

THE ROLE OF ARTIFICIAL INTELLIGENCE IN ASSESSING THE REVENUE MANAGEMENT EFFECTIVENESS

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Abstract: *This paper develops and evaluates an organizational mechanism for AI-enhanced revenue management (RM) in hospitality that combines monitoring and analytics, machine-learning-driven dynamic pricing, advanced AI segmentation, strategic partnerships, and staff motivation programs. The main objective is to propose and validate a dual-metric assessment framework that enables holistic optimization of RM subsystems by linking quantitative financial, HR, and resource indicators with complementary qualitative marketing, environmental, and digital metrics. Methodologically, the study uses mixed methods: quantitative modelling and metric definition (CostPar—average cost per occupied room, Occ—average occupancy rate, staff labor productivity, and Market Penetration Index) are paired with qualitative socio-economic evaluation (ecological activity cost coefficient and digitalization cost coefficient); these metrics are tested through scenario analyses and comparative assessment to demonstrate their integrative capability. Results show that (1) combining AI-driven pricing and segmentation with real-time monitoring improves revenue capture and occupancy efficiency; (2) the dual-metric framework more accurately reflects subsystem performance than single-dimension measures, revealing trade-offs between short-term financial gains and longer-term marketing, ecological, and digital investments; and (3) specific metrics (CostPar, Occ, staff productivity, MPI, ecological and digital cost coefficients) provide actionable insights for targeted interventions. The discussion highlights practical implications: hospitality managers should adopt the proposed framework to balance revenue maximization with sustainability and digital transformation goals; AI tools must be embedded within organizational processes and staff incentive systems; and multi-indicator evaluation is necessary for justified, generalized RM assessments. The framework supports data-driven decision-making and offers a roadmap for implementing AI-enabled, sustainable RM in hospitality.*

Keywords: *Revenue management, artificial intelligence, revenue management effectiveness, digital revenue management technologies, synchronization coefficient.*

INTRODUCTION

The significant impact of methodological approach to evaluating revenue management metrics based on a balanced scorecard framework, especially for AI-enhanced hospitality operations small and independent facilities, due to limited economic and investment opportunities, deteriorating competitiveness and revenue shortfalls. To define the key concepts of revenue management effectiveness, a structured methodology for their assessment has been proposed. In the hotel industry, revenue management (RM) increasingly utilises artificial intelligence-based tools—such as dynamic pricing using machine learning, advanced market segmentation via AI algorithms, and real-time monitoring of key performance indicators—with

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the aim of boosting revenue generation and operational efficiency. However, the prevailing methodological approaches to evaluating RM effectiveness remain predominantly financial and one-dimensional, focusing on individual metrics such as revenue per available room or average occupancy rate. This narrow focus creates a critical gap in the literature: there is a limited number of empirical and theoretical recommendations on how to evaluate RM subsystems holistically, considering the trade-offs between short-term financial benefits and long-term investments in marketing, sustainability, digitalisation and human capital. For small and independent hotels — constrained by limited economic and investment capacity, reduced competitiveness and a persistent revenue shortfall — this gap is particularly problematic, as single-metric evaluation can lead to the misallocation of scarce resources and undermine the strategic value of AI implementation.

Theoretical concepts from the fields of management and organisational sciences offer promising avenues, but they have not yet been systematically integrated into the methodology for evaluating resource management. The Balanced Scorecard (Kaplan & Norton, 1996) rethinks performance evaluation by going beyond financial results to include aspects related to customers, internal processes and learning/development, yet its application to AI-based resource management in the hospitality sector remains under-researched. The theory of dynamic capabilities (Teece, 2007) emphasises the capabilities of perception, utilisation and reconfiguration, which are critical for adaptive resilience, but empirical studies linking AI-based resource management to the development of dynamic capabilities in small hotels are few and far between. Similarly, the theory of external control of organizations (Pfeffer & Salancik, 2015) and agency theory (Meckling & Jensen, 1976) suggest that multi-dimensional metrics are necessary for strategic prioritisation and mitigating myopic optimisation; yet the literature on revenue management in the hospitality sector has not empirically confirmed how balanced multi-indicator frameworks improve the consistency of decisions or the accuracy of their implementation under resource constraints.

Assessing the performance of subsystems — financial, human resources, resource management, marketing, environmental and digital — using a standardised scale allows for the consolidation and systematisation of data, revealing patterns in resource utilisation and the dynamics of indicators as factors influencing revenue across different hotel categories (e.g., 3*, 4*, 5*).

The development of integration profiles for indicators, derived from the financial reports of Ukrainian hotels and expert surveys, highlights imbalances in 3-star hotels, indicating a dispersion of resources and vulnerability to market risks.

The assessment process consists of three stages: scaling qualitative/quantitative indicators, calculating integrated indices of subsystems, and constructing integration profiles to track interdependencies and forecast adjustments.

From an organisational perspective, such balanced integration facilitates the coordination of revenue centres, targeted budgeting and resource optimisation; from a methodological perspective, it enables the identification of system characteristics, cause-and-effect relationships and the monitoring of imbalances for proactive revenue forecasting.

AI-driven digital metrics act as catalysts for balance in the digital economy, identifying revenue reserves through intelligent data integration.

Efficiency concepts focus on maximising revenue by utilising resource potential whilst minimising financial risks, relying on booking systems that track key performance indicators (KPIs). The evaluation process involves three stages: scaling qualitative/quantitative metrics, computing subsystem integral indices, and constructing integration profiles to track interdependencies and forecast adjustments. In organizational terms, this balanced integration fosters revenue center coordination, targeted budgeting, and resource optimization;

methodologically, it yields temporal system characteristics, causal links, and imbalance monitoring for proactive revenue forecasting.

Digital metrics, powered by AI, serve as catalysts for balance in the digital economy by identifying revenue reserves through intelligent data integration in different spheres (Mikava & Mamulaidze, 2023; Weis & Vukasović, 2025).

Effectiveness concepts emphasize maximizing income via resource potential while minimizing financial risks, drawing from booking systems tracking core KPIs like Occupancy Rate, RevPAR, ADR, MPI, and extended ones (HRPar, ECPAr, DCPAr).

Strategic partnerships, tech access, and stakeholder feedback enhance external cores (marketing, ecological, digital), though challenges persist in metric misalignment and skill gaps—addressed via corporate/regional outsourcing for scalable, objective gains.

The methodology sequences analytical steps to optimize resource use, demand satisfaction, cost control, and dynamic pricing in AI-driven revenue management. for AI-enhanced hospitality operations. It defines key concepts of revenue management effectiveness and proposes a structured methodology for their assessment.

Evaluation of subsystem metrics—financial, HR, resource, marketing, environmental, and digital—using a unified scale enables generalization and systematization, revealing resource utilization patterns and metric dynamics as revenue drivers across hotel categories.

In organizational terms, this balanced integration fosters revenue center coordination, targeted budgeting, and resource optimization; methodologically, it yields temporal system characteristics, causal links, and imbalance monitoring for proactive revenue forecasting.

The main objective of the article is to develop and empirically test a methodology that combines quantitative financial, human resources and resource indicators (CostPar, Occ, staff productivity, MPI) with complementary qualitative marketing, environmental and digital indicators (environmental activity cost ratio, digitalisation cost ratio) to ensure the holistic optimisation of resource management subsystems using artificial intelligence. Using a mixed-methods approach — quantitative modelling of indicators combined with qualitative socio-economic assessment and scenario-based comparative testing — the aim is to investigate how this system improves revenue generation, identifies trade-offs in performance and helps allocate the limited resources of hotel operators.

METHOD

I.1. Sample and population

Data collection and interviews with hotel managers took place between February and May 2024 and covered the data collection period from 2012 to 2023, using the CAWI (computer-assisted web interview) method. Hotel managers from Ukraine were invited to participate in the survey (senior management and/or heads of departments – sales, marketing and reservations).

I.2. Data Collection Process and Methods

To operationalize the methodological approach for evaluating revenue management metrics, detailed justification focuses on metric content within the context of its empirical testing across a sample of hotels varying by star category. Hotel category serves as the primary grouping criterion, as survey results indicate that revenue management systems—whether comprehensive or partial—are predominantly implemented in 3* and higher establishments, making it a stable, time-invariant indicator immune to inflation and foundational to all financial and operational metrics.

Sample selection criteria included observation volume (economic analyses often rely on small samples of 5–30 units); location; ownership form; enterprise size; and market

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saturation. The diversity of economic phenomena, research objectives, and heterogeneous data necessitated grouping techniques, forming homogeneous clusters from the statistical population based on typical features. Group homogeneity was assessed via variation coefficients ranging from 41–42%, confirming sufficient uniformity for analyzing factor impacts on hotel operations and development. Hotels were then stratified into three groups by category: Group 1 (5* hotels, n=3); Group 2 (4* hotels, n=9); Group 3 (3* hotels, n=6). Groupings ensured comparable economic conditions, competitive markets, locations, customer bases, service levels, categories, and service volumes, with "proximity" or "similarity" across attributes as the homogeneity benchmark.

RESULTS

In accordance with the established methodological framework for the use of artificial intelligence in revenue management, we propose the following three-stage sequence for its application (Boiko et al., 2025), assessment of qualitative and quantitative metrics based on a standardised scale; determination and calculation of an integrated metric indicator for each subsystem; construction of revenue management metric integration profiles.

This is the general logic for evaluating revenue management metrics based on a balanced approach, which can be used in practical settings, albeit with some refinements, as the academic literature presents evaluation methods only for financial revenue management metrics, namely indicators of gross revenue, pre-tax profit and cost reduction, which have a quantitative representation (Remy et al., 2023; Boo et al., 2025; Ismail et al., 2002). At the same time, experts from the American consulting firm Allied Market Research, in their report 'Revenue Management: Global Opportunity Analysis and Industry Forecast 2023–2032' have identified the need to consider human resources and marketing metrics that determine the strategic ability to maximise revenue (Schwartz et al., 2017).

A revenue management methodology based on a balanced approach utilising artificial intelligence at the methodological, instrumental and organisational levels establishes a systematic foundation for the optimal combination of operational and strategic objectives based on quantitative and qualitative metrics, as outlined in the report by the consulting firm Allied Market Research. The quantitative indicators of the 'financial subsystem' metric reflect the status and effectiveness of financial resources in terms of financial stability, liquidity, profitability and financial performance, and their impact on revenue management in the hospitality industry (Kazmi, 2026; Ballani, 2025; Salami, 2025; Vasconcelos, 2025).

For the quantitative indicators under the 'human resources subsystem' metric, it is proposed to use those that enable the assessment of how the effectiveness of human resources policy influences revenue generation (Kumar et al., 2024; Sun, 2025; Vasconcelos, 2025).

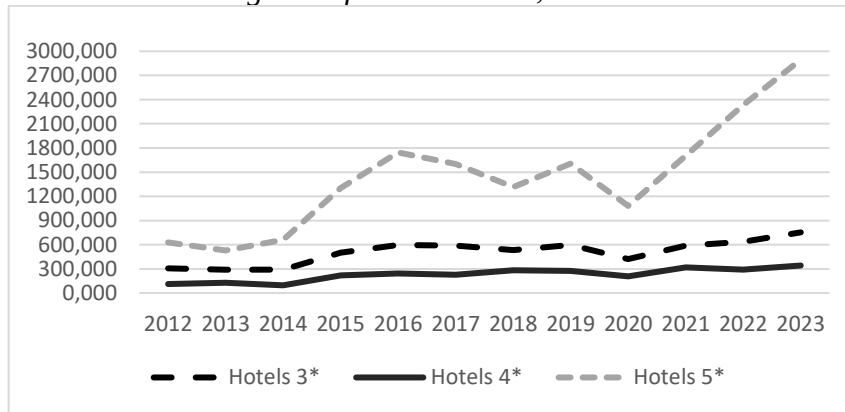
The resource metric is formed by quantitative indicators that are important for assessing the effectiveness of operational activities as a whole and serve as the basis for decision-making regarding room inventory management, business diversification, service expansion, prioritisation of revenue centres, and the use of chatbots (Hossain, 2026; Kühr, 2024; Kilanko, 2023; Coman et al., 2023). The marketing subsystem of revenue management comprises a set of quantitative (monitoring and measuring the financial results of marketing campaigns and operational efficiency) and qualitative indicators, (which form the basis for monitoring consumer behaviour, activities related to distribution channels, and customer satisfaction levels) (Karunakaran et al., 2024; Kavita et al., 2024; Smrutirekha et al., 2022).

The rationale we have established for incorporating quantitative and qualitative indicators of environmental metrics is aimed at enhancing the environmental sustainability and energy efficiency of a hospitality enterprise, which, through cost optimisation and the identification of new revenue streams, will enable the expansion of the target segment and the

maximisation of revenue. The scope of digital metrics comprises both quantitative indicators (the financial efficiency of digitalisation and the optimisation of cost structures) and qualitative indicators (improved service quality, accelerated operational and business processes, and the capabilities of artificial intelligence).

To assess financial metrics, the ‘average cost per room (CostPar)’ indicator was analysed; its trend indicates growth, with five-star hotels dominating the average figure. The rise in hotel costs is a consequence of rising utility and energy prices, increases in the minimum wage and staff social security costs; growing competition in the hospitality sector is forcing businesses to invest in service improvements as a key factor influencing their financial performance. Average costs per room rose steadily between 2012 and 2023 (Figure 1).

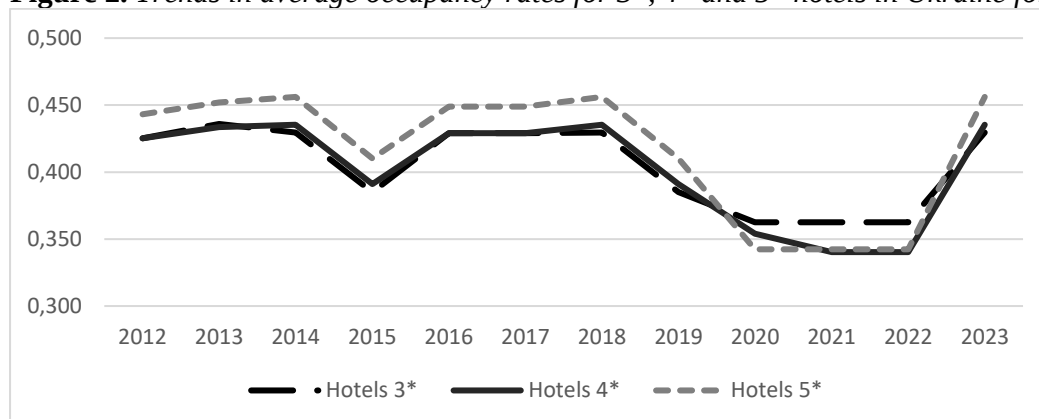
Figure 1. Trends in average cost per room in 3*, 4* and 5* hotels in Ukraine for 2012–2023



Source: Design of authors

In order to assess resource metrics, the quantitative indicator ‘average occupancy rate (Occ)’ was analysed; its trend shows significant fluctuations, particularly due to the impact of the war and economic factors. In 2021, the average occupancy rate for hotels in Ukraine stood at around 37%, which is an improvement compared to 34% in 2020, but still below pre-war levels (approximately 44% in 2013). Following the start of the full-scale invasion in February 2022, many hotels closed or experienced very low occupancy rates (10–20%). However, a gradual recovery began as early as September 2022, and occupancy began to rise thanks to the hosting of events and the accommodation of small groups. In 2023, the average occupancy rate in Ukraine’s hotel market reached 45.19%, which is 10.45% higher than the previous year (Figure 2).

Figure 2. Trends in average occupancy rates for 3*, 4* and 5* hotels in Ukraine for 2012–2023

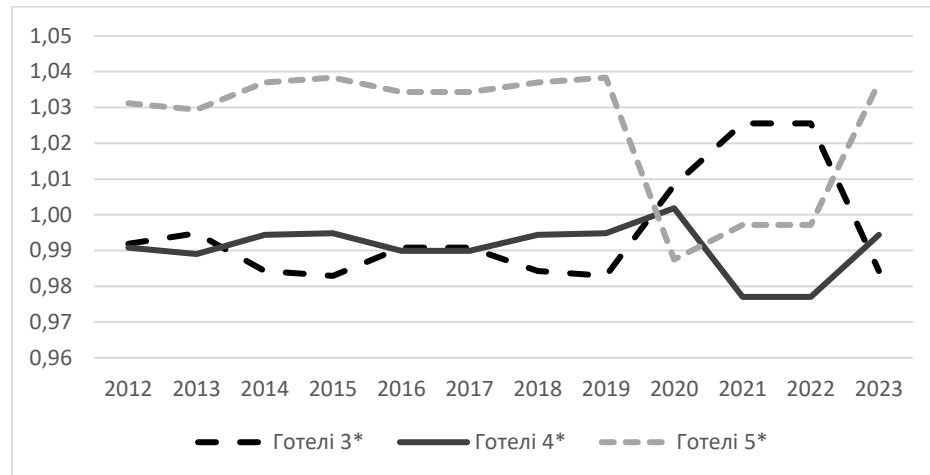


Source: Design of authors

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To assess marketing metrics, the 'market share (MPI)' indicator was examined; trends in this indicator suggest that the war and economic changes have significantly affected all categories of the hotel industry. Three-star hotels are facing the greatest difficulties due to a decline in demand, whilst four-star and five-star hotels continue to adapt to the new conditions and are showing signs of recovery (Figure 3).

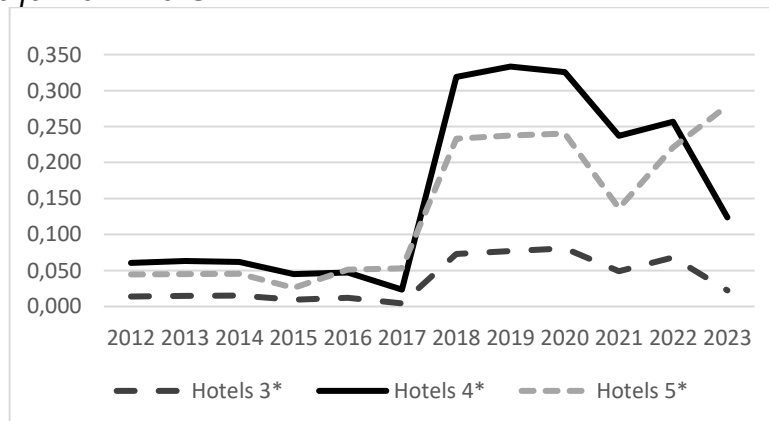
Figure 3. Dynamics of the average market share of 3*, 4* and 5* hotels in Ukraine for 2012–2023



Source: Design of authors

To assess staffing metrics, the 'staff productivity' indicator for three-star, four-star and five-star hotels in Ukraine was analysed from the start of martial law in 2022, reflecting the significant impact of military operations on the hotel industry (Figure 4).

Figure 4. Dynamics of the labour productivity indicator for staff at 3*, 4* and 5* hotels in Ukraine for 2012–2023



Source: Design of authors

Due to the war, many hotels suffered significant staff losses. Some staff left their jobs, migrated or joined the armed forces. This led to staff reductions, which had a negative impact on overall labour productivity. The remaining staff often face the need to perform additional duties due to staff shortages. This can lead to an increased workload for employees and a decline in service quality.

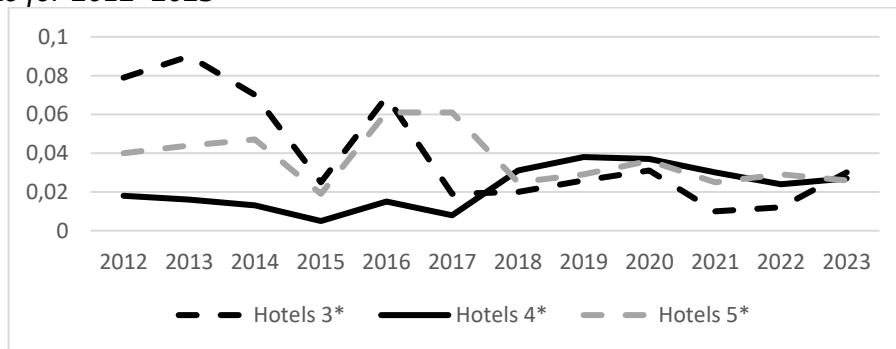
Hotels are being forced to adapt their processes to the new reality, including the introduction of safety measures for staff and guests. This may involve training staff on how to respond to emergencies and providing shelters in the event of air raid alerts.

In three-star hotels, productivity has fallen due to lower levels of automation and limited resources. These establishments often target the budget segment, making them more vulnerable to changes in demand. Four-star hotels have suffered fewer productivity losses compared to three-star hotels thanks to greater resources and better organisation. They have been able to adapt more quickly to the new conditions. Five-star hotels demonstrated the greatest resilience thanks to their high level of service and investment in staff training. They were able to retain some of their skilled staff and adapt their work to the new conditions.

To assess environmental metrics, the ‘environmental expenditure ratio’ was analysed, the dynamics of which indicate an environmental focus and activities aimed at reducing their negative impact on the environment by reducing water and energy consumption through the introduction of energy-saving technologies and the use of alternative energy sources, which is more characteristic of five-star hotels. The dynamics of these costs reflect the overall stability and specific characteristics of each hotel category (Figure 5). To assess digital metrics, the ‘digitalisation cost ratio’ of three-star, four-star and five-star hotels in Ukraine was analysed. The trend in this indicator reflects the overall digitalisation of each hotel category (Figure 6).

As a result of hostilities, hotel property in Ukraine was destroyed or damaged, leading to the loss of infrastructure and resources necessary for operations.

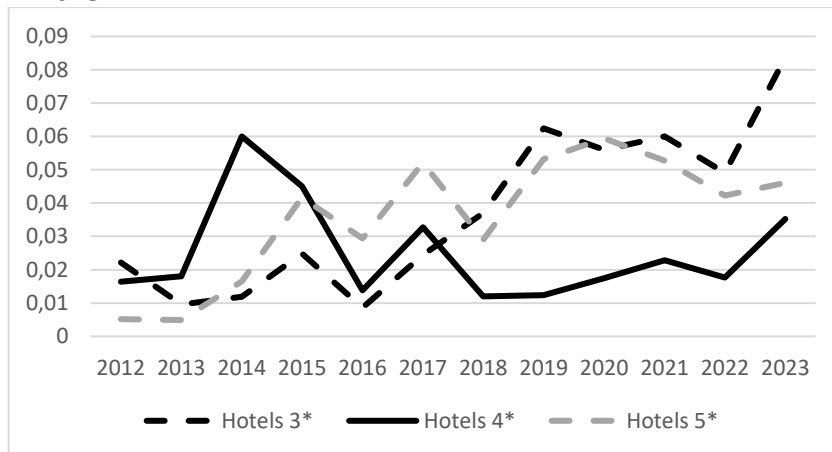
Figure 5. Trends in the cost ratio for environmental activities of 3*, 4* and 5* hotels in Ukraine for 2012–2023



Source: Design of authors

This applies to all categories of hotels, but those located in active combat zones have been hit hardest. Due to the war, the number of tourists has fallen, leading to a reduction in revenue and, consequently, in resources for the digitalisation of hotels. Hotels were forced to invest in security measures, such as shelters and warning systems, which further reduced opportunities for digitalisation.

Figure 6. Dynamics of the digitalisation expenditure ratio for 3*, 4* and 5* hotels in Ukraine for 2012–2023



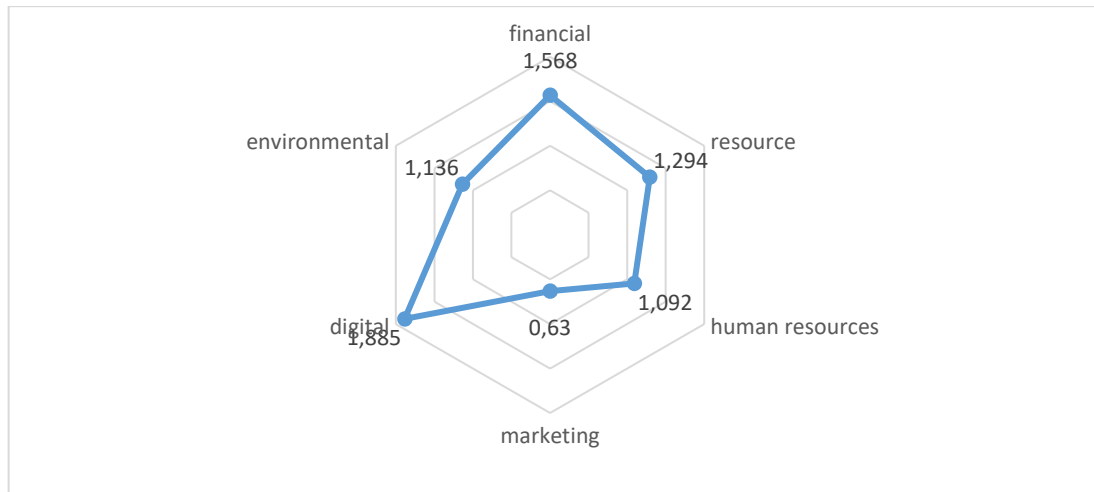
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To compare and standardise the quantitative and qualitative revenue metrics to uniform values, growth rates reflecting their average annual growth rates were used. It has been established that the metrics of different subsystems are interrelated; their assessment and monitoring have made it possible to track how changes in one subsystem can affect other subsystems.

To visualise the results, integration profiles of revenue management metrics have been modelled. (Figure 7-9).

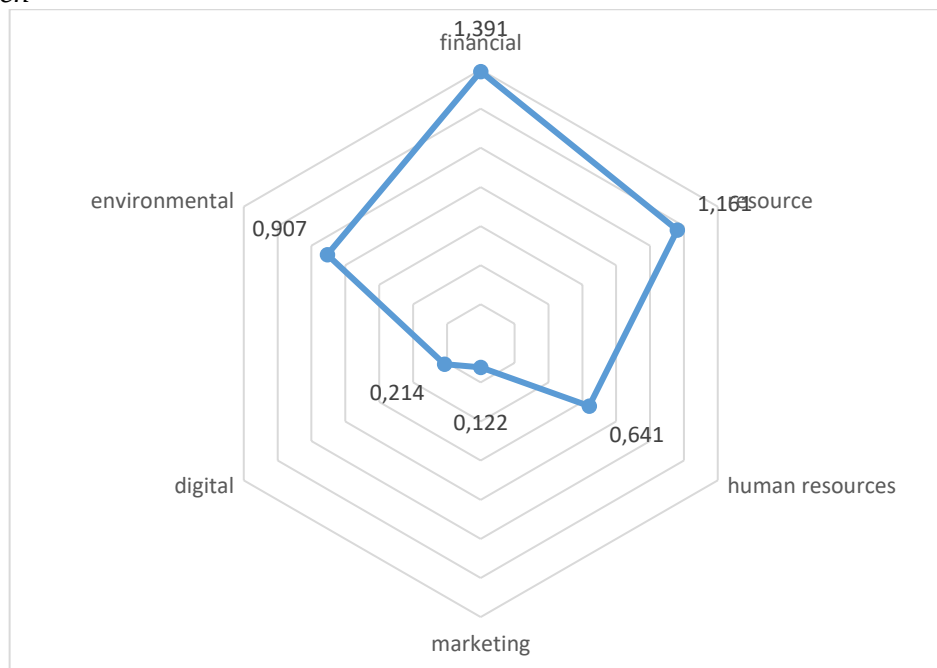
Figure 7. Profile of revenue management metric integration in 3* hotels based on a balanced approach



Source: compiled by the authors using data from the financial statements of Ukrainian hotel enterprises and the results of an expert survey of a sample

In 3* hotels, an imbalance has been identified between digital and marketing revenue management metrics (the range between metric values is 1.26).

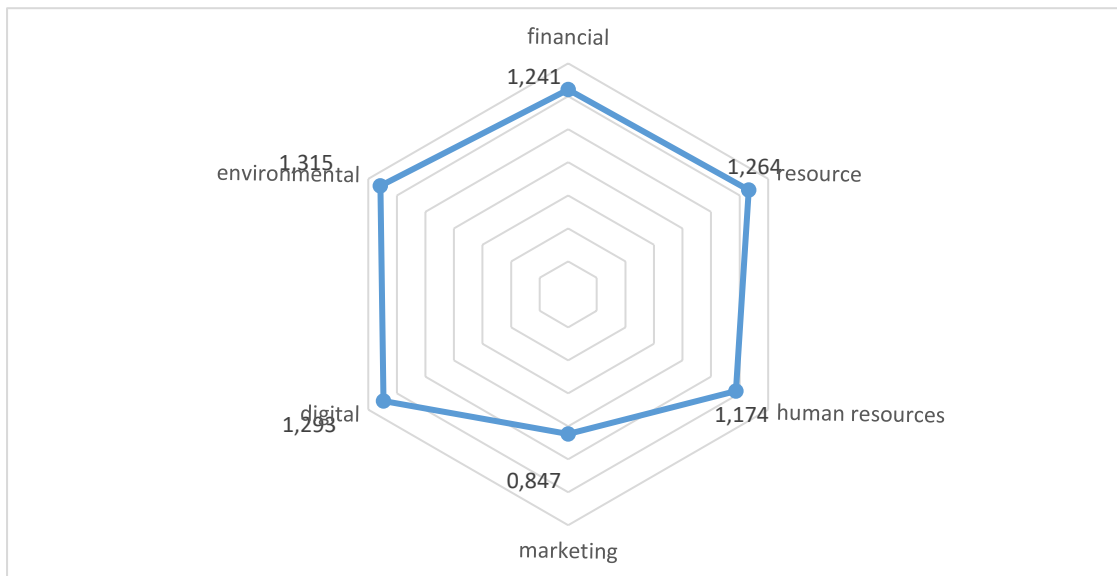
Figure 8. Profile of revenue management metric integration in 4* hotels based on a balanced approach



Source: compiled by the authors using data from the financial statements of Ukrainian hotel enterprises and the results of an expert survey of a sample

In 4* hotels, an imbalance has been identified between financial and marketing metrics (range – 1.27); and between digital and human resources metrics (ranges – 1.18 and 0.75 respectively). A high range between revenue management metrics indicates a dissipation of resources and serves as an indicator of increased risks in the event of market fluctuations; it points to problems in revenue planning and the development of staff digital competencies, leading to stagnation and a decline in revenue in the future.

Figure 9. Profile of the integration of revenue management metrics for 5* hotels based on a balanced approach



Source: compiled by the authors using data from the financial statements of Ukrainian hotel enterprises and the results of an expert survey of a sample

The congruence of revenue management metrics in 5-star hotels (low range from 0 to 0.59) indicates their positive impact on the flexibility and adaptability of revenue management. The balance of revenue management metrics across subsystems facilitates the achievement of revenue management objectives, as adherence to revenue management principles ensures that focusing solely on maximising short-term profits during peak seasons does not compromise the achievement of long-term financial stability. It is precisely the integration and balance of metrics in 5-star hotels that positively influence the flexibility and adaptability of revenue management tools.

Thus, the proposed methodological approach to evaluating revenue management metrics based on a balanced approach makes it possible, depending on the category of the hotel enterprise, to determine the utilisation of resource potential in terms of the dynamics of changes and the consistency of metrics as a source of revenue generation.

The evaluation of revenue management subsystem metrics for hotel enterprises based on a balanced approach, followed by their generalisation and systematisation, has made it possible, depending on the category of the hotel enterprise, to determine the utilisation and deployment of resource potential in relation to the dynamics of change and the alignment of metrics as a source of revenue generation.

DISCUSSION/CONCLUSION

In order to assess the impact of artificial intelligence in hotel revenue management, the quantitative metrics of the ‘financial subsystem’, ‘human resources subsystem’ and ‘resource

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subsystem' have been characterised and assigned threshold values, along with the quantitative and qualitative metrics of the 'digital subsystem', 'marketing subsystem' and 'environmental subsystem' in the context of testing a methodological approach to evaluating revenue management metrics based on a sample comprising hotels of various categories. To evaluate the metrics, the indicators of three-star, four-star and five-star hotels in Ukraine were analysed.

It has been established that Ukrainian hotels exhibit an imbalance between digital and marketing, financial and marketing, and digital and HR revenue management metrics, indicating a significant increase in risks in the event of market fluctuations, which necessitates prompt adjustments to revenue planning. A methodology has been developed for assessing revenue management metrics by subsystems of balance, with a graphical representation of the integration profile in the form of a hexagon, which has been tested in the hotel industry and enables the congruence of metrics to be assessed and areas for revenue maximisation and cost optimisation to be identified. The balance of revenue management metrics across subsystems in 5-star hotels has been identified, which facilitates the achievement of revenue management objectives due to compliance with revenue management principles, the flexibility and adaptability of revenue management tools, and the integration of business processes.

This study analyzed existing approaches to evaluating revenue management (RM) metrics and concluded that a justified, generalized assessment can only be achieved through a comprehensive, multi-indicator approach. The analysis encompassed six key metrics: (1) average cost per occupied room (CostPar) – a financial metric; (2) average occupancy rate (Occ) – a resource metric; (3) staff labor productivity – an HR metric; (4) market penetration index (MPI) – a marketing metric; (5) ecological activity cost coefficient – an environmental metric; and (6) digitalization cost coefficient – a digital metric. These metrics were evaluated using data from three-star, four-star, and five-star hotels in Ukraine. The findings reveal a significant imbalance in Ukrainian hotels between digital and marketing metrics, financial and marketing metrics, and digital and HR metrics. This disbalance indicates substantial vulnerability to market fluctuations and underscores the need for timely adjustments in revenue planning.

To address these challenges, we developed a methodology for evaluating RM metrics across balanced subsystems, featuring a graphical representation of the integration profile in the form of a hexagon. This methodology was applied to hotel enterprises and enables the assessment of metric congruence, identification of areas for revenue maximization, and optimization of costs. The analysis revealed that RM metrics are balanced across subsystems in five-star hotels, which facilitates the achievement of RM goals. This balance is attributable to adherence to RM principles, flexibility and adaptability of RM tools, and the integration of business processes. These findings align with balanced scorecard theory, which posits that multi-dimensional performance measurement enhances strategic alignment and decision coherence.

The conceptual framework of RM effectiveness defines a hotel enterprise's capacity to maximize revenue while optimally utilizing its resource potential and minimizing financial risks. We identified and analyzed outcome indicators generated by the enterprise's resource potential as concepts of the internal and external core of hotel effectiveness. Graphically modeled curves depict the relationship between hotel revenue and average room rate (ARI), MPI, investments in personnel development, and investments in digital, energy-saving, and ecological technologies. The study demonstrates that an adequate representation of RM effectiveness concepts is achieved through the enterprise's resource capabilities, which create an internal leverage effect for revenue formation and growth. This finding supports dynamic capabilities theory, suggesting that resource-based capabilities enable hotels to sense market opportunities, seize revenue potentials, and reconfigure operations for sustained performance.

These results carry important implications for small and independent hospitality operators facing investment constraints. The hexagon-based balanced assessment framework provides a practical tool for identifying metric imbalances, prioritizing investments, and aligning AI-driven RM tools with organizational capabilities. For Ukrainian hotels – particularly those in the three- and four-star categories – the identified imbalances suggest that operational adjustments in digitalization, marketing, and HR development are necessary to mitigate market volatility risks. The demonstrated effectiveness in five-star hotels offers a benchmark for best practices, indicating that integrated business processes and flexible RM toolkits are critical for achieving RM objectives. Future research should examine how these metric imbalances evolve under different market conditions and test the hexagon methodology in international hospitality contexts.

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