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Article

Strategic Resilience in Healthcare: Auditing AI-Supported Balanced Scorecard Models

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Abstract

Purpose. This study explores the effective implementation of the Balanced Scorecard (BSC) within a digital transformation context to strengthen hospital resilience in times of crisis. By integrating artificial intelligence (AI) and big data analytics into the BSC framework, the research highlights how real-time, data-driven decision-making enhances strategic agility and performance monitoring in healthcare institutions. The findings suggest that this digitalized approach enables a more adaptive and accountable response to healthcare emergencies, aligning operational processes with strategic objectives under conditions of uncertainty. **Design/Methodology/Approach.** This study employs a qualitative case study approach centred on the Centro Hospitalar de Vila Nova de Gaia/Espinho (CHVNGE), a major public healthcare institution in Portugal. Data were collected through three complementary methods: (1) document analysis of institutional digital transformation policies and BSC implementation strategies; (2) semi-structured interviews with key hospital administrators to explore perceptions regarding the impact of digitalization on strategic crisis response; and (3) comparative performance assessment using internal metrics to evaluate operational efficiency and responsiveness before and after the digital integration of the BSC. **Findings.** Preliminary findings indicate that BSC digitalization significantly enhances organizational resilience, with its impact categorized into three key areas:

- Predictive decision-making → Leveraging predictive analytics to optimize patient flow management and resource allocation.
- Increased operational flexibility → Enabling real-time adjustments in financial and healthcare strategies.
- Enhanced strategic integration → Aligning crisis response strategies with long-term institutional objectives.

Originality/Value. While traditional Balanced Scorecard (BSC) models have been widely applied across various disciplines to support crisis management, this study introduces a digitalized BSC framework, integrating artificial intelligence (AI) and big data analytics. This approach shifts crisis management from a reactive to a predictive and proactive model, enhancing strategic preparedness and operational efficiency. This study provides valuable theoretical contributions, expanding the existing body of knowledge on digital transformation in hospital management. However, as the research is based on a single case study, further comparative analyses across different hospital contexts and healthcare systems are needed to assess the scalability and generalizability of the proposed model. **Practical Implications.** The findings offer a scalable framework for BSC digitalization in hospital management, equipping healthcare managers and policymakers with more effective crisis response strategies. By leveraging AI-driven decision-making and real-time data analytics, hospitals can enhance resource allocation, operational agility, and resilience during crises. **Social Implications.** The digitalization of the BSC serves as a comprehensive performance management framework that strengthens inter-organizational healthcare systems. By ensuring efficiency, service continuity, and coordinated crisis response, this approach significantly contributes to public health preparedness and resilience, particularly during large-scale emergencies.

Keywords: balanced scorecard; healthcare resilience; digital transformation; crisis management; artificial intelligence; big data analytics; hospital performance; decision-making; sustainability; strategic management

JEL Codes: I18; M10; M15; O33; H75

1. Introduction

The increasing frequency and complexity of healthcare crises — including pandemics, natural disasters, cyber-attacks, and systemic failures — has underscored the urgent need for healthcare institutions to strengthen their operational and strategic resilience. Traditional management models, often characterised by rigid structures and reactive responses, have proven inadequate in addressing the dynamic challenges that arise during such emergencies.

In this context, digital transformation has emerged not only as a technological advancement but also as a strategic imperative that fosters agility, preparedness, and sustainable performance. Among the tools available for strategic management, the Balanced Scorecard (BSC) stands out for its multidimensional approach to performance evaluation. Originally developed to align organisational activities with long-term strategic objectives, the BSC has evolved into a powerful framework for integrated decision-making in complex environments.

This study focuses on the digitalisation of the BSC at the Centro Hospitalar de Vila Nova de Gaia/Espinho (CHVNGE), Portugal, aiming to explore how digital tools — particularly artificial intelligence (AI) and big data analytics — enhance the BSC's ability to support hospitals during crises. By embedding real-time data flows and predictive analytics into the BSC framework, healthcare institutions can shift from reactive crisis management to proactive and adaptive strategies.

While previous research has explored the role of digital health systems and AI in operational efficiency, there is limited evidence on how digitalising strategic frameworks like the BSC can contribute to institutional resilience. This study builds on existing work in sustainability reporting, AI integration in healthcare, and entrepreneurial sensemaking, offering new insights into how a digitally enhanced BSC can improve decision-making, resource allocation, and long-term strategic alignment.

The remainder of the article is structured as follows: Section 2 reviews the relevant literature on the BSC's evolution, digital healthcare transformation, and entrepreneurial organisational culture. Section 3 describes the research methodology, including the qualitative case study approach. Section 4 presents the findings based on document analysis, semi-structured interviews, and performance indicators. Section 5 discusses theoretical and practical implications. Section 6 concludes with key reflections and directions for future research.

2. Methodology

To achieve the objectives of this study, a qualitative research approach was adopted, focusing on a case study within a hospital that implements a strategic management model. The research was structured to examine the relationship between Balanced Scorecard (BSC) digitalisation and hospital resilience, using a systematic data collection and analysis process.

The Following Data Collection Methods Were Employed

Theoretical synthesis → Analysis of existing theoretical frameworks, principles, and best practices related to the application of BSC and digital transformation strategies in crisis management.

Semi-structured interviews → Conducted with hospital administrators and healthcare professionals to explore their perceptions of the role of digital tools in decision-making processes and crisis response strategies.

Quarterly assessment → Performance indicators were analysed up to October 2023, comparing hospital efficiency, resource allocation effectiveness, and response time before and after BSC digitalisation.

Data Analysis

A thematic analysis was conducted to identify recurring patterns regarding the impact of BSC digitalisation on hospital resilience. To ensure research rigour and validity, data triangulation was applied, integrating insights from documentary evidence, participant interviews, and hospital performance metrics.

3. Results and Discussion

3.1. Decision-Making and Digital Transformation with BSC

The digitalisation of the Balanced Scorecard (BSC) in hospital management has played a crucial role in optimising decision-making processes and enhancing operational efficiency during crisis scenarios. The integration of AI-powered intelligent dashboards has led to a 30% reduction in average response time in emergency situations.

This advancement has been made possible through the implementation of predictive algorithms and big data analytics, enabling:

- Real-time tracking of key hospital performance metrics, such as occupancy rates, patient flow, and resource availability.
- Forecasting hospital demand, allowing for dynamic redistribution of staff and essential resources.
- AI-driven strategic recommendations, enhancing decision-making efficiency and reducing hospital managers' reaction times.

The predictive capabilities of BSC digitalisation have transformed hospital management by shifting crisis responses from reactive problem-solving to proactive, opportunity-driven strategies. This transition ensures greater strategic alignment, improved operational efficiency, and enhanced healthcare service quality.

3.2. Maximizing the Balanced Scorecard: A Human-Centered Process Enabled by AI and Big Data

The digitalisation of the Balanced Scorecard (BSC), supported by artificial intelligence (AI) and big data analytics, has significantly enhanced hospital management systems, particularly in crisis scenarios. The integration of advanced data analysis technologies has driven substantial improvements in key administrative functions, enabling hospitals to operate more strategically and efficiently.

The key advantages include:

- Enhanced financial management → AI enables the dynamic allocation of financial resources in response to emergency demands, ensuring that budgets are adjusted in real time during healthcare and operational crises.
- Optimisation of internal processes → Big data analytics reduce operational inefficiencies, streamline workflows, and improve crisis management strategies. Additionally, automated administrative processes help minimise human error, leading to more effective resource utilisation.
- Organisational learning and growth → Machine learning algorithms facilitate continuous training for emergency response teams, addressing previously identified skill gaps. This ongoing reskilling of healthcare professionals strengthens hospitals' preparedness and response capabilities during emergencies.

By combining AI, big data, and digital BSC frameworks, hospital management becomes more agile, predictive, and resilient. The implementation of this data-driven approach ensures that crisis

management plans remain aligned with long-term institutional objectives, reinforcing strategic decision-making in high-pressure situations.

3.3. Case Study: Implementing a Digitalized BSC at CHVNGE

The implementation of a digitalized Balanced Scorecard (BSC) at Centro Hospitalar de Vila Nova de Gaia/Espinho (CHVNGE) has significantly enhanced hospital resilience by optimizing decision-making processes and crisis response strategies. The integration of artificial intelligence (AI), big data, and interactive control dashboards has played a pivotal role in improving strategic hospital management during emergencies.

The preliminary analysis comparing pre- and post-digitalization periods highlights the following key outcomes:

- 25% reduction in resource wastage during crises → The adoption of predictive modeling has improved the distribution and planning of medical resources, personnel, and medications, leading to reduced waste and more efficient operational management.
- Increased adaptability to emergency scenarios → Predictive analytics have enhanced real-time decision-making, allowing hospital operations to dynamically adjust in response to epidemiological outbreaks and critical events.
- Improved internal communication and strategic coordination → The use of interactive dashboards and automated alert systems has facilitated efficient information-sharing between clinical and administrative teams, reducing the risk of misinformation and enabling a faster, more coordinated crisis response.

The experience at CHVNGE demonstrates that BSC digitalization not only enhances operational efficiency but also strengthens hospital resilience. These findings suggest that the adoption of digital technologies in hospital management represents a robust strategy for improving crisis preparedness and response in future healthcare challenges.

Table 1. Impact of Digitalization on the Balanced Scorecard (BSC).

Indicators	Before Digitalization (%)	After Digitalization (%)
Reduction in decision-making time during emergencies	0	30
Improvement in resource allocation efficiency	0	25
Increase in hospital adaptability to crises	Low	Significant

Note. Data compiled from the qualitative case study analysis of CHVNGE (Centro Hospitalar de Vila Nova de Gaia/Espinho), supplemented by relevant literature on the digitalization of the Balanced Scorecard in hospital management (Kaplan & Norton, 1996; Cornelissen et al., 2012; Muñoz & Dimov, 2023).

4. Conclusions

The findings highlight the extent to which the digital transformation of the Balanced Scorecard (BSC) can significantly enhance hospital resilience by enabling a more proactive, data-driven approach to crisis management. The integration of big data and artificial intelligence (AI) serves as a decision-making optimiser, leveraging multiple data formats to enhance predictive analytics and strategic planning. By incorporating big data-driven medical activity models, hospitals can improve decision-making processes, operational efficiency, and crisis preparedness. This approach allows healthcare institutions to anticipate challenges, supply chain disruptions, and resource management issues with greater precision.

From a practical perspective, hospital managers can utilise insights generated through digitalized BSC models to implement more strategic crisis management processes, enhance

preparedness, and adopt real-time decision-making frameworks. The integration of AI-powered analytics into BSC frameworks fosters a more adaptive and resilient healthcare system, bridging short-term crisis response strategies with long-term institutional objectives.

Future research should expand this model to other hospital settings, assessing its scalability and adaptability across different healthcare systems. Additionally, further investigation should focus on identifying potential barriers to digital transformation in hospital management and defining best practices for successful implementation. Understanding these factors will be essential to optimising the impact of digitalized performance management tools in healthcare.

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