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The managerial impact of adopting artificial intelligence technologies in supply chain management, in companies from Romania

- SUMMARY -

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1. Introduction and Research Objectives

In the context of rapid technological transformation and increasing global supply chain complexity, the integration of Artificial Intelligence (AI) technologies has emerged as a strategic priority for organizations seeking resilience, agility, and data-driven decision-making. Despite the accelerating interest in digital tools across the logistics and operations sectors, AI adoption remains uneven, particularly in transitional economies such as Romania. Barriers include not only technological limitations but also organizational readiness, data governance maturity, and cultural resistance to change. This doctoral research addresses a critical gap in the understanding of AI adoption behavior within Romanian supply chains, focusing on both technical and organizational-environmental drivers.

Building on the Technology Acceptance Model 2 (TAM2), the study proposes a refined framework that incorporates variables such as Perceived Ease of Use (PEOU), Perceived Usefulness (PU), Organizational Readiness (OR), Data Ethics & Quality (DEQ), Behavioral Intention (BI), and Organizational Impact (OI). The central research objective is to empirically validate this adapted model in the Romanian supply chain management context, through a mixed-method approach combining qualitative insight and quantitative structural equation modeling. In doing so, the study aims to illuminate how AI adoption is shaped not merely by technological features but also by internal organizational capabilities and ethical trust in data systems. The ultimate goal is to inform both scholarly understanding and practical strategies for more effective, human-aligned digital transformation.

2. Literature Review Overview

The adoption of Artificial Intelligence (AI) in supply chain management (SCM) represents one of the most transformative developments of the past decade. AI technologies such as machine learning, predictive analytics, and autonomous decision systems have the potential to enhance forecasting accuracy, optimize logistics and inventory flows, and improve real-time responsiveness across the value chain. However, AI adoption is not purely a technical process; it is strongly influenced by organizational, strategic, and ethical dimensions. This realization has led researchers to re-evaluate classical adoption models to better reflect the complex, dynamic realities of digital transformation in the supply chain domain.

A foundational framework in understanding technology adoption is the Technology Acceptance Model (TAM), originally developed by Davis (1989) and later expanded into TAM2 by Venkatesh and Davis (2000). These models emphasize two core determinants of adoption behavior: Perceived Ease of Use (PEOU) and Perceived Usefulness (PU). Over time, TAM2 introduced social and cognitive influences, yet retained the essential logic that user perceptions govern intention to adopt and use technology. Despite its empirical strength, TAM2 has been criticized for its limited consideration of contextual factors—particularly those related to organizational capabilities and data governance. This limitation is especially relevant in emerging economies where institutional maturity, leadership support, and digital infrastructures vary significantly.

To respond to this gap, recent literature on digital transformation in SCM has advocated for broader conceptualizations that account for human, organizational, and ethical readiness. Concepts such as Organizational Readiness (OR) have gained traction, referring to the degree to which companies possess the infrastructure, culture, and strategic alignment necessary to implement advanced technologies. Studies by Warner and Wäger (2019), George et al. (2014), and others suggest that without adequate readiness, even the most promising technologies fail to achieve operational impact. In parallel, Data Ethics and Quality (DEQ) has emerged as a critical construct in AI adoption studies, linking user trust to issues of transparency, data integrity, algorithmic bias, and regulatory compliance. Research by Matin et al. (2023) and Töytäri et al. (2017) highlights that perceived ethical risks associated with AI can undermine both user confidence and organizational commitment to digital initiatives.

In the Romanian context, the literature remains scarce and fragmented, with little empirical work exploring how local firms approach AI integration in supply chain operations. While national digitalization strategies exist, they are not always reflected in the actual practices of supply chain actors. Many firms face structural constraints, including outdated systems, skills gaps, and hesitation toward algorithmic decision-making. Against this backdrop, a nuanced framework that combines TAM2 with constructs like OR and DEQ offers a more realistic lens for understanding AI adoption behavior in Romanian SCM environments.

The literature review thus justifies the construction of an adapted TAM2 model, where PEOU influences PU; OR and DEQ shape both PU and BI; and PU and BI, in turn, drive Organizational Impact (OI). This structure reflects not only individual perceptions but also the enabling or

constraining role of organizational and ethical infrastructures. The theoretical grounding for the research is therefore both evolutionary—extending TAM2—and contextual, targeting the unique features of a digitalizing supply chain sector within a transitional economy.

3. Research Methodology

This study adopts a mixed-methods research design to investigate the factors influencing the adoption of Artificial Intelligence (AI) technologies in supply chain management (SCM) in Romania. The methodological approach is grounded in the belief that understanding both the subjective reasoning of professionals and the structural relationships between adoption variables requires the integration of qualitative and quantitative data. The philosophical orientation aligns with a pragmatic paradigm, valuing methodological pluralism and practical insight over rigid epistemological boundaries. This structure supports a comprehensive exploration of how AI adoption unfolds across both perception-based and organizational dimensions.

The research was structured in two sequential phases. The first phase was qualitative and exploratory, designed to uncover real-world perspectives on AI integration from professionals operating in Romanian supply chains. A focus group methodology was used, involving participants from various sectors such as logistics, procurement, IT management, and manufacturing operations. The focus group protocol was developed using constructs from the extended Technology Acceptance Model 2 (TAM2), enriched with themes such as data ethics, organizational readiness, and user trust. Discussions were recorded, transcribed, and analyzed thematically. The key outcome of this phase was a confirmation of construct relevance and the identification of specific barriers and enablers to AI adoption in the Romanian context, particularly around governance, infrastructure, and strategic commitment.

The second phase was quantitative and confirmatory, aimed at empirically testing the adapted TAM2 model using structural equation modeling (SEM) in SmartPLS. A bilingual questionnaire (Romanian and English) was developed based on both the validated literature and insights from the focus group. The instrument consisted of six multi-item constructs: Perceived Ease of Use (PEOU), Perceived Usefulness (PU), Organizational Readiness (OR), Data Ethics & Quality (DEQ), Behavioral Intention (BI), and Organizational Impact (OI). Responses were collected from

120 qualified SCM professionals across Romania using a combination of purposive and snowball sampling. The final sample included decision-makers, operational managers, IT specialists, and AI implementation professionals with direct knowledge of SCM processes and digital transformation projects.

To validate the measurement model, internal consistency reliability, convergent validity, and discriminant validity were assessed using Cronbach's Alpha, Composite Reliability, Average Variance Extracted (AVE), Fornell-Larcker criteria, and HTMT ratios. The structural model was evaluated using bootstrapping with 5,000 resamples to estimate path coefficients, significance levels, and model fit indices, including R^2, f^2, Q^2, and SRMR. The model testing process was conducted in two iterations: the first based on the original theoretical structure and a second, final version refined based on empirical findings and theoretical coherence.

This methodologically rigorous approach allowed for the contextual validation of TAM2 while accommodating Romania's unique economic and organizational environment. The adapted model not only preserved the core relationships from TAM2 but also tested new hypotheses around the roles of OR and DEQ—constructs that proved to be empirically significant and contextually appropriate. By combining qualitative insight with quantitative precision, the methodology enabled the study to deliver both theoretical clarity and practical relevance.

4. Key Findings, Conclusions, and Future Research Directions

The empirical analysis confirmed the robustness of the adapted TAM2 model in explaining AI adoption behavior in Romanian supply chains. Based on structural equation modeling results from SmartPLS, the validated model demonstrated both statistical reliability and theoretical consistency. The most significant finding was the strength of Behavioral Intention (BI) in predicting Organizational Impact (OI), highlighting the central role of user intention as a mediator between perception and operational transformation. BI itself was primarily influenced by Organizational Readiness (OR) and Data Ethics & Quality (DEQ), while the effect of Perceived Usefulness (PU) on BI was found to be marginal. This suggests that in Romanian SCM contexts, adoption is shaped more by internal capability and ethical trust than by perceived functional advantage alone.

Perceived Ease of Use (PEOU) had a strong and statistically significant effect on Perceived Usefulness (PU), reaffirming the classical TAM logic. Organizational Readiness also had an indirect influence on BI through its enhancement of PU. DEQ emerged as a dual driver, affecting both PU and BI directly, which underlines the importance of trustworthy, transparent, and well-governed data systems in enabling AI adoption. The model's explanatory power was validated through high R^2 values for BI (0.644) and OI (0.504), while f^2 effect sizes confirmed the relative strength of OR and DEQ in shaping intention. The model fit was deemed excellent, with an SRMR of 0.054, and Q^2 values indicated strong predictive relevance for endogenous variables.

These findings carry several implications. Theoretically, the study extends TAM2 by contextualizing it for a transitional economy where organizational maturity and ethical infrastructure are not to be assumed. It demonstrates that classical models must be adapted to account for digital readiness and data governance, especially in domains such as SCM where the consequences of poor implementation can be operationally disruptive. Practically, the research offers Romanian organizations a validated framework to assess their AI adoption potential, guiding them to focus not only on software and algorithms but also on staff training, ethical protocols, and internal alignment.

The study also offers a strong argument for the inclusion of Data Ethics and Quality as a core construct in future technology adoption research. As AI systems become more autonomous and opaque, user trust will increasingly depend on how organizations manage and communicate about data. Ethical AI is not a peripheral concern; it is integral to sustained implementation and stakeholder acceptance.

While the research achieved its objectives, several limitations remain. The sample was limited to Romanian professionals and may not generalize to other transitional or developed economies. The cross-sectional design offers a snapshot rather than a dynamic view of adoption behavior over time. Additionally, although the mixed-methods design added depth, future studies could benefit from longitudinal data or cross-country comparisons.

Looking ahead, future research could explore the interaction between AI adoption and supply chain resilience, particularly in post-crisis settings. Expanding the model to include cultural dimensions, sectoral differences, or external institutional pressures could yield deeper insight into what drives

or hinders digital transformation. Comparative studies between Romania and other Central and Eastern European economies could also help refine regional adoption models and policies.

In conclusion, this thesis contributes to a more grounded and context-aware understanding of how AI is adopted in supply chain environments. By validating a TAM2-based model enriched with organizational and ethical dimensions, the research helps bridge the gap between abstract theory and operational reality. It supports a more nuanced view of digital transformation—one that prioritizes not only efficiency but also readiness, trust, and long-term strategic integration.