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Evolution of Balanced Scorecard in the Context of Digital Transformation: A Systematic Literature Review

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Abstract: This research investigates the evolution of the Balanced Scorecard (BSC) in the context of digital transformation using a Systematic Literature Review (SLR). Although BSC has been widely applied, existing studies remain fragmented and lack an integrated explanation of how BSC adapts to digital complexity. This study analyzes 31 Scopus-indexed articles published between 2020 and 2025 using the PRISMA approach. The findings reveal three major shifts: (1) BSC has evolved from a static performance measurement tool into a dynamic, data-driven strategic management system supported by AI, big data analytics, and cloud computing; (2) BSC perspectives have developed through either the addition of new dimensions, such as IT environment and sustainability, or the redefinition of the four classical perspectives; and (3) key performance indicators have shifted toward digital-oriented measures, including digital maturity, data security, and sustainability performance. This study contributes by providing an integrated conceptual understanding of the Digital Balanced Scorecard (DBSC) and offers practical insights for organizations in designing adaptive, data-driven performance management systems in the digital era.

Keywords: Balanced Scorecard, Digital Transformation, Performance Management System, Key Performance Indicators (KPI), Strategic Management.

INTRODUCTION

The digital era has fundamentally transformed organizational operations, driven by technological advancements and efficiency requirements (Oner et al., 2024). However, this adaptation process is not straightforward, and the high failure rate of digital transformation initiatives demands a comprehensive framework to support such endeavors (Fabac, 2022). In this context, the Balanced Scorecard (BSC) serves as a strategic control mechanism that has proven its effectiveness and is now evolving to adapt to the complexities of the digital era.

The future of strategic management is shaped by data-driven decision-making, agility, and comprehensive approaches to performance measurement (Intrafocus, 2024). Modern organizations no longer focus solely on financial aspects but also strive to create value for all

stakeholders through the integration of digital technology into all business areas. Organizations actively develop and adopt diverse information systems that strengthen the importance of information as a fundamental asset. Thus, the contemporary digital era requires modifications to traditional approaches and strategic tools (Zaychenko et al., 2024). These transformations encompass the implementation of AI, smart learning systems, large-scale data analysis, IoT technologies, cloud-based computing, and process roboticization that collectively reshape the contemporary business landscape.

Although traditional BSC has been considered solid, this conventional model is limited in accommodating the complex digital dimensions. Research indicates that the strategy of using digital transformation is more important than the technology itself and requires systematic organizational support (Fabac, 2022). This gap necessitates the modification and adaptation of BSC to effectively integrate critical aspects of digital transformation, such as IT environment, information system sustainability, data security, integration speed, customer digital maturity, and predictive capabilities based on advanced technology.

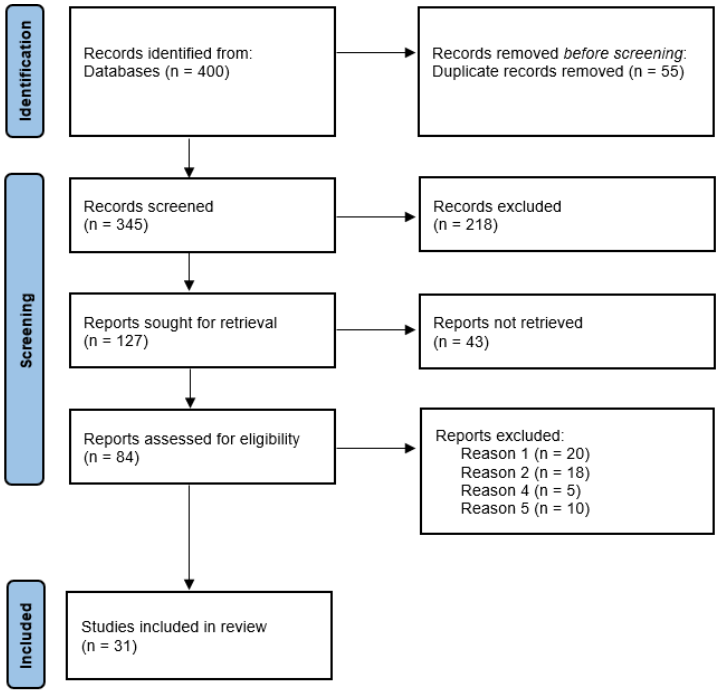
Moreover, this phenomenon affirms the importance of a deeper understanding of how BSC may operate beyond a performance assessment mechanism, acting as a dynamic strategic learning framework in response to accelerating digital evolution. BSC integrated with advanced technology has the potential to become a linking mechanism between business strategy and organizational digital capabilities, enabling data-driven decision-making and continuous organizational agility enhancement. This argument is further supported by empirical evidence showing that the integration of knowledge management and the BSC can significantly enhance organizational performance, highlighting its continued relevance as a strategic management tool in increasingly digital and complex environments (Ramadhika & Kusmiyanti, 2025).

However, despite the growing relevance of the BSC in the digital transformation era, existing studies remain fragmented and tend to focus on specific aspects of its development, such as digital technology adoption, perspective modification, or KPI adjustment. These studies are often conducted in isolation, resulting in a limited understanding of how BSC evolves as an integrated strategic management framework in response to digital complexity. Furthermore, there is still inconsistency in the literature regarding whether BSC should incorporate new perspectives or adapt the classical four perspectives to remain relevant in the digital context. This lack of integrative and consistent understanding highlights a clear research gap in explaining the comprehensive evolution of BSC in the digital era.

Therefore, this research aims to systematically analyze the evolution of BSC in the digital transformation context using a Systematic Literature Review (SLR) approach covering publications from 2020 to 2025. This research focuses on examining changes in strategic roles, perspective development, and KPI adaptation within a unified framework. This research is important given that digital transformation significantly impacts organizational efficiency and quality (Hügle & Grek, 2023). By providing an integrated conceptual synthesis, this research contributes to the development of the Digital Balanced Scorecard (DBSC) and offers practical insights for organizations in designing adaptive, data-driven performance management systems to respond to the demands of an evolving business environment (Intrafocus, 2024).

METHOD

The literature study method, or literature review, serves as the technique for gathering data in this research. Literature review is understood as a systematic way to collect and synthesize previous research and can be a powerful tool for understanding research trends, integrating findings, and driving theory development across various disciplines (Snyder, 2019). More specifically, this study uses a Systematic Literature Review (SLR) structured according to the PRISMA standards approach.



Source: Processed by the Author

Figure 1. PRISMA Flowchart

The beginning phase involves searching for scholarly articles using keywords "Balanced Scorecard" OR "BSC" and "Digital Transformation" OR "Industry 4.0" in databases including Springer, Emerald, ScienceDirect, Taylor and Francis, MDPI, and other Scopus-indexed journals. Selected articles include at least one more specific keyword, such as "Balanced Scorecard Digital" OR "DBSC" OR "IT BSC" OR "BSC Industry 4.0" and "Performance Measurement" OR "KPI BSC" as part of the title or abstract.

All articles that pass the elimination stage are then thoroughly analyzed from introduction to conclusion, with eligibility determined by inclusion criteria such as (i) Publications between January 2020 and December 2025; (ii) Articles must link BSC with digital transformation context, digitalization, Industry 4.0, or specific digital technology; (iii) Articles coverage of at least one theme related to BSC in the digital era (changes, perspective development, KPIs, or benefits and challenges); and (iv) Articles indexed in Scopus Q1/Q2/Q3/Q4. While exclusion criteria include (i) Articles focusing solely on traditional BSC without digital relevance; (ii) Articles addressing only digital transformation without BSC; (iii) Duplicates across databases; (iv) Articles not written in English; and (v) Articles not indexed in Scopus. This screening process resulted in 31 articles for final analysis.

Table 1. 31 Selected Articles

Author & Year	Title	Index
Akinbowale, O. E., Klingelhöfer, H. E., & Zerihun, M. F. (2020)	Analysis of Cyber-Crime Effects on the Banking Sector Using the Balanced Scorecard: A Survey of Literature	Q1
Frederico, G. F., Reyes, J. A. G., Kumar, A., & Kumar, V. (2020)	Performance Measurement for Supply Chains in the Industry 4.0 Era: A Balanced Scorecard Approach	Q1
Zanon, G. N., Szejka, A. L., & Loures, E. F. R. (2021)	Towards an Integrated MCDM and BSC Method to Support the Digital Transformation Strategy in Railway Companies	Q4

Author & Year	Title	Index
Moinzad, H., & Akbarzadeh, M. H. (2022)	How to Improve Information Technology Strategic Planning Effectiveness Using Balanced Scorecard, Risk, and Maturity Analysis, Case Study: Health Information Technology? A qualitative study	Q2
Pierce, E. (2022)	A Balanced Scorecard for Maximizing Data Performance	Q2
Fabac, R. (2022)	Digital Balanced Scorecard System as a Supporting Strategy for Digital Transformation	Q1
Body, A. L., Willoughby, L., & Body, L. L. (2022)	Applying Balanced Scorecard to Blackboard Technology in Accounting Education	Q4
Vărzaru, A. A. (2022)	An Empirical Framework for Assessing the Balanced Scorecard Impact on Sustainable Development in Healthcare Performance Measurement	Q2
Kashchena, N., Nesterenko, I., Chmil, H., Kovalevska, N., Velieva, V., & Lytsenko, O. (2023)	Digitalization of Biocluster Management on Basis of Balanced Scorecard	Q3
Kumar, S., Lim, W. M., Sureka, R., Jabbour, C. J. C., & Bamel, U. (2023)	Balanced Scorecard: Trends, Developments, and Future Directions	Q1
Hügle, T., & Grek, V. (2023)	Digital Transformation of an Academic Hospital Department: A Case Study on Strategic Planning Using the Balanced Scorecard	Q1
Oner, M., Cebeci, U., & Dogan, O. (2024)	BSC-Based Digital Transformation Strategy Selection and Sensitivity Analysis	Q2
Karmeni, K., Beldi, A., & Saadi, T. (2024)	Exploring the Performance Effects of Digitalisation: A Measurement Tool Based on The Sustainability Balanced Scorecard Framework	Q2
Ioanid, A., Panduru, D. A., Scarlat, C. (2024)	Towards Maturity of Digital Transformation: Development of Digital Maturity Scorecard	Q4
Zaychenko, I., Prokudina, A., Chzhou, H., & Fedorova, E. (2024)	Modification of the Balanced Scorecard in a Digital Economy	Q4
Samsuden, N. S., Kohar, U. H. A., Khatib, S. F. A., & Abbas, A. F. (2024)	Digital Capabilities and Business Performance: A Systematic Literature Review	Q1
Vienažindien, M., Chorna, L., Kovalenko, O., & Kudlaenko, S. (2024)	System of Balanced Indicators—Bioeconomy Information Map	Q4
Arputharaj, J.V., Yakub, M. E., Haruna, A. A., & Kumar, A. S. (2024)	Review and Design of Integrated Dashboard Model for Performance Measurements	Q4
Mellouli, H., Meddaoui, A., & Zaki, A. (2024)	Enhanced Industrial Decision-Making: Leveraging Artificial Intelligence for an Optimized Decision Model	Q4
Sorko, S. R., & Herzog, C. L. (2024)	Development of a Strategy Roadmap for the Widespread Implementation of Extended Reality	Q3
Alvarez, L. M., Arcentales, S. D. A., & Risco, A. A. (2024)	Innovation Using Dynamic Balanced Scorecard Design as an Industrial Safety Management System in A Company in the Mining Metallurgical Sector	Q1
Mahboub, R., & Ghanem, M. G. (2024)	The Mediating Role of Knowledge Management Practices and Balanced Scorecard in the Association Between Artificial Intelligence and Organization Performance: Evidence From MENA Region Commercial Banks	Q2
Silva, A., Maldonado, I., Da Silva, M., & Cepeda, C. (2025)	Sustainability Balanced Scorecard: Systematic Literature Review	Q2
Kalista, A., Az-Zahro, S., & Wibowo, M. M. A. (2025)	Designing Key Performance Indicators Based on the Sustainable Digital Balanced Scorecard for Herbal Medicine and Cosmetic Companies	Q4
Gamboa, L. (2025)	AI-Boosted Decision Techniques for Strategy Formulation and Implementation	Q2
Pietsch, W. (2025)	Balancing the Sustainability of Digital Product Management from a Strategic Business Perspective	Q3

Author & Year	Title	Index
Larsson, D., Ratnayake, R. M. C., & Samarakoon, S. M. S. M. K. (2025)	Agile Balanced Scorecard and Strategy Map Framework for Engineering-to-Order Projects: Enhancing Adaptability and Performance	Q2
Kočišová, M., Fiľo, M., Kádárová, J., & Suhányiová, A. (2025)	Assessing Company Financial Health Using an Integrated BSC-DEA Framework with a Focus on Process Digitization	Q4
Irawan, T., Isa, C. R., & Alfan, E. (2025)	The Effect of Digital Banking Adoption and Risk Management on Bank Performance: The Intervening Role of Balanced Scorecard	Q3
Suseno, N. S., Aulawi, H., & Septiana, Y. (2025)	Digital Transformation of Leather Workman MSMES Innovation in Garut Regency	Q4
Kang, M., Lai, Q., Wang, T., Jung, C. H. (2025)	Employing the Balanced Scorecard Model in Examining Cloud ERP Performances	Q3

Source: Authors' compilation

RESULTS AND DISCUSSION

This dataset comprises 31 scholarly articles systematically curated for literature analysis on the BSC in the digital era, with publication distribution showing two articles (6%) in 2020, one (3%) in 2021, five (16%) in 2022, three (10%) in 2023, peaking at 11 (35%) in 2024, and nine (29%) in 2025. The 2024–2025 period reflects a maturity phase where research shifts from conceptual development toward empirical implementation and adoption of new technologies AI and cloud computing, while article titles illustrate an evolution from general terms like "Digital Transformation" and "Performance Measurement" in early years (2020–2023) to more specific references in recent years (2024–2025) such as "AI-Boosted," "Cloud ERP," "Digital Maturity Scorecard," and "Sustainable Digital BSC," indicating a transition of Digital BSC research from conceptual exploration to practical application with explicit technologies.

Methodology distribution shows a preference for conceptual development approaches and case studies, with a total of 15 articles (48%) using Conceptual Framework Development or Case Study. Six articles (19%) employ Empirical Quantitative Survey. Five articles (16%) conduct Systematic Literature Review. Relatively rarely used methods are Machine Learning Modeling, Design Science Research, and Action Research. The preference for conceptual methods and case studies indicates a focus on theoretical exploration rather than empirical testing.

Table 2. Classification by Research Methodology

Research Methodology	Amount	%	Characteristics
Conceptual/Framework Development	9	29%	Development of theoretical models, new frameworks, or strategic roadmaps for DBSC implementation
Case Study (Qualitative)	6	19%	In-depth studies of specific organizations (single/multiple sites) to understand practical implementation
Empirical Quantitative	6	19%	Survey, SEM, PLS, and DEA for testing causal relationship hypotheses of BSC-performance
Systematic Literature Review	5	16%	Systematic/bibliometric review mapping BSC research trends
AI/Machine Learning Modeling	2	6%	Development of AI/ML algorithms for BSC decision-making optimization
MCDM Analysis	1	3%	Multi-Criteria Decision Making for Digital Transformation Strategy Selection
Design Science Research	1	3%	Design and evaluation of artifacts (dashboard model)
Action Research	1	3%	Researcher-practitioner collaboration for Agile BSC framework development

Research Methodology	Amount	%	Characteristics
TOTAL	**31**	**100%**	

Source: Authors' compilation

Sector distribution shows significant diversification with multi-sector/theoretical becoming the largest category (Six articles, 19%), followed by manufacturing/industry/supply chain (Five articles, 16%), banking/finance (Four articles, 13%), and health (Four articles, 13%). Other noteworthy sectors include technology (Three articles, 10%), bioeconomy (Three articles, 10%), and SMEs (Two articles, 6%), along with unique sectors such as mining, education, and Extended Reality technology. The diverse sector distribution indicates specific trends, such as digital acceleration in banking and transformation in the healthcare sector, while also highlighting the dominance of manufacturing linked to Industry 4.0 and a significant research gap in the MSME sector, despite its vital economic role.

Table 3. Classification by Sector/Industry Context

Sector / Industry Context	Amount	%	Primary Focus
Multi-sector / Theoretical	6	19%	General frameworks applicable across industries
Manufacturing / Industry / Supply Chain	5	16%	Industry 4.0, safety management, and engineering projects
Banking / Finance	4	13%	Digital banking, cybersecurity, and AI integration
Health / Hospital	4	13%	Hospital transformation, sustainable healthcare
Technology / Digital Services	3	10%	Dashboard tech, Extended Reality, digital product management
Sustainability / Bioeconomy	3	10%	Biocluster, bioeconomy data management systems
SMEs / Family Business	2	6%	Digitalization of SMEs
ERP / Information Systems	1	3%	Cloud ERP performance measurement
Mining	1	3%	Industrial safety management
Transportation / Railways	1	3%	Railway company digital strategy
Education	1	3%	Accounting education technology
TOTAL	**31**	**100%**	

Source: Authors' compilation

Geographic distribution shows Asia dominance with 10 articles (32%), followed by Europe with 11 articles (35%), the Americas with four articles (13%), and Africa/Middle East with four articles (13%). Additionally, multi-country studies account for two articles (6%). This geographic pattern indicates DBSC research has reached the global adoption phase with contributions from both developed and developing economies, each with research agendas reflecting their economic development priorities.

Table 4. Classification by Geographic Distribution

Region	Amount	%	Countries
Asia	10	32%	Indonesia, India, South Korea, Malaysia, Iran, Vietnam, Sri Lanka
Europe	11	35%	Germany, Sweden, Romania, Croatia, Ukraine, Lithuania, Austria, Slovakia
Americas	4	13%	USA, Brazil, Peru
Africa & Middle East	4	13%	MENA Region, South Africa, Algeria, Morocco

Region	Amount	%	Countries
Multi-country	2	6%	
TOTAL	**31**	**100%**	

Source: Authors' compilation

Changes in BSC in the Digital Era

Beginning with the classical Balanced Scorecard concept created by Kaplan & Norton in 1992, followed by the adaptation of BSC into the information technology domain called IT Balanced Scorecard, modified by Van Grembergen in 1997, this strategic planning system has undergone significant development to the present, where rapid digital era development is occurring. In response to this shift, BSC has also adapted according to digital transformation needs. These changes mark a fundamental transition from merely a performance measurement tool into an adaptive strategic management system, data-driven, and integrated with digital technology. This evolution reflects the need for organizations to adapt to increasingly complex, digitalized environments where data-driven decision-making is central to strategy. Today, BSC not only measures outcomes but also guides organizations through digital transformation, ensuring alignment between strategy, technology, and people (Ioanid et al., 2024; Zaychenko et al., 2024).

The first visible change is the move from a static scorecard to an adaptive digital strategy framework. According to Ioanid et al. (2024), implementation of the Digital Maturity Scorecard helps organizations assess digital readiness before implementing BSC fully, ensuring alignment between strategy and technology capability. This aligns with Sorko & Herzog's (2024) an idea combining Strategy Map and Transformation Map in BSC to ensure the digital vision translates into concrete action maps. Fabac (2022) affirms this transformation by introducing the Digital Balanced Scorecard, positioning digitalization as BSC's central axis. The DBSC model incorporates a management cycle, strategy map, and hierarchical structure that connects digital activities with strategic goals, financial outcomes, and sustainability objectives, while addressing challenges and opportunities in digital transformation.

Developments in data and AI technology have also transformed the BSC paradigm from a reporting system into a real-time decision-making engine. Gamboa (2025) affirms that Generative AI, Retrieval Augmented Generation (RAG), and Digital Twin integration enable organizations to monitor performance indicators dynamically and predict strategic outcomes through scenario simulation. A similar approach appears in Mellouli et al. (2024), combining BSC, Analytic Hierarchy Process (AHP), and Artificial Neural Networks (ANN) to create a Smart Decision System that automatically adjust KPI weights in response to changing contexts. In the workplace safety industry context, Alvarez et al. (2024) introduce a Dynamic BSC based on System Dynamics, enabling organizations to simulate policy impacts on operational performance, replacing traditional BSCs' retrospective function.

In a similar context, Mahboub & Ghanem (2024) add that digitalized BSC success depends not solely on AI technology but also on knowledge management practices (KMP) supporting strategy effectiveness. AI reinforces BSC by providing real-time data, predictive analytics, and reporting automation, while KMP supports BSC by ensuring strategic knowledge is available and effectively used. Here, BSC serves as a bridge connecting technology and strategy, enabling organizations to align operational activities with digital vision, systematically measure digital transformation impact, and improve overall organizational performance.

Across sectors, BSC’s role has shifted. Irawan et al. (2025) show that in the digital banking sector, BSC mediates the adoption of technology and risk management practices toward financial performance. In the SME context, Suseno et al. (2025) apply the BSC mapping digitalization roadmap for leather craftspeople, where BSC functions as a strategic navigation

tool directing business from the "digital indifferent" to "digital adaptive." In the manufacturing industry, Pietsch (2025) positions BSC within the QFD-based strategy deployment framework, balancing customer goals, technology, and organization, thereby strengthening BSC's relevance as a strategy synchronization tool in the digital production sector.

From these overall changes, BSC has evolved from a periodic measurement tool into a strategic orchestrator linking strategy, data, and technology. AI and data analytics integration demands strong information governance and a continuous learning culture across organizational levels. BSC in the digital era now executes the measure, learn, reprioritize, act cycle, replacing the static annual paradigm (Alvarez et al., 2024; Kočišová et al., 2025). With increasingly inclusive architecture toward digital and sustainability aspects, BSC becomes a strategic platform for resilience and growth amid transformation complexity (Larsson et al., 2025; Silva et al., 2025). BSC changes in the digital era represent evolution toward an integrated, adaptive, and learning-oriented performance management system. From AI adoption to sustainability principles, it now becomes a strategic foundation connecting digital vision with practical execution and enabling organizations to adapt, learn, and grow sustainably amidst digital era turbulence.

Development of BSC Perspectives in the Digital Era

BSC changes in the digital era raise questions about whether the four classical perspectives remain adequate for capturing organizational complexity. A debate has also emerged as to whether the BSC requires new perspective additions, or whether classical perspective redefinition suffices to accommodate complex digital reality. Literature shows two main currents, one advocating dimensional expansion, the other deepening the classical perspectives. The expansion view is represented by Zaychenko et al. (2024), who propose an "IT Environment" dimension in BSC architecture. This perspective encompasses data quality indicators, information security, system stability, and customer digital maturity. Without this, they argue, cause-and-effect relationships in BSC become unbalanced, since almost all strategic processes now depend on data and digital infrastructure. Thus IT Environment becomes a strategic foundation supporting the effectiveness of all BSC dimensions in the digital era.

Aligned with this, Silva et al. (2025) identify trends in environmental and social perspective additions in the Sustainable Digital BSC (SDBSC) model. They find two main approaches, namely additive (explicit ESG perspective addition) and integrative (absorption of sustainability principles into the four classical perspectives). The results show that sustainability and digital transformation are viewed as inseparable, positioning the BSC into more than a measurement tool, making it a strategic governance system aligned with economic, social, and ecological value. Vienazindien et al. (2024) research reinforces this, highlighting the importance of adding new perspectives more relevant to long-term objectives in an increasingly digitalized and sustainability-focused world. In this context, BSC functions not merely to measure financial and operational performance but also integrates social and environmental sustainability objectives, making it more suitable for organizations adopting sustainability principles in operations.

A similar approach is also raised by Vărzaru (2022), affirming that classical BSC perspectives need expansion with innovation and social responsibility dimensions facing the digital economy. He highlights that organizational performance is no longer measured only by profitability but also by adaptation ability to new technology and society's contribution. This new perspective strengthens the argument that BSC must integrate social value, innovation, and digital trust as modern strategy pillars. Similarly, Pierce (2022) emphasizes the importance of data governance as an additional layer in BSC. He proposes data and analytics dimension be treated as a separate perspective or minimally as a transversal subcomponent connecting

four classical perspectives, since data governance now determines strategic decision-making effectiveness.

Meanwhile, the second current argues redefining the classical four suffices. Fabac (2022) through DBSC concept states that the classical four-perspective structure remains relevant. Financial, customer, internal process, and learning perspectives can be reframed digitally toward value creation, digital customer experience, innovation, and agility/data literacy. According to Fabac, digitalization is not adding perspectives but changing how each perspective operates in a more responsive and data-driven system. Frederico et al. (2020) research reinforces this view, mapping BSC integration into the Supply Chain 4.0 model. He finds that four classical perspectives can be adjusted through a cyber-physical systems-based approach, where financial efficiency, customer satisfaction, and process innovation depend on real-time data connectivity. A similar point is made by Zanon et al. (2021) proposing a Balanced Digital Performance Model where the internal process perspective expands to cross-functional collaboration aspects, knowledge management, and big data analytics.

Simultaneously, some studies offer adaptive mechanisms within the classical BSC framework. Oner et al. (2024) introduce a Dynamic BSC based on machine learning and fuzzy logic, enabling automatic perspective weight updates according to real-time data dynamics. This model makes BSC more agile without needing new dimensions, since inter-perspective relationships can change contextually. Mahboub & Ghanem (2024) add a digital intelligence dimension as cross cross-perspective layer in the smart manufacturing context. By connecting IoT sensor data, AI, and human performance indicators, they show that modern BSC operates adaptively within an intelligent systems network. Kumar et al. (2023) support this approach, proposing an AI-driven BSC where machine learning algorithms not only help predict financial outcomes but also assess customer perspective and learning effectiveness in a continuous innovation context.

Additionally, Samsuden et al. (2024) make an important contribution, highlighting how the learning and growth perspective evolves into the core of organizational digital transformation. They view digital capabilities encompassing technology, agility, and digital marketing as strategic learning elements directly affecting financial and customer performance. This means learning in the digital age is not confined to human resource competency improvement but includes organizational ability to build, adopt, and leverage technology adaptively. Meanwhile, Body et al. (2022) adjusts classical perspectives for digital environment applications supported by Blackboard technology. The most obvious change appears in the classical Customer perspective replacement with "Blackboard-Supported Student Value Proposition Perspective," reflecting educational organization efforts to attract and retain students in the e-learning era.

From these overall findings, although some research adds new perspectives (such as IT Environment, Sustainability, or Data Governance), many emphasize redefining the classical four to remain digital-native. Both indicate convergence toward adaptive multidimensional BSC, namely strategic framework balancing economic, social, technological, and sustainability values without losing systemic unity. Thus new perspective addition is not the main goal but a consequence of maintaining BSC relevance as a strategic management tool amidst digital transformation complexity.

KPI Adjustment and Mapping in the Digital Era BSC

BSC perspective development in the digital era not only opens space for new framework dimensions but also reshapes how organizations define, map, and evaluate Key Performance Indicators (KPIs) relevant to digital transformation. One important development appears in KPI selection and evaluation. Kashchena et al. (2023) propose an multicriteria decision making (MCDM) based model using AHP and TOPSIS, selecting the most relevant KPIs for

organizational digital objectives. This model can reduce KPI assessment bias and ensure consistency, aligning financial, operational, and digital indicators such as service uptime, latency, or AI accuracy, replacing traditional measures like employee productivity.

Meanwhile, Arputharaj et al. (2024) introduce a new method for arranging and adjusting KPIs in a digital transformation context, combining BSC with AHP and an objective matrix to identify and prioritize relevant KPIs based on factors changing with digitalization. The research also emphasizes the importance of using advanced technology like IoT and real-time dashboards for more effective and efficient performance monitoring. Hügle & Grek's (2023) introduce Digital Twin BSC, linking real-world KPIs with simulations to predict outcomes, enabling managers to assess impacts before implementation. This shifts KPIs from static measures to predictive tools for faster decisions and risk mitigation.

Like Kang et al. (2025) research applying BSC in a modern information technology context (Cloud ERP) directly reflects KPI adjustment and mapping in the Digital Era BSC. There is a shifting focus from financial metrics to digital capability, process efficiency, and customer satisfaction, culminating in financial outcomes tied to long-term competitiveness. Meanwhile, Karmeni et al. (2024) highlight the importance of KPI linkage with digital transformation in the public service sector, where traditional indicators often fail to capture digital innovation value. They propose a hybrid KPI mapping approach combining digital metrics like platform interoperability, digital adoption index, and user engagement ratio into each BSC perspective. For example, from a customer perspective, "service satisfaction" indicator now accompanies digital self-service rate, while the internal process perspective includes digital process automation ratio assessing technology effectiveness in driving organizational efficiency. This approach shows KPI relevance now measured from the digital transformation value generated rather than mere quantitative output.

This KPI evolution direction consistency also appears in other research. Larsson et al. (2025) agile BSC model uses an AHP-based dashboard approach for KPI prioritization, maintaining strategy assessment flexibility changing rapidly. Kočišová et al. (2025) BSC Data Envelopment Analysis (DEA) approach enables relative performance evaluation across organizational units, ensuring KPIs remain measured and balanced between financial and digital efficiency. In the banking context, Irawan et al. (2025) emphasize KPIs like digital transaction growth, cyber risk index, and system uptime now serve as a connector between digital transformation and bank financial performance. At the micro level, SME BSC shows the KPI role as a learning tool in the phased digitalization process. KPIs like online transaction number, customer online response speed, and e-commerce platform adoption help SMEs transition from the digital observer toward the adopter stage. This model confirms that KPIs function dually as a measurement tool and a digital journey map guiding competitive improvement strategy (Suseno et al., 2025).

Meanwhile, technology-oriented literature like Gamboa (2025) and Mellouli et al. (2024) highlight modern KPIs must be designed to integrate the AI and analytics pipeline. KPIs can now be automatically generated through big data pattern analysis, updating indicator weights according to current trends, even predicting strategic achievement before actual realization. This approach produces self learning BSC where KPIs function not merely as measurement results but as input for the organizational intelligence system. Additionally, Kalista et al. (2025) highlight that KPI adjustment in the digital era BSC must consider ethics and social responsibility aspects of technology use. They argue performance indicators should not merely focus on digital efficiency or productivity but also include measures related to ethical AI use, data privacy compliance, and digital inclusion. Thus, KPIs beyond serving as a digital transformation success measurement tool also function as a moral control mechanism and governance, ensuring innovation aligns with transparency and social responsibility principles.

Therefore, KPI development direction in the digital era BSC affirms that organizations can no longer rely on traditional metrics alone. KPIs now become a living strategic measurement system combining analytical methods, digital simulation, and public transformation context with an agile, adaptive, and prediction-oriented approach. At the core, relevant indicators in the digital era are those capable of connecting strategy, data, and technology in one responsive, prescriptive, and sustainable BSC framework.

Benefits and Challenges of BSC Application in the Digital Era

Beyond indicators, the BSC application also presents significant benefits while bringing new complexity and challenges not ignorable. One key identified benefit is its capability to align strategy with operations amidst rapid change. In the banking sector, Irawan et al. (2025) show BSC enables accurate measurement of digital initiatives like transaction growth and cybersecurity, supporting financial and customer goals. This alignment helps organizations achieve long-term objectives without sacrificing innovation and technology change.

BSC also facilitates real-time performance monitoring. Hügle & Grek (2023) reveals that using models like Digital Twin BSC, organizations can simulate and monitor KPIs related to innovation and digital processes, such as real-time operational efficiency and system downtime. This allows managers to reach faster data-driven decisions, increasing organizational responsiveness to disruptions or opportunities emerging in a digitally connected business environment. However, the main BSC application challenge in the digital era is complexity in KPI selection and weighting. With expanding data and technology, organizations often struggle to determine appropriate KPIs measuring integrated digital performance. Kashchena et al. (2023) Identify that in many cases, traditional KPIs like revenue growth or customer retention no longer suffice in measuring digitalization impact. Therefore, more sophisticated approaches like MCDM or DEA are needed to select and assess KPIs suited to the digital context and evolving technology.

Additionally, data governance challenges become a major issue in the digital era BSC application. With increasing data generation and organization processing, challenges regarding data quality, security, and compliance become more complex. Karmeni et al. (2024) show that in the public service sector, although BSC can increase operational efficiency, a major challenge lies in managing relevant and accurate data for digital-based KPIs. Indicators like platform interoperability or digital adoption rate require an excellent data pipeline, avoiding measurement errors, and ensuring results truly reflect desired performance. Another major challenge is organizational culture change resistance. Zanon et al. (2021) observe that many firms struggle to shift from traditional systems to data-driven ones, especially in manufacturing where employees must adapt to IoT and analytics. This shows that digital transformation requires profound organizational culture development for successful BSC application. Additionally, Akinbowale et al. (2020) add that in banking, cybersecurity threats complicate BSC use, requiring adaptive KPIs such as response time and breach frequency to maintain relevance.

Despite these challenges, benefits outweigh obstacles. Pierce (2022) emphasizes that in organizations successfully overcoming these challenges, data data-based BSC application can accelerate strategic decision making and increase operational efficiency. Digital BSC provides not merely performance measurement benefits but also opens new opportunities for continuous innovation and competitive advantage, critically important in a business era highly dependent on technology and data. Moinzad & Akbarzadeh (2022) research adds perspective on technology readiness importance facilitating digital BSC application in the health sector. They show that BSC must adjust to existing IT system capabilities, and KPIs established must include measures relevant to health IT like system uptime, patient data access efficiency, and

digital health records integration. Without strong digital readiness, the BSC application will not maximally drive technology-based health service efficiency and quality.

Overall, the digital era BSC application offers numerous benefits in aligning and optimizing organizational performance. However, challenges related to appropriate KPI selection, effective data management, and organizational culture change must be carefully addressed for BSC to fully deliver maximum benefits. Relevant KPI selection, advanced analytical technology use, and change management commitment become success keys for BSC application in a dynamic digital environment.

CONCLUSION

Based on the results and discussion, this study confirms that the Balanced Scorecard (BSC) has evolved from a static performance measurement tool into a dynamic strategic orchestrator integrating strategy, data, and digital technology. This transformation is reflected in three key dimensions, the shift in BSC's strategic role toward a data-driven management system, the development of perspectives through both expansion and redefinition, and the adaptation of KPIs toward digital-oriented indicators such as digital maturity, data security, and sustainability performance. These findings address the existing fragmentation in the literature by providing an integrated conceptual understanding of the Digital Balanced Scorecard (DBSC) as a unified strategic framework in the digital era. The research contributes theoretically by elucidating the holistic evolution of BSC, and practically by offering guidance for organizations in designing adaptive, data-driven performance management systems.

This research has limitations, such as the systematic literature review method depends on Scopus-indexed publications with keyword and publication year restrictions. Thus, relevant research may be overlooked, particularly from gray literature or non-English publications possessing unique DBSC implementation practices. Additionally, the article dataset demonstrates qualitative approach and conceptual framework dominance, while quantitative empirical research remains limited, reducing the ability for generalization and DBSC effectiveness empirical verification.

REFERENCES

Akinbowale, O. E., Klingelhöfer, H. E., & Zerihun, M. F. (2020). Analysis of cyber-crime effects on the banking sector using the balanced score card: A survey of literature. *Journal of Financial Crime*, *27*(3), 945–958. https://doi.org/10.1108/JFC-03-2020-0037

Alvarez, L. M., Arcentales, S. D.-A., & Risco, A. A. (2024). Innovation using dynamic balanced scorecard design as an industrial safety management system in a company in the mining metallurgical sector. *Journal of Open Innovation: Technology, Market, and Complexity*, *10*(3), 100362. https://doi.org/10.1016/j.joitmc.2024.100362

Arputharaj, J. V., Yakub, M. E., Haruna, A. A., & Senthil Kumar, A. (2024). Review and Design of Integrated Dashboard Model for Performance Measurements. In H. Zen, N. M. Dasari, Y. M. Latha, & S. S. Rao (Eds.), *Soft Computing and Signal Processing* (Vol. 840, pp. 1–10). Springer Nature Singapore. https://doi.org/10.1007/978-981-99-8451-0_1

Body, A. L., Willoughby, L., & Body, L. L. (2022). Applying Balanced Scorecard to Blackboard Technology in Accounting Education: *International Journal of Technology and Human Interaction*, *18*(1), 1–19. https://doi.org/10.4018/IJTHI.300281

Fabac, R. (2022). Digital Balanced Scorecard System as a Supporting Strategy for Digital Transformation. *Sustainability*, *14*(15), 9690. https://doi.org/10.3390/su14159690

Frederico, G. F., Garza-Reyes, J. A., Kumar, A., & Kumar, V. (2020). Performance measurement for supply chains in the Industry 4.0 era: A balanced scorecard approach.

International Journal of Productivity and Performance Management, *70*(4), 789–807. https://doi.org/10.1108/IJPPM-08-2019-0400

Gamboa, L. (2025). AI-Boosted Decision Techniques for Strategy Formulation and Implementation. In A. A. Juan, J. Faulin, & D. Lopez-Lopez (Eds.), *Decision Sciences* (Vol. 14778, pp. 50–59). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-78238-1_5

Hügle, T., & Grek, V. (2023). Digital transformation of an academic hospital department: A case study on strategic planning using the balanced scorecard. *PLOS Digital Health*, *2*(11), e0000385. https://doi.org/10.1371/journal.pdig.0000385

Intrafocus. (2024, July 29). The Future of the Balanced Scorecard. *Intrafocus*. https://www.intrafocus.com/2024/07/the-future-of-the-balanced-scorecard/

Ioanid, A., Panduru, D. A., & Scarlat, C. (2024). Towards Maturity of Digital Transformation: Development of Digital Maturity Scorecard. In L. Moldovan & A. Gligor (Eds.), *The 17th International Conference Interdisciplinarity in Engineering* (Vol. 928, pp. 471–481). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-54671-6_35

Irawan, T., Isa, C. R., & Alfan, E. (2025). The Effect of Digital Banking Adoption and Risk Management on Bank Performance: The Intervening Role of Balanced Scorecard. *International Journal of Innovative Research and Scientific Studies*, *8*(4), 965–980. https://doi.org/10.53894/ijirss.v8i4.7980

Kalista, A., Az-Zahro, S., & Wibowo, M. M. A. (2025). Designing Key Performance Indicators Based on the Sustainable Digital Balanced Scorecard for Herbal Medicine and Cosmetic Companies. In A. J. Obaid, M. Ika Joesidawati, S. Lafta Farhan, E. A. M. S. Al-Heety, & N. Radwan (Eds.), *Advances in Environment and Sustainability: Addressing Global Challenges* (pp. 466–480). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-97301-7_36

Kang, M., Lai, Q., Wang, T., & Jung, C.-H. (2025). Employing the Balanced Scorecard Model in Examining Cloud ERP Performances: An Empirical Study. *International Journal of Enterprise Information Systems*, *20*(1). https://doi.org/10.4018/IJEIS.386133

Karmeni, K., Beldi, A., & Saadi, T. (2024). Exploring the Performance Effects of Digitalisation: A Measurement Tool Based on The Sustainability Balanced Scorecard Framework. *Technology Analysis & Strategic Management*, 1–15. https://doi.org/10.1080/09537325.2024.2346156

Kashchena, N., Nesterenko, I., Chmil, H., Kovalevska, N., Velieva, V., & Lytsenko, O. (2023). Digitalization of Biocluster Management on Basis of Balanced Scorecard. *Journal of Information Technology Management*, *15*(4). https://doi.org/10.22059/jitm.2023.94711

Kočišová, M., Fiľo, M., Kádárová, J., & Suhányiová, A. (2025). Assesing Company Financial Health using an Integrated BSC-DEA Framework with a Focus on Process Digitization. *Acta Mechanica et Automatica*, *19*(1), 164–171. https://doi.org/10.2478/ama-2025-0019

Kumar, S., Lim, W. M., Sureka, R., Jabbour, C. J. C., & Bamel, U. (2023). Balanced Scorecard: Trends, Developments, and Future Directions. *Review of Managerial Science*, *18*(8), 2397–2439. https://doi.org/10.1007/s11846-023-00700-6

Larsson, D., Ratnayake, R. M. C., & Samarakoon, S. M. S. M. K. (2025). Agile Balanced Scorecard and Strategy Map Framework for Engineering-to-Order Projects: Enhancing Adaptability and Performance. *Engineering Management Journal*, 1–22. https://doi.org/10.1080/10429247.2025.2538065

Mahboub, R., & Ghanem, M. G. (2024). The mediating role of knowledge management practices and balanced scorecard in the association between artificial intelligence and organization performance: Evidence from MENA region commercial banks. *Cogent Business & Management*, *11*(1), 2404484. https://doi.org/10.1080/23311975.2024.2404484

Mellouli, H., Meddaoui, A., & Zaki, A. (2024). Enhanced Industrial Decision-Making: Leveraging Artificial Intelligence for an Optimized Decision Model. In Y. Mejdoub & A. Elamri (Eds.), *Proceeding of the International Conference on Connected Objects and Artificial Intelligence (COCIA2024)* (Vol. 1123, pp. 1–7). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-70411-6_1

Moinzad, H., & Akbarzadeh, M. H. (2022). How to improve information technology strategic planning effectiveness using balanced scorecard, risk and maturity analysis, case study health information technology? A qualitative study. *Health Science Reports*, *5*(6), e926. https://doi.org/10.1002/hsr2.926

Oner, M., Cebeci, U., & Dogan, O. (2024). BSC-Based Digital Transformation Strategy Selection and Sensitivity Analysis. *Mathematics*, *12*(2), 225. https://doi.org/10.3390/math12020225

Pierce, E. (2022). A Balanced Scorecard for Maximizing Data Performance. *Frontiers in Big Data*, *5*, 821103. https://doi.org/10.3389/fdata.2022.821103

Pietsch, W. (2025). Balancing the Sustainability of Digital Product Management from a Strategic Business Perspective. In D. Petrik, A. Saltan, & A. Helferich (Eds.), *Digital Product Management in the Era of Data Economy, Artificial Intelligence, and Ecosystems* (Vol. 528, pp. 15–27). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-71515-0_2

Ramadhika, M. F. & Kusmiyanti. (2025). The Impact of Knowledge Management on Organizational Performance through the Balanced Scorecard at Correctional Facilities in Central Java. *Dinasti International Journal of Economics, Finance & Accounting*, *6*(5), 4337–4347.

Samsuden, N. S., Kohar, U. H. A., Khatib, S. F. A., & Abbas, A. F. (2024). Digital Capabilities and Business Performance: A Systematic Literature Review. *Sustainability*, *16*(24), 11108. https://doi.org/10.3390/su162411108

Silva, A., Maldonado, I., Da Silva, M., & Cepeda, C. (2025). Sustainability Balanced Scorecard: Systematic Literature Review. *Journal of Risk and Financial Management*, *18*(6), 324. https://doi.org/10.3390/jrfm18060324

Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. *Journal of Business Research*, *104*, 333–339. https://doi.org/10.1016/j.jbusres.2019.07.039

Sorko, S. R., & Herzog, C. L. (2024). Development of a Strategy Roadmap for the Widespread Implementation of Extended Reality. *Tehnički Glasnik*, *18*(1), 157–162. https://doi.org/10.31803/tg-20230523140033

Suseno, N. S., Aulawi, H., & Septiana, Y. (2025). Digital Transformation of Leather Workman Msmes Innovation in Garut Regency. *Quality-Access to Success*, *26*(206). https://doi.org/10.47750/QAS/26.206.10

Vărzaru, A. A. (2022). An Empirical Framework for Assessing the Balanced Scorecard Impact on Sustainable Development in Healthcare Performance Measurement. *International Journal of Environmental Research and Public Health*, *19*(22), 15155. https://doi.org/10.3390/ijerph192215155

Vienažindienė, M., Chorna, L., Kovalenko, O., & Kudlaenko, S. (2024). System of Balanced Indicators—Bioeconomy Information Map. In B. Awwad (Ed.), *The AI Revolution: Driving Business Innovation and Research* (Vol. 525, pp. 661–669). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-54383-8_51

Zanon, G. N., Szejka, A. L., & Loures, E. D. F. R. (2021). Towards an Integrated MCDM and BSC Method to Support the Digital Transformation Strategy in Railway Companies. In L. Newnes, S. Lattanzio, B. R. Moser, J. Stjepandić, & N. Wognum (Eds.), *Advances in Transdisciplinary Engineering*. IOS Press. https://doi.org/10.3233/ATDE210109

Zaychenko, I., Prokudina, A., Chzhou, H., & Fedorova, E. (2024). Modification of the Balanced Scorecard in a Digital Economy. In T. C. Devezas, M. A. Berawi, S. E. Barykin, & T. Kudryavtseva (Eds.), *Understanding the Digital Transformation of Socio-Economic-Technological Systems* (Vol. 951, pp. 315–323). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-56677-6_24