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AI-DRIVEN QUALITY MANAGEMENT IN HIGHER EDUCATION: ANALYTICAL SUPPORT FOR SUSTAINABLE IT BUSINESS PROCESSES AND CIRCULAR ECONOMY DEVELOPMENT

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Abstract. *Purpose.* The purpose of the study is to develop an integrated analytical framework for embedding Artificial Intelligence (AI) into quality management systems (QMS) of Higher Education Institutions (HEIs), ensuring analytical support for sustainable IT business processes and enabling the transition toward circular economy models. *Methodology.* The study is based on a multi-stage research design that combines system analysis, structural-functional and comparative analysis, abstraction, and modeling. A risk-oriented approach is applied to identify and assess challenges related to AI implementation, while content analysis is used to systematize existing scientific contributions. HEIs are conceptualized as complex socio-economic systems, allowing for the integration of AI technologies, QMS elements, and IT business processes within a unified analytical framework. *Results.* The results confirm that AI acts as a key driver in transforming QMS from static, compliance-based models into adaptive, data-driven, and predictive systems. AI technologies are systematically embedded across core QMS elements, including quality planning, assurance, control, improvement, risk management, and internal audit. This integration enhances decision-making accuracy, enables real-time monitoring, strengthens internal control mechanisms, and supports proactive risk management. Additionally, AI-driven IT business processes contribute to the implementation of circular economy principles through resource optimization, digitalization, and waste reduction. *Practical implications.* The proposed framework provides HEIs with a structured and applicable model for implementing AI-driven QMS, incorporating internal audit and risk management mechanisms. It supports improved governance, operational efficiency, compliance with international standards, and alignment with sustainability objectives. *Value / originality.* The study offers a novel, integrated approach that links AI, quality management systems, and IT business processes with circular economy principles. Unlike fragmented existing research, it provides a comprehensive, system-based perspective on the transformation of higher education management.

Keywords: AI, Quality Management Systems, HEIs, IT, Business Processes, Circular Economy, Risk-oriented Management, Sustainability.

JEL Classification: I23, M15, M10, O32, Q01, M42

1. Introduction

The increasing global emphasis on sustainability, particularly since the United Nations' 2015 Sustainable Development Goals (SDGs), has underscored the necessity for HEIs to integrate sustainable practices within their operational frameworks (Özşen et al., 2022). This integration often involves leveraging advanced technologies like AI (AI) to enhance quality management and foster sustainable IT business processes, thereby contributing to circular economy development (Khan et al., 2025). In particular, AI, through its capabilities in mimicking human cognitive functions such as learning and problem-solving, can optimize processes and drive innovation within educational contexts (Claro & Bayona, 2025). This includes its application in Total Quality Management

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(TQM) to improve institutional effectiveness and educational quality through data-driven insights and adaptive learning systems (Alotaibi, 2024; Warren et al., 2025). Furthermore, the profound transformation of teaching and learning processes, driven by the integration of Information and Communication Technologies, positions AI as a significant force in augmenting the quality of higher education (Sir et al., 2025). The emergence of generative AI tools, such as ChatGPT, further exemplifies this transformative potential by altering the landscape of information and communication in educational settings and facilitating sustainable development (Boustani et al., 2024). This technological evolution necessitates a comprehensive examination of how AI can be strategically deployed to enhance the quality of higher education, particularly within the framework of sustainable IT business processes and the broader objectives of a circular economy (Katsamakas et al., 2024a, 2024b; Oliinyk et al., 2026; Kucheriava & Lisovyi, 2024; Kucheriava & Bychykhin, 2024).

The reviewed literature demonstrates a consistent shift toward the integration of sustainability principles, digital transformation, and advanced technologies in higher education. In particular, the convergence of AI, quality management approaches, and IT-enabled business processes reflects a growing recognition of the need for data-driven, adaptive, and efficiency-oriented institutional models. Existing studies confirm the significant potential of AI to enhance educational quality, optimize resource utilization, and support sustainable development objectives, including those aligned with the circular economy paradigm.

At the same time, the analysis reveals a fragmentation of research efforts. Most contributions focus either on the application of AI in teaching and learning, the modernization of quality management systems, or the development of sustainable and circular practices in isolation. Limited attention has been given to the systemic integration of these domains within a unified analytical framework, particularly in the context of HEIs as complex socio-economic ecosystems.

In this regard, the present study on AI-driven quality management in higher education: analytical support for sustainable IT business processes and circular economy development is both timely and relevant. It addresses an important research gap by proposing an integrated approach that connects AI, quality management systems, and IT business processes with the principles of the circular economy. The study contributes to the advancement of theoretical and methodological foundations by conceptualizing AI not only as a technological tool, but as a strategic driver of transformation toward adaptive, sustainable, and analytically supported management models in higher education.

The purpose of the study is to develop a comprehensive analytical framework for the integration of AI into quality management systems of HEIs, ensuring analytical support for sustainable IT business processes and facilitating the transition toward circular economy models.

To achieve the stated purpose, the following o**bjectives** are defined:

to investigate the theoretical and methodological foundations of AI-driven quality management systems in HEIs, including the transformation of traditional quality management approaches under the influence of AI technologies;

to develop an analytical framework for integrating AI, higher education systems, and IT business processes, with a focus on ensuring data-driven decision-making, process optimization, and alignment with strategic management objectives;

to substantiate the role of AI-driven IT business processes in supporting the development of circular economy models within HEIs, including the identification of key mechanisms for resource optimization, waste reduction, and sustainable value creation.

2. Research Methodology

The research is based on a structured, multi-stage approach that ensures the consistent development of an analytical framework for integrating AI into quality management systems of HEIs. At the initial stage, a comprehensive literature review is conducted to systematize theoretical approaches to quality management, AI applications, and circular economy concepts. This is followed by the identification of key transformation drivers, including digitalization, sustainability requirements, and the increasing role of IT business processes. The next stage involves the conceptualization of AI-driven quality management systems through the analysis of their evolution and structural components. Based on this, an analytical framework is developed that integrates AI technologies, QMS elements, and IT business processes within HEIs. Particular attention is given to the incorporation of a risk-oriented dimension and internal audit mechanisms to ensure system reliability, transparency, and sustainability. The final stage focuses on substantiating the role of AI-driven IT business processes in supporting circular economy development through resource optimization, waste reduction, and sustainable value creation.

The methodological basis of the study includes system analysis, which allows HEIs to be considered as complex socio-economic systems; comparative and structural-functional analysis to identify relationships between AI technologies, quality management elements, and IT business processes;

as well as abstraction and generalization for the development of a conceptual framework. In addition, the modeling method is applied to construct the analytical framework, while a risk-oriented approach is used to assess potential challenges associated with AI implementation and define appropriate control and internal audit mechanisms. Content analysis is employed to identify key trends in scientific literature. The combination of these methods ensures a comprehensive and interdisciplinary approach, enabling the formation of an integrated, data-driven model of quality management aligned with sustainable development and circular economy principles.

3. AI-Driven Quality Management Systems in Higher Education

The rapid digitalization of the educational environment, coupled with the growing complexity of stakeholder requirements and increasing accountability pressures, has fundamentally transformed approaches to quality management in HEIs (HEIs). Traditional and standardized models of quality assurance, while instrumental in establishing formalized procedures and compliance mechanisms, are increasingly insufficient in addressing the dynamic, data-intensive, and innovation-driven nature of contemporary higher education systems.

In this context, the integration of AI (AI) emerges not merely as a technological enhancement, but as a systemic shift toward adaptive, predictive, and data-driven quality management. AI-driven systems enable real-time monitoring of educational processes, advanced analytics of student performance and institutional effectiveness, and the automation of quality assurance procedures. This transition reflects a broader paradigm shift from static quality assurance frameworks to intelligent, continuously learning systems capable of responding to complex environmental changes.

Moreover, the evolution of quality management in HEIs demonstrates a clear trajectory from academic autonomy and informal evaluation mechanisms to structured, standardized, and eventually digitally enabled models. Understanding this evolutionary path is essential for conceptualizing the role of AI as a natural and necessary extension of prior quality management paradigms.

Against this background, the following table systematizes the key stages in the evolution of quality management systems in higher education, highlighting the conceptual approaches, core characteristics, leading scholars and schools of thought, as well as their implications for HEIs. This provides the analytical foundation for further examining AI-driven quality management systems as the next stage of this evolution.

The systematization of AI applications in quality management systems of HEIs demonstrates a multidimensional impact that extends beyond operational efficiency to strategic transformation. First, AI significantly enhances data-driven decision-making

Table 1
Evolution of Quality Management Systems in HEIs (HEIs)

Stage / Period	Conceptual Approach	Key Characteristics in HEIs	Key Authors / Schools	Implications for HEIs
Pre-quality stage (before 1980s)	Traditional academic control	Quality ensured through academic autonomy, peer review, and reputational mechanisms	Wilhelm von Humboldt (Humboldt, 1970); John Henry Newman (Newman , 1852)	Focus on academic freedom, limited formalized quality systems
1980s–1990s	Total Quality Management (TQM)	Introduction of quality culture, continuous improvement, student as "customer"	W. Edwards Deming (Deming, 1986); Joseph M. Juran (Juran, 1988); Kaoru Ishikawa (Ishikawa , 1985)	Shift to process orientation, internal quality assurance systems emerge
1990s–2000s	Standardization (ISO-based systems)	Implementation of ISO 9001 in universities, formal procedures and documentation	International Organization for Standardization (ISO, 2015); David Hoyle (Hoyle, 2009)	Formalization of quality processes, documentation and audits
2000s–2010s	European quality assurance frameworks	Development of ESG standards, accreditation systems, external Quality Assurance (QA) agencies	European Association for Quality Assurance in Higher Education (ENQA, 2015); European Higher Education Area (EHEA, 2020)	Institutionalization of internal and external QA, accountability and transparency
2010s–2020s	Excellence models and stakeholder orientation	Adoption of EFQM, focus on stakeholders, employability, outcomes-based education	European Foundation for Quality Management (EFQM, 2020); Robert Kaplan (Kaplan&Norton, 1996)	Integration of performance management and strategic governance
2020s–present	Digital and AI-driven quality management	Integration of learning analytics, AI, digital QA tools, real-time monitoring	George Siemens (Siemens, 2013)	Transition to adaptive, data-driven quality management systems

Source: developed by author

by enabling institutions to process large volumes of structured and unstructured data, thereby improving the accuracy and timeliness of managerial responses. The implementation of real-time monitoring tools and continuous quality control mechanisms ensures the ongoing assessment of educational processes, allowing for immediate identification of deviations and performance gaps.

A critical advantage lies in the use of predictive analytics for risk management, which supports early detection of potential academic, administrative, and financial risks. Simultaneously, AI facilitates the personalization of educational trajectories, aligning learning processes with individual student needs and competencies. The automation of quality assurance procedures reduces administrative burden while increasing consistency and objectivity in evaluations.

Furthermore, AI contributes to the integration of internal and external quality assurance systems, strengthening transparency, accountability, and compliance with international standards. The establishment of continuous feedback loops fosters a culture of ongoing improvement, while optimization of resource allocation enhances institutional efficiency. Importantly, AI supports strategic alignment and performance management, reinforcing the resilience of HEIs in conditions of uncertainty and systemic challenges.

These advantages collectively illustrate the transformative role of AI in redefining quality management systems. In this context, Fig. 1 visually summarizes the key benefits of AI application in quality management systems of HEIs, providing a structured overview of its functional and strategic contributions.

The integration of AI into QMS represents a shift from procedural and compliance-based models toward adaptive, predictive, and intelligence-driven systems, where quality management becomes an embedded, continuously evolving function of institutional governance.

Building upon the identified advantages of AI integration into quality management systems, it is necessary to operationalize these benefits through a structured mapping of specific AI tools to core QMS elements in HEIs. Such an approach allows not only to conceptualize AI as a general enabler, but also to clearly identify its functional roles within distinct components of the quality management system – ranging from quality planning and assurance to internal audit, risk management, and strategic performance control. In this context, Table 2 presents a comprehensive alignment between AI technologies, their functional applications, and their corresponding impact on quality management processes and strategic development of HEIs.

The analysis of Table 2 demonstrates that AI serves as an integrative backbone of modern quality management systems, ensuring coherence between operational processes and strategic objectives. The deployment of machine learning, predictive analytics, and intelligent automation tools enables a shift from reactive to proactive and predictive quality management. In particular, the integration of AI into internal audit and risk management functions

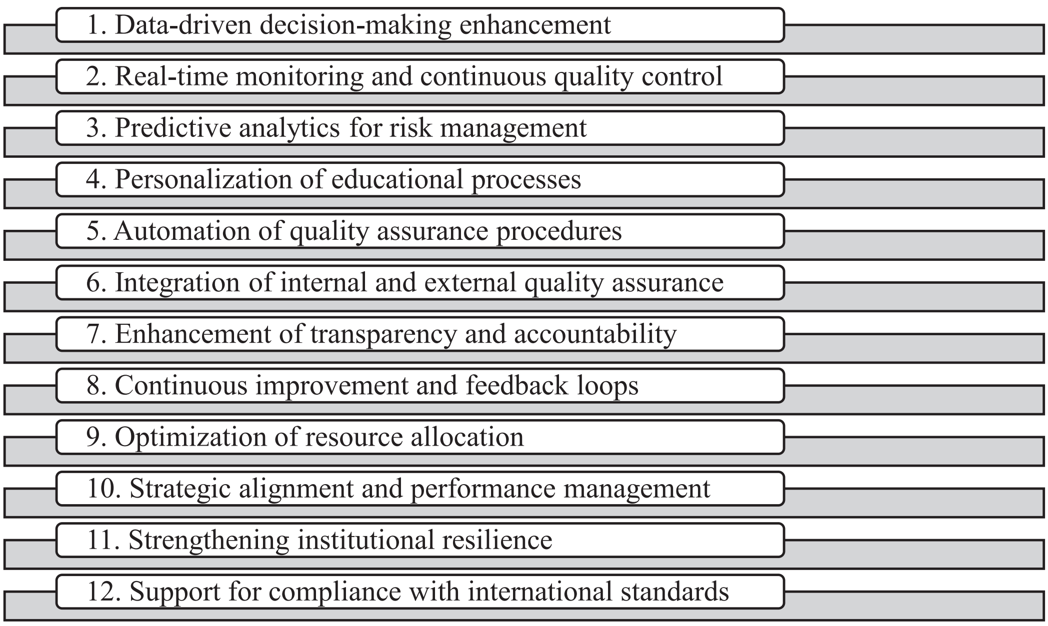

Figure 1. Advantages of AI Application in Quality Management Systems of HEIs.

Source: developed by authors

Table 2
AI Tools and Their Role within Quality Management System Elements in HEIs

QMS Element in HEIs	AI Tools / Technologies	Functional Role	Impact on Quality Management	Strategic Implication
Quality Planning	Machine Learning (ML); Predictive Analytics	Forecasting demand for educational programs; identifying labor market trends	Improves alignment of curricula with external requirements	Supports strategic positioning of HEIs
Quality Assurance (Internal QA)	Learning Analytics Systems; AI-based Monitoring Platforms	Continuous monitoring of learning processes and teaching quality	Enables real-time control and early detection of deviations	Transition to proactive QA systems
Quality Control	Automated Assessment Systems; Natural Language Processing (NLP)	Automated grading, plagiarism detection, content evaluation	Ensures objectivity and consistency of assessment	Reduces operational burden and bias
Quality Improvement	Recommender Systems; Adaptive Learning Platforms	Personalization of learning trajectories and interventions	Enhances learning outcomes and student satisfaction	Supports student-centered education
Risk Management in QMS	Predictive Risk Models; Anomaly Detection Algorithms	Identification of academic, operational, and systemic risks	Strengthens risk-oriented quality management	Enhances institutional resilience
Internal Audit of Quality Systems	AI-driven Audit Analytics; Continuous Auditing Systems; Process Mining	Automated testing of internal controls; continuous monitoring of compliance; detection of anomalies and inefficiencies	Increases reliability of internal control systems; ensures early identification of risks and non-compliance	Transforms internal audit into a continuous, data-driven assurance function integrated with QMS
Decision Support Systems	AI-based DSS; Data Mining	Analytical support for managerial decisions	Improves speed and accuracy of decisions	Enables evidence-based governance
Stakeholder Feedback Management	Sentiment Analysis (NLP); Chatbots	Processing feedback from students and stakeholders	Enhances responsiveness and engagement	Strengthens transparency
Accreditation and Compliance	Intelligent Document Processing (IDP); Robotic Process Automation (RPA)	Automation of reporting and compliance procedures	Reduces administrative workload and errors	Facilitates ESG and standards alignment
Performance Management	AI-enhanced KPI Systems; Balanced Scorecard Analytics	Monitoring institutional performance indicators	Aligns quality objectives with outcomes	Integrates QMS with strategy
Resource Management	Optimization Algorithms; AI Scheduling Systems	Allocation of human, financial, and infrastructure resources	Improves efficiency and cost-effectiveness	

Source: (IIA, 2024; ISO, 2015)

strengthens the reliability of internal control systems and enhances the capacity for early detection of deviations and non-compliance.

Moreover, the use of AI-driven decision support systems and performance analytics contributes to evidence-based governance, while adaptive learning technologies reinforce student-centered approaches and improve educational outcomes. The incorporation of AI into accreditation and compliance processes further reduces administrative inefficiencies and supports alignment with international standards and ESG requirements. Overall, the systemic integration of AI tools transforms QMS into a dynamic, data-driven framework that enhances institutional resilience, transparency, and long-term strategic competitiveness.

The integration of AI into quality management systems of HEIs reflects a transition toward adaptive, data-driven, and continuously evolving governance models. AI enables the alignment of quality planning, assurance, control, and improvement processes with real-time data analytics, predictive capabilities, and automation tools. This transformation enhances the effectiveness of internal control, strengthens risk-oriented management, and supports evidence-based decision-making. At the same time, the incorporation of AI into internal audit and compliance functions ensures higher transparency, reliability, and responsiveness of quality systems. Overall, AI-driven QMS contributes to increased institutional resilience and strategic competitiveness in dynamic environments.

Building on these findings, the next stage of the research focuses on the development of an analytical framework that integrates AI, higher education systems, and IT business processes, providing a systemic foundation for sustainable and strategically aligned quality management.

4. Analytical Framework for Integrating AI, Higher Education and IT Business Processes

The analytical framework is structured around the integration of AI technologies into the quality management system of HEIs through IT-driven business processes. This approach ensures a shift toward data-driven, adaptive, and risk-oriented quality management. The inclusion of a risk and internal audit dimension strengthens the reliability and sustainability of the system.

To operationalize this analytical framework and demonstrate its practical applicability, it is essential to specify how particular AI technologies are embedded within distinct elements of the quality management system and corresponding IT business processes in HEIs. Such structuring allows for a clear identification of the functional roles of AI, as well as the analytical value it generates across different management domains, including quality planning, assurance, control, risk management, and decision support.

In this context, Table 3 presents a systematic mapping of AI technologies to QMS elements and IT-driven business processes, highlighting their respective analytical functions and illustrating how AI enables the transformation of quality management into an integrated, data-driven and process-oriented system.

The analysis of AI integration risks within quality management systems of HEIs demonstrates that the implementation of intelligent technologies is inherently associated with a spectrum of systemic, operational, and ethical challenges. The most critical risks are concentrated around data quality and privacy, algorithmic bias, over-reliance on automated decision-making, and potential distortions in analytical outputs. These risks directly affect the reliability of quality assurance processes, the objectivity of assessment, and the overall trustworthiness of institutional governance.

At the same time, the findings confirm that effective risk mitigation is achievable through the integration of structured control mechanisms, including model validation procedures, data governance policies, benchmarking practices, and hybrid decision-making frameworks. A key role in this architecture is assigned to internal audit, which evolves into a continuous, data-driven function focused on verifying the accuracy, fairness, and compliance of AI systems. The incorporation of continuous auditing and monitoring tools ensures early detection of anomalies and strengthens the resilience of quality management systems.

Thus, AI integration does not eliminate risks but transforms them into manageable elements within a controlled and auditable environment, reinforcing the shift toward risk-oriented and adaptive QMS models.

In light of the above, Table 4 further systematizes the interconnections between AI applications, risk types, control mechanisms, and the role of internal audit, providing a structured framework for ensuring the reliability and sustainability of AI-driven quality management systems in HEIs.

The systematization of AI integration risks and corresponding control mechanisms confirms that the sustainability of AI-driven quality management systems in HEIs depends on the balance between technological capabilities and governance frameworks. The identified risk categories – including model bias, data privacy violations, algorithmic opacity, and systemic errors – highlight the necessity of embedding robust control procedures at each stage of AI application.

The analysis demonstrates that effective risk management is achieved through the combination

Table 3
Integration of AI into Higher Education Quality Management and IT Business Processes

AI Technology	QMS Element in HEIs	IT Business Process	Analytical Function
Machine Learning (ML)	Quality Planning	Curriculum design; labor market analytics	Forecasting demand for skills and educational programs
Learning Analytics	Quality Assurance	Learning Management Systems (LMS); student monitoring	Real-time tracking of performance and engagement
Natural Language Processing (NLP)	Quality Control	Assessment systems; academic integrity tools	Automated grading; plagiarism detection; content analysis
Recommender Systems	Quality Improvement	E-learning platforms; adaptive learning systems	Personalization of learning trajectories
Predictive Analytics	Risk Management	Student retention systems; performance monitoring	Identification of dropout risks and inefficiencies
AI-based DSS	Decision Support	Institutional data systems; reporting platforms	Data-driven managerial decision-making
Sentiment Analysis	Stakeholder Management	Feedback systems; surveys; communication platforms	Analysis of stakeholder perceptions and feedback
RPA & Intelligent Document Processing	Compliance & Accreditation	Reporting systems; accreditation procedures	Automation of documentation and compliance checks

Source: developed by authors

Table 4
AI Integration Risks and Control Mechanisms in QMS of HEIs

AI Application	Risk Type	Control Mechanism	Role of Internal Audit
Predictive analytics (student performance)	Model bias; inaccurate predictions	Model validation; data quality controls	Verification of model reliability and fairness
Learning analytics systems	Data privacy violations	Data governance policies; GDPR compliance	Audit of data protection and access controls
Automated assessment (NLP)	Algorithmic bias; unfair grading	Benchmarking; human oversight mechanisms	Evaluation of assessment transparency and consistency
Recommender systems	Over-personalization; reduced academic autonomy	Algorithm transparency; control of recommendation logic	Assessment of alignment with educational objectives
AI-based DSS	Over-reliance on automated decisions	Hybrid decision-making frameworks	Testing effectiveness of decision support systems
RPA in accreditation	Errors in automated reporting	Control procedures; exception monitoring	Audit of compliance and reporting accuracy
Sentiment analysis tools	Misinterpretation of feedback	Calibration of models; validation datasets	Verification of analytical accuracy and reliability
Continuous monitoring systems	Systemic errors; false alerts	Threshold tuning; anomaly validation	Continuous auditing of system performance

Source: (ISO, 2018; ISO, 2019)

of technical controls (model validation, anomaly detection, data governance) and managerial instruments (hybrid decision-making, transparency requirements, benchmarking practices). In this context, internal audit plays a pivotal role as an independent assurance function, ensuring the reliability, fairness, and compliance of AI-based processes. Its transformation into a continuous, analytics-driven mechanism enables not only ex post verification but also real-time monitoring of system performance and risk exposure.

Overall, the integration of AI into QMS necessitates the formation of a comprehensive control environment that supports trust, accountability, and resilience of HEIs in a digitalized landscape.

In this context, the next stage of the study focuses on the role of AI-driven IT business processes in enabling the transition toward circular economy models in HEIs, with particular attention to resource optimization, waste reduction, and sustainable value creation.

5. Circular Economy Development through AI-Driven IT Business Processes (the case of HEIs)

HEIs should be considered as complex socio-economic ecosystems with significant potential for the implementation of circular economy principles. Their multifunctional nature – combining educational, research, organizational, and infrastructural activities – creates favorable conditions for integrating sustainable practices across multiple levels of operation. In this context, HEIs are capable of simultaneously acting as generators of knowledge, platforms for innovation, and drivers of behavioral change, shaping new value systems and competencies aligned with sustainable development and circular production models.

The implementation of circular economy approaches within HEIs encompasses key areas such as waste management, campus sustainability, digitalization of administrative processes, research and innovation activities, and active engagement of stakeholders. Through these dimensions, universities can reduce resource consumption, optimize operational processes, and promote environmentally responsible practices both internally and externally.

At the same time, despite the substantial transformative potential of HEIs, the implementation of circular economy principles often remains fragmented and lacks a unified, system-based approach. This creates the need for integrating advanced technologies, particularly AI, as a tool for ensuring coherence, scalability, and analytical support of circular initiatives.

In this context, the following analysis focuses on the role of AI-driven IT business processes as a key mechanism for enabling circular economy development within HEIs.

To substantiate the practical implementation of circular economy principles within HEIs, it is essential to examine how AI-driven IT business processes contribute to resource optimization, waste reduction, and sustainable value creation. This approach allows for linking technological capabilities with circular economy principles, demonstrating how digital transformation supports environmental and operational efficiency at the institutional level. In this context, Table 5 systematizes the key IT business processes in HEIs, corresponding AI applications, and their functional effects and expected outcomes within the framework of the circular economy.

Table 5
AI-Driven IT Business Processes for Circular Economy in HEIs

IT Business Process in HEIs	AI Application	Circular Economy Principle	Functional Effect	Expected Outcome
E-learning systems	Adaptive learning, content optimization	Reduce (resource use)	Reduction of physical materials consumption	Lower environmental footprint
Campus energy management	AI-based energy optimization	Reduce / Optimize	Smart energy consumption	Energy efficiency and cost reduction
Waste management systems	AI-based sorting and monitoring	Recycle	Automated waste classification	Increased recycling rates
Resource allocation (facilities)	Optimization algorithms	Reuse / Optimize	Efficient use of classrooms and infrastructure	Reduced idle capacity
Digital administration	RPA, document automation	Reduce	Paperless processes	Operational efficiency and sustainability
Research & innovation processes	AI analytics for circular solutions	Redesign	Development of circular innovations	Knowledge-based circular economy

Source: developed by authors

The analysis of Table 5 confirms that AI-driven IT business processes act as a critical enabler of circular economy transformation in HEIs. The integration of adaptive learning systems, energy optimization tools, automated waste management solutions, and resource allocation algorithms ensures a significant reduction in resource consumption and operational inefficiencies. In particular, AI facilitates the transition toward paperless environments, smart energy use, and optimized infrastructure utilization, directly contributing to environmental sustainability and cost efficiency.

Moreover, the application of AI in research and innovation processes strengthens the capacity of HEIs to generate circular solutions and knowledge-based innovations. This not only enhances institutional sustainability but also extends the impact of universities beyond their internal operations, positioning them as active contributors to broader circular economy ecosystems.

Overall, the integration of AI into IT business processes provides a systemic foundation for embedding circular economy principles into the operational and strategic activities of HEIs, ensuring their long-term resilience, sustainability, and competitiveness.

6. Findings

The findings of the study confirm that the integration of AI into quality management systems of HEIs constitutes a systemic transformation rather than a partial technological enhancement. AI-driven approaches enable the transition from traditional, compliance-oriented quality management models to adaptive, data-driven, and predictive systems that are capable of continuous improvement and real-time responsiveness. This shift significantly enhances the effectiveness of decision-making processes, strengthens internal control mechanisms, and supports the implementation of risk-oriented management within HEIs.

The results demonstrate that AI technologies are functionally embedded across all key elements of quality management systems, including planning, assurance, control, improvement, and internal audit. Their application ensures the automation of routine procedures, increases objectivity and transparency, and enables early identification of deviations and risks. At the same time, the incorporation of continuous auditing and advanced analytics contributes to the formation of a reliable control environment, enhancing institutional accountability and governance quality.

Furthermore, the study establishes that AI-driven IT business processes serve as a critical enabler of circular economy development within HEIs. Through resource optimization, digitalization of administrative functions, smart energy management, and waste reduction, AI supports the implementation of sustainable practices and improves operational efficiency. In this context, HEIs are positioned as active agents of sustainable transformation, capable of generating innovative solutions and promoting circular economy principles.

Overall, the findings confirm the feasibility and strategic importance of developing an integrated analytical framework that combines AI, quality management systems, and IT business processes, ensuring long-term sustainability, resilience, and competitiveness of HEIs.

7. Conclusions

The integration of AI into quality management systems of HEIs reflects a fundamental shift toward the formation of adaptive, analytically supported, and system-oriented governance models. The conceptualization of AI as a structural element of QMS ensures coherence between institutional processes, strategic objectives, and external requirements, including sustainability and circular economy principles. The developed analytical framework provides a unified basis for aligning

AI technologies with IT business processes and quality management components, enabling the formation of an integrated management architecture within HEIs.

The transformation of quality management systems is characterized by the transition to continuous monitoring, predictive analytics, and automated control mechanisms, which collectively enhance institutional flexibility and responsiveness to dynamic environmental conditions. The incorporation of a risk-oriented approach and an internal audit dimension ensures the reliability, transparency, and controllability of AI-driven processes, forming a stable foundation for long-term institutional development.

The systemic integration of AI also contributes to embedding circular economy principles into the operational and strategic activities of HEIs, facilitating resource optimization, reduction of environmental impact, and the development of innovation-oriented ecosystems. This positions HEIs as key actors in sustainable transformation and knowledge-based economic development.

Further research should focus on the empirical validation of the proposed analytical framework within specific HEIs, including the development of quantitative indicators for assessing the effectiveness of AI-driven quality management systems. Particular attention should be given to the integration of AI with ESG indicators and reporting standards, as well as to the development of methodological approaches for evaluating the impact of AI on educational quality and sustainable development outcomes. Additionally, further studies should deepen the risk-oriented approach by addressing ethical aspects of AI implementation, including algorithmic transparency, data protection, and the assurance of academic integrity.

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