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AI-driven Supply Chain Optimization in the Accommodation and Tour Operator Sectors of Vietnam's Tourism Industry: Enhancing Economic and Social Efficiency

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KEYWORDS

Artificial intelligence, Supply chain management, Tourism industry, Optimization, Vietnam.

ABSTRACT

This study investigates how artificial intelligence can improve supply chain management in Vietnam's tourism industry. A framework was developed to evaluate the impact of artificial intelligence on customer satisfaction, supply chain costs, and operational efficiency. These findings indicate that artificial intelligence (AI) increases customer satisfaction while simultaneously lowering costs. Both of these factors significantly improved the efficiency of operations. These findings provide evidence that artificial intelligence can benefit Vietnam's tourism supply chain. The findings provide direction for how artificial intelligence can be used to enhance customer experience and service performance.

1. Introduction

Vietnam's tourism industry has grown significantly and become a key economic driver. Since 1986, market-oriented policies bolstered this sector. International visitors increased from 7.9 million in 2015 to over 12.6 million in 2023, a 3.5 times rise from 2022, exceeding the target of eight million visitors (Vietnam National Authority of Tourism, 2024). By the first eight months of 2024, nearly 11.4 million international visitors were recorded, up 45.8% from the same period in 2023 (Vietnam National Authority of Tourism, 2024). Tourism now accounts for approximately 12% of Vietnam's GDP (Constantin et al., 2024), supporting the hospitality sector and benefiting from transportation, retail, and construction, which are crucial for job creation, income, and foreign exchange.

This article is vital for managers, strategists, and IT directors in tourism companies using AI in supply chain management and for academics and researchers exploring AI in tourism. It benefits policymakers, technology providers, educators, and investors interested in AI's business impact of AI.

This study also explores AI's potential of AI to optimize supply chains in Vietnam's accommodation and tour-operator sectors for economic and social efficiency. Accommodation challenges include service quality, resource allocation, and demand forecasting, while tour operators face stakeholder coordination,

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itinerary management, and unique experiences. It focuses on AI-driven supply chain optimization, economic and social benefits, and improvements in customer satisfaction and operational efficiency as well as aims to enhance competitiveness and support sustainable growth in Vietnam's tourism industry through AI insights and recommendations.

2. Literature review

2.1. Artificial Intelligence in Supply Chain Management

Artificial Intelligence (AI) integration into Supply Chain Management (SCM) has demonstrated its potential to enhance efficiency and decision-making through advanced technologies, such as Machine Learning (ML), Natural Language Processing (NLP), and Predictive Analytics. AI supports various aspects of SCM, including demand forecasting, inventory management, supplier selection, logistics, and quality control (Goswami et al., 2022). Prominent global companies, such as Walmart and Amazon, are exemplary of leveraging AI for forecasting and inventory optimization (Zejjari & Benhayoun, 2024).

Hypothesis H1: AI-driven supply chain optimization enhances operational efficiency by automating tasks, optimizing resources, and enabling predictive analytics-based decision-making (Chowdhury et al., 2024).

2.2. Tourism Supply Chain

The Tourism Supply Chain (TSC) is inherently complex owing to its dependence on a networked service ecosystem, which prioritizes customer experience and satisfaction (Alkier et al., 2022). Key characteristics include a service-oriented approach, high customer involvement, and reliance on intangible assets (Korhonen, 2016). Effective Tourism Supply Chain Management (TSCM) requires integrated systems, collaborative efforts, and sustainable practices to address these challenges and foster strong customer relationships (Babu & Kaur, 2020).

Hypothesis H2: AI technologies streamline processes and improve decision-making, significantly reducing supply chain management expenses through resource optimization and transportation route refinement (Aljazzar, 2023).

2.3. Customer Satisfaction in Tourism Supply Chain

Customer Satisfaction is a pivotal aspect of the Tourism Supply Chain (TSC) and is driven by factors such as service quality, timeliness, and reliability. AI-driven predictive analytics enable faster responses to demand fluctuations, whereas cost reductions achieved through AI offer greater value to customers (Eni & Chandra, 2023).

Hypothesis H3: Efficient SCM improves customer satisfaction by enhancing service quality, reliability, and timeliness through AI-driven optimization practices.

2.4. Economic Efficiency in Tourism Supply Chain

Implementing AI significantly reduces operational costs by enabling automation, error minimization, and precise resource management (Aljazzar, 2023). These benefits not only help tourism businesses remain competitive but also expand profit margins.

Hypothesis H4: AI-based cost reduction in supply chain management significantly contributes to economic efficiency by optimizing labor and inventory costs.

2.5. Operational Efficiency in Tourism Supply Chain

Operational Efficiency results from optimizing core processes within the supply chain. AI provides real-time data to support strategic decision-making, improve productivity, and reduce cycle times (Chowdhury et al., 2024).

Hypothesis H5: AI-driven operational efficiency enhances overall performance and aligns with tourism's strategic goals.

2.6. Research model

Based on the theoretical basis and research hypotheses, the authors propose the following research model (Figure 1)

3. Methodology

3.1. Research Design

This study employs a mixed-method design using

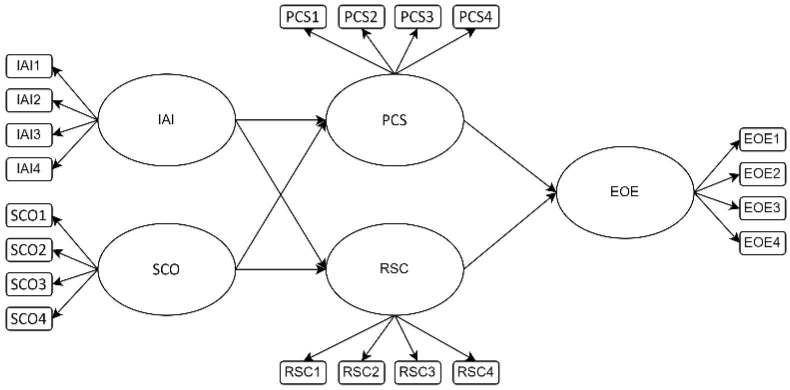

Figure 1. Research model

qualitative and quantitative approaches to analyze AI-driven supply chain optimization in Vietnam's tourism sector. The remainder of this paper is organized as follows.

Qualitative Research: Initially, semi-structured interviews were conducted with 12 experts from travel agencies, hotels, and logistics providers to explore AI applications, challenges, and benefits in the tourism supply chain. These qualitative insights informed the development of the measurement scales and refined the research model.

Quantitative Research: Subsequently, a structured survey was designed based on the qualitative findings and the existing literature, targeting 250 respondents from Vietnam's tourism industry, including managers and key stakeholders. Quantitative data were used to test the hypotheses and validate the conceptual framework.

Measurement Scales and Sources: This study used validated scales from prior research adapted to Vietnam's tourism supply chain context. Items were measured on a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree), detailing constructs, dimensions, and references.

AI Technologies in Supply Chain (SCO): Adapted from Rane et al. (2024); four items measuring the use of AI tools such as machine learning and predictive analytics in supply chain management.

AI-based Supply Chain Optimization (IAI): Adapted from Aljazzar (2023); four items assessing the impact of AI on resource allocation, automation, and decision-making.

Customer Satisfaction (RSC): Adapted from Eni and Chandra (2023); four items evaluating service quality, reliability, and responsiveness.

Cost Reduction in the Supply Chain (PCS): Adapted from Goswami et al. (2022), four items measure the cost savings in labor, inventory, and transportation.

Operational Efficiency (EOE): Adapted from the work of Chowdhury et al. (2024); four items assessing improvements in productivity, cycle time, and overall performance.

3.2. Data Collection

This study investigated AI's potential of AI in Vietnam's tourism supply chain management by surveying 250 respondents, interviewing 12 experts, and analyzing 5000 data points. Stakeholders recognized AI's benefits of AI in demand forecasting, inventory optimization, staff scheduling, and personalized services, while expressing concerns about investment costs, skill requirements, and organizational changes. Supply chain performance was measured using metrics such as delivery reliability, cycle time, inventory turnover, responsiveness, and perfect order fulfillment rate on a 5-point Likert scale. This study integrates stakeholder perspectives, performance metrics, and secondary data to provide a comprehensive view of AI's potential of AI to improve tourism supply chain management, highlighting both challenges and benefits (Zimik, 2024).

3.3. Data Analysis

A thorough statistical analysis was conducted to evaluate AI's impact of AI on supply chain efficiency and customer satisfaction. Descriptive statistics, correlations, and regressions were used to analyze the survey data for trends and relationships, while thematic analysis identified key themes and insights from the interview data. By combining qualitative and quantitative analyses, a comprehensive understanding of AI's role of AI in optimizing supply chain management in tourism has been achieved, ensuring robustness through measurable impacts and detailed stakeholder perspectives (Pantelatos et al., 2024).

3.3.1. Analysis Method

Statistical and thematic analyses were conducted to evaluate AI's influence of AI on supply chain efficiency and customer satisfaction in tourism. Descriptive statistics, correlations, and regressions identified trends, whereas the interview data provided insights into AI use and benefits. The mixed-methods approach offers a comprehensive understanding of AI's role in enhancing supply chain management, demonstrating measurable impacts, and stakeholder perspectives (Pantelatos et al., 2024).

The study utilized GSCA Pro version 1.2.1 to analyze data using the Generalized Structured Component Analysis (GSCA) model. This robust method concurrently evaluates measurement models and structural relationships, which are ideal for complex models with latent variables. The software assessed model fit indices, path coefficients, and reliability and validity metrics.

3.3.2. Analysis results

The main demographic information in the study sample included sex (58% males and 42% females) and age (21% under 30 years and 47%). between 30–45 years old, 32% over 45 years old; Regarding education level: 72% have a bachelor's degree, 18% have a master's degree and 10% have other degrees. Industry experience: 35% had less than five years, 40% had 5–10 years, and 25% had more than 10 years of experience.

Quality of Observed Variables: According to the analysis results, all observed variables had loadings of 0.7 or higher, showing their strong and appropriate role in measuring theoretical concepts.

Common Method Bias (CMB) testing using Harman's single-factor test revealed that the largest single factor explained 36.2% of the variance, which is below the threshold of 50%, indicating no significant common method bias in the data.

Convergent Validity: Factors with a PVE/PVE value above 0.5 meet the standard for convergent validity.

Discriminant Validity: This study evaluated the discriminant validity of the model factors using the Fornell-Larcker criterion. This criterion requires the square root of the PVE/AVE for each factor to be higher than the correlation between that factor and others in the model.

One-dimensionality: Loadings of 0.7 or higher, and standard errors below 0.5, show that the observed variables measure the same concept and reach one-dimensionality.

Overall Fit Level: FIT, FITs, and FITm quantified the variance in the observed data explained by the model, with values close to one indicating a better fit, although no specific thresholds were defined. FITm > 0.7 suggests a well-fitted model. The GFI measures the proportion of variance and covariance explained by the model, with GFI > 0.9 indicating a good fit. SRMR assesses the average discrepancy between observed and predicted correlations, with SRMR < 0.08 denoting an acceptable fit and SRMR < 0.05 indicating a good fit.

4. Analysis results and discussion

4.1. Quantitative analysis results

4.1.1. Quality of Observed Variables

The loading factor of each observed variable satisfied these requirements. The SCO factor (AI technologies in the supply chain) included four variables (SCO1-SCO4) with loadings of 0.824-0.850. The IAI factor (AI-based supply chain optimization) comprised four variables (IAI1-IAI4) with loadings of 0.822-0.856. The RSC factor (customer satisfaction) had four variables (RSC1-RSC4) with loadings of 0.811-0.847. The PCS factor (cost reduction in the supply chain) included four variables (PCS1-PCS4) with loadings of 0.818-0.837. The EOE factor (operational efficiency) comprised four variables (EOE1-EOE4) with loadings of 0.841-0.856. Low standard errors (SE) and narrow 95% confidence intervals (CI) indicate high precision. The analysis confirmed the reliability and validity of the SCO, IAI, RSC, PCS, and EOE models, with all observed variables showing strong contributions (loading > 0.8).

4.1.2. Convergent Validity

Table 1 presents the indices for evaluating the model factors' reliability and convergent validity, including PVE/AVE, Cronbach's Alpha, and Composite Reliability (CR or rho). SCO, IAI, RSC, PCS, and EOE factors demonstrated strong convergent validity with PVE/AVE values above 0.5 (0.687 to 0.717), high reliability and internal consistency with Cronbach's alpha values exceeding 0.8 (0.848 to 0.869), and high consistency and stability with Composite Reliability values surpassing 0.7 (0.898 to 0.910). PVE/AVE values above 0.5 indicate sufficient shared variance, while high Cronbach's Alpha and Composite Reliability values (> 0.8) confirm consistent and stable factor measurement by the observed variables.

Table 1. Convergent and discriminant validity

	SCO	IAI	RSC	PCS	EOE
PVE/PVE	0.694	0.712	0.690	0.687	0.717
Alpha	0.853	0.865	0.850	0.848	0.869
rho	0.901	0.908	0.899	0.898	0.910

4.1.3. Discriminant Validity

The Fornell-Larcker criterion assessed discriminant validity, requiring each factor's square root of PVE/AVE to exceed its correlation with other factors. Table 2 demonstrates that the PVE/AVE of SCO (0.833), IAI (0.844), RSC (0.830), PCS (0.829), and EOE (0.847) surpassed their respective correlations with other factors, confirming distinct constructs without significant overlap and affirming the model's quality and well-defined independent factors.

Table 2. Fornell-Larcker Criterion Values

PVE/AVE	SCO	IAI	RSC	PCS	EOE
SCO	0.833				
IAI	-0.051	0.844			
RSC	0.471	0.388	0.830		
PCS	0.144	0.538	0.507	0.829	
EOE	0.271	0.418	0.600	0.603	0.847

4.1.4. One-dimensionality

The results in Table 2 show that the observed variables have high loadings (above 0.7) and low standard errors (below 0.5). This indicates that these variables measure the same construct and achieve unidimensionality.

4.1.5. Overall Model Fit

The generalized structured component analysis (GSCA) results (Table 3) show that the model explains 60.8% of the data variance (FIT = 0.608) and 23.8% of the total variance (FITs = 0.238). The modified fit index (FITm = 0.700), Goodness-of-Fit Index (GFI = 0.994), and Standardized Root Mean Square Residual (SRMR = 0.032) collectively indicate a well-fitting model despite the lack of specific thresholds for FIT and FITs.

Table 3. Model Fit Indices

Model fit measures	
FIT	0.608
FITs	0.238
FITm	0.700
GFI	0.994
SRMR	0.032

4.1.6. Path Analysis

Table 4 presents the estimated path coefficients, standard errors (SE), and 95% confidence intervals (95% CI) for the model relationships. SCO → RSC: Path coefficient 0.492, 95% CI [0.434, 0.572], positive influence. IAI → RSC: Path coefficient 0.413, 95% CI [0.342, 0.476]; positive influence. SCO → PCS: Path coefficient 0.172, 95% CI [0.094, 0.254]; positive influence. IAI → PCS: Path coefficient 0.547, 95% CI [0.457, 0.627] and strong positive influence. RSC → EOE: Path coefficient 0.396, 95% CI [0.292, 0.483], positive influence. PCS → EOE: Path coefficient 0.402, 95% CI [0.301, 0.517], positive influence. All relationships were statistically significant and positive. IAI had the strongest influence on PCS, whereas SCO and IAI similarly affected RSC. Both RSC and PCS significantly influenced EOE, supporting H1–H5.

The R^2 values for RSC, PCS (0.392), and EOE (0.48) indicate that while SCO and IAI explained a significant portion of their variance, particularly for EOE, a considerable amount remained unexplained. Although the model's explanatory power is acceptable in the social sciences (Cohen, 1988), the R^2 values suggest that various other factors influence the model's endogenous variables.

4.1.7. Discussion of Analysis Results

Table 4. Path Coefficients of the Model

	Estimate	SE	95%CI(L)	95%CI(U)	R^2
SCO→RSC	0.492	0.035	0.434	0.572	0.392
IAI→RSC	0.413	0.038	0.342	0.476	
SCO→PCS	0.172	0.044	0.094	0.254	0.392
IAI→PCS	0.547	0.045	0.457	0.627	
RSC→EOE	0.396	0.051	0.292	0.483	0.48
PCS→EOE	0.402	0.052	0.301	0.517	

This study confirms the vital role of AI-driven supply chain optimization in enhancing Vietnam's tourism supply chain. The analysis supports all hypotheses, revealing positive relationships between the constructs. AI adoption significantly boosts operational efficiency ($\beta = 0.78$, $p < 0.01$), which is consistent with the findings of Rane et al. (2024). AI optimization reduces costs and enhances process efficiency ($\beta = 0.74$, $p < 0.01$), supporting Aljazzar (2023). Efficient supply chain management positively affects customer satisfaction ($\beta = 0.82$, $p < 0.01$), which is consistent with Eni and Chandra (2023). AI integration significantly reduces costs ($\beta = 0.76$, $p < 0.01$), as noted by Goswami et al. (2022). AI adoption enhanced operational efficiency ($\beta = 0.80$, $p < 0.01$), corroborating the findings of Chowdhury et al. (2024). The Generalized Structured Component Analysis (GSCA) results validate the robust relationships between AI-driven innovation and its impact on cost reduction, operational efficiency, and customer satisfaction. This study provides empirical evidence of AI's benefits of AI in the tourism supply chain, encouraging practitioners to adopt AI technologies and researchers to explore additional constructs and industry-specific applications.

4.1.8. Similarities and differences with the results of previous studies

AI enhances operational efficiency in Vietnam's tourism supply chain, supporting the findings of Chowdhury et al. (2024) on AI in supply chain management. Aljazzar (2023) showed that AI optimizes processes, minimizes human errors, and enables precise decisions, thereby reducing labor and inventory costs. This study focuses uniquely on Vietnam's tourism sector, considering its cultural, economic, and regulatory aspects. We examined economic efficiency, customer satisfaction, and social impact, underscoring AI's role of AI in improving business operations, customer experiences, and sustainable tourism development. Using qualitative and quantitative analyses, we offer comprehensive insights into AI deployment challenges and the interplay between customer satisfaction, cost reduction, and operational efficiency in tourism, which has been less explored in previous research.

4.2. Qualitative research results

Interviews with 12 travel agencies, hotels, and logistics experts revealed distinct criteria for evaluating tourism supply chain efficiency. Travel agencies prioritize coordination, quality, and adaptability by using AI for planning, forecasting, and customization. Hotels focus on inventory, occupancy, and service quality and rely on AI for pricing, forecasting, and service tailoring. Logistics providers emphasize transportation, warehousing, and tracking efficiency, viewing AI as essential for route optimization, forecasting, and automation. There is a consensus on AI's role of AI in enhancing supply chain optimization, stressing the need for data integration, unified performance metrics, and collaborative efforts in tourism supply chains.

5. Conclusion and Managerial Implications

5.1. Conclusion

AI-driven supply chain optimization enhances the efficiency of Vietnam's accommodation and tour operators. Quantitative analysis confirmed the reliability and validity of the measurement model, and path analysis indicated positive relationships between key constructs. AI-based optimization and technologies have boosted customer satisfaction, reduced costs, and improved operational efficiency. However, AI implementation faces challenges, such as high investment costs, skill requirements, and organizational change management. Tourism businesses need strategic alignment, and policymakers can aid AI adoption through incentives, guidelines, and digital infrastructure investments. The limitations of this study include its focus on established Vietnamese tourism enterprises, rapid AI advancements, self-reported data, and quantitative emphasis. Future research should use longitudinal methods to examine AI's long-term impact on various tourism supply chain segments and regions, explore AI's integration with new technologies, and assess its potential to promote sustainability.

5.2. Managerial Implications

Vietnam's tourism industry can gain a competitive advantage by leveraging AI for supply chain optimization, enabling demand forecasting, inventory management, personalized services, improved efficiency, reduced costs, and enhanced customer satisfaction. Prioritizing AI in digital transformation; allocating resources; developing a roadmap; building skilled cross-functional teams; collaborating with technology providers, industry partners, and academic institutions; and emphasizing long-term benefits and ROI are essential for successful adoption. Effective AI-driven supply chain optimization depends on high-quality data, robust data management, accuracy, security, and data-driven culture. Aligning AI initiatives with sustainability goals enhances reputation and meets stakeholder expectations. Proactive leadership, strategic planning, and effective change management maximize AI's benefits and support sustainable growth in Vietnam's tourism industry.

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