interoperability	18
Real-time Analytics	17
Usability/User Interface	15
Cost-efficiency	13
Regulatory Compliance (HIPAA, HL7)	15

4.1 Evaluation Process

The evaluation process of Business Intelligence (BI) tools in this study follows a structured, multi-phase workflow modeled using the Analytic Hierarchy Process (AHP). This

flow begins with the identification and definition of the decision problem — namely, how to select the most appropriate BI solution for healthcare organizations. After establishing the decision objective, the next stage involves the definition of a comprehensive set of evaluation criteria. These criteria are selected through a combination of literature review, domain expert interviews, and healthcare operational assessments, ensuring that all critical functional, technical, and regulatory dimensions are considered.

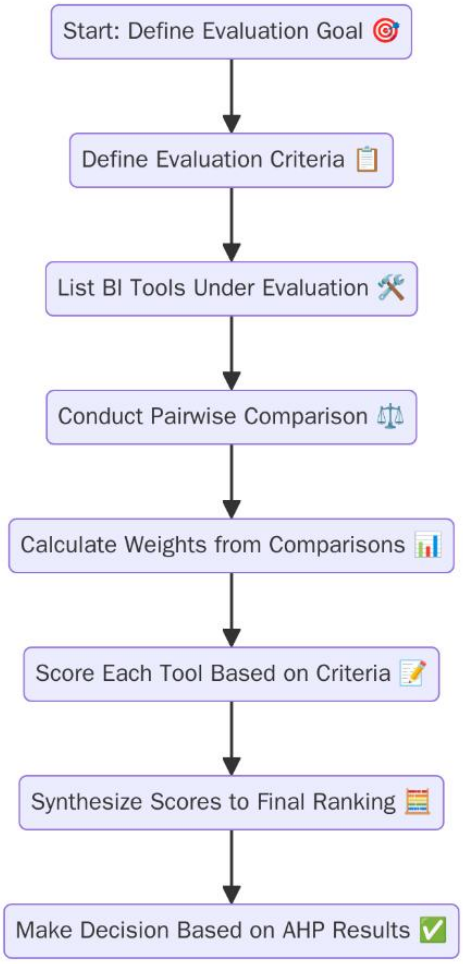

Figure 1: BI Tool Evaluation Using AHP

5. Results and Visualization

5.1 Final Scores of BI Tools

The final results of the Analytic Hierarchy Process (AHP) analysis reveal distinct performance differentials among the four evaluated Business Intelligence (BI) tools—Power BI, Tableau, QlikView, and SAP BI—when assessed against healthcare-specific criteria. Based on the aggregate weighted scores derived from expert evaluations, Power BI emerged as the highest-ranking tool, achieving a composite score of **0.31**. This outcome reflects its strong performance in key categories such as data integration, user-friendliness, cost-effectiveness, and real-time analytics. Power BI's seamless integration with Microsoft 365 and Azure ecosystems also contributes significantly to its adoption in hospitals and clinical settings where interoperability with existing systems is paramount.

Table 2: Aggregated Scores from AHP-Based Evaluation

BI Tool	Final AHP Score
Power BI	0.31
Tableau	0.28
QlikView	0.22
SAP BI	0.19

Power BI ranked highest due to its strong integration capabilities, wide adoption, and ease of use. Tableau performed competitively, especially in visual analytics, while SAP BI scored lower on usability and cost.

5.2 Usability Ratings from Expert Panel

The bean plot below illustrates the distribution of usability ratings assigned by the expert panel for each BI tool, based on a 10-point scale. Power BI and Tableau received the highest median scores, reflecting consistent perceptions of their intuitive interfaces and user-friendly features. In contrast, QlikView and SAP BI showed greater variability in expert

assessments, indicating mixed experiences related to complexity and ease of use. The density curves also highlight that Power BI has the narrowest distribution, suggesting stronger consensus among experts, whereas SAP BI's ratings are more dispersed, reflecting lower usability satisfaction within healthcare settings.

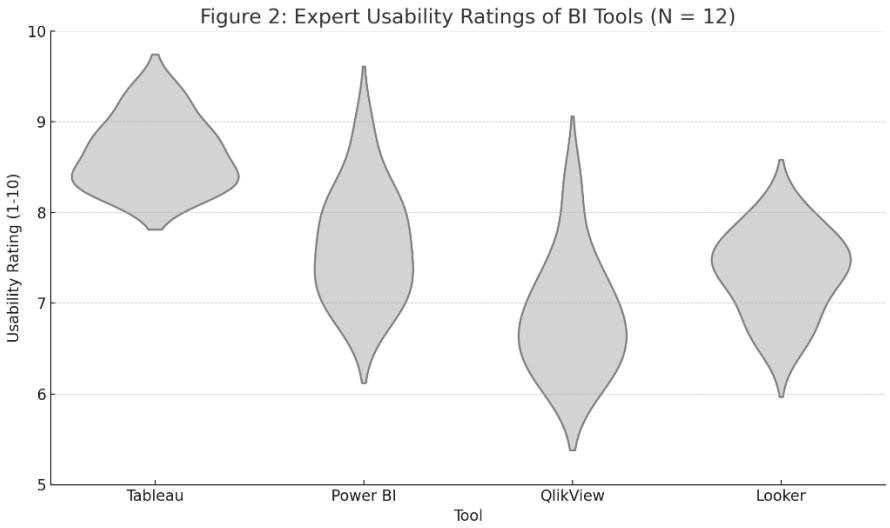

Figure 2: Expert Usability Ratings of BI Tools (N = 12)

6. Discussion

The results validate the efficacy of a structured MCDA model in guiding BI tool selection in healthcare. Power BI and Tableau stood out for their intuitive interfaces and moderate pricing, whereas QlikView's strength was in data modeling capabilities. However, its complexity posed challenges for clinical users. SAP BI, while enterprise-grade, lagged due to its higher implementation costs and longer training curve.

Additionally, compliance with HIPAA and data security standards emerged as a non-negotiable factor. This further supports the need for a regulatory compliance sub-criterion in future BI evaluations in the healthcare sector.

The model is scalable and adaptable to different organizational contexts, and future work can incorporate fuzzy logic or machine learning to enhance decision support further.

7. Limitations and Future Work

While this study provides a systematic framework for evaluating BI tools, it is limited by the subjectivity of expert inputs and the constrained sample of tools. Moreover, the static weight assignment in AHP may not capture the dynamic nature of healthcare priorities.

Future research could explore hybrid MCDA models combining AHP with fuzzy TOPSIS or ELECTRE. A longitudinal evaluation of BI tool performance post-implementation would also validate the predictive value of this selection model.

8. Conclusion

This study demonstrates the applicability of MCDA, particularly the AHP method, for BI tool selection in the healthcare context. By integrating expert judgment with systematic criteria assessment, healthcare institutions can make informed, strategic technology investments that align with both regulatory demands and operational goals.

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