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Factors Affecting the Adoption of Electronic Supply Chain Management in the Zambian Aviation Industry

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Abstract

The dynamic growth of the Zambian aviation industry necessitates enhanced operational efficiency, making the adoption of Electronic Supply Chain Management (e-SCM) crucial for meeting demand and improving performance. Grounded in Rogers' (2003) Diffusion of Innovation (DOI) theory, this study examines the factors influencing e-SCM adoption within Zambia's primary aviation authority, Zambia Airports Corporation Limited (ZACL). Despite the importance of e-SCM, empirical research within this specific context is limited. This study employed a cross-sectional survey design using a quantitative approach, collecting data from 252 ZACL employees through a structured questionnaire. Data was analysed using correlation and multiple regression. The findings revealed that perceived innovation characteristics (β=.682, p< .001) and innovation communication channels (β= .244, p< .001) are significant positive predictors of e-SCM adoption. Conversely, adopter characteristics showed an unexpected significant negative predictive relationship (β= -.145, p< .029). Collectively, these factors explained 52.8% of the variance in e-SCM adoption. The study concludes that while perceived benefits and effective communication are key facilitators, the negative influence of adopter characteristics highlights unique contextual complexities that must be addressed. It is recommended that ZACL management prioritizes initiatives that enhance the perceived advantages of e-SCM and strengthen communication strategies to drive adoption.

Keywords: E-SCM, Technology Adoption, Diffusion of Innovation Theory, Aviation Industry, Perceived Innovation Characteristics, Adopter Characteristics, Zambia

1. Introduction

The aviation industry is a critical driver of the global economy, facilitating international trade, tourism, and connectivity (Samunderu, 2024). In Zambia, the sector is experiencing a period of dynamic growth (ZACL, 2024). Passenger traffic, which grew at a compounded annual rate of approximately 6% in the decade leading up to the COVID-19 pandemic (MTL, 2021), is now rebounding strongly after taking a plunge during the pandemic. ZACL's Q1 2024 performance demonstrates this recovery, with a 119% return to pre-pandemic passenger levels, and some airports, like KKIA, exceeding those levels with a 133% recovery (ZACL, 2024). Similarly, while air cargo saw a pre-pandemic annual average growth of 6.7% (MTL, 2021), it experienced a significant downturn during the pandemic and, despite some recovery, Q1 2024 cargo volumes through ZACL airports were still below 2019 levels (ZACL, 2024). This fluctuating cargo traffic, coupled with the projected growth driven by international trade, e- commerce, and tourism, necessitates efficient and adaptable cargo handling systems. This growth underscores the critical need for improved operational efficiency, a priority explicitly stated in the Ministry of Transport and Logistics' (MTL) aviation strategy for 2022-2026 (MTL, 2021). The adoption of Electronic Supply Chain Management (e-SCM) technologies presents itself as a solution to this issue (Singh, et al., 2020).

E-SCM leverages digital platforms to optimize the flow of information and goods, enabling better coordination, reducing costs, and improving service delivery (Singh, et al., 2020). However, the adoption of such technologies, particularly in developing regions, is often hindered by complex factors including inadequate technological infrastructure, high implementation costs, and organizational resistance to change (Kala, 2023; Jack, et al., 2015; Bwalya, 2010). Consequently, because of these challenges, there is high potential for mismatch between the rapid operational demands of Zambia's growing aviation industry and the capacity of its current supply chain practices. Without the effective adoption of e-SCM, the sector risks operational inefficiencies, increased costs, and a failure to meet strategic national objectives. This could ultimately hinder its modernization and development (MTL, 2021).

Guided by the Diffusion of Innovation (DOI) theory, this study aims to examine the factors affecting the adoption of e-SCM innovations within the Zambian aviation industry, with a specific focus on Zambia Airports Corporation Limited (ZACL). ZACL is a parastatal organization responsible for managing Zambia's four international airports and several aerodromes, making it a central and representative entity for this research.

2. Review of Literature

2.1 Theoretical framework

There are several theories that give insight into the factors that affect the adoption of technologies in any industry. For instance, the 7Ps of Marketing (Kotler & Keller, 2016), traditionally used in product marketing, can offer some insights into how e-SCM systems might be "marketed" within an organization to encourage adoption. For example, considering the "price" (cost) of implementing e-SCM, the "promotion" (communication) strategies used, and the "place" (accessibility) of the technology can be relevant indicators on the factors influencing the adoption of an innovation.

The UTAUT (Venkatesh et al., 2003) and TAM (Davis, 1989) focus primarily on individual user acceptance of technology. TAM emphasizes the perceived usefulness and perceived ease of use of a technology as key determinants of adoption. UTAUT expands on TAM by incorporating additional factors such as performance expectancy, effort expectancy, social influence, and facilitating conditions. While these theories are valuable for understanding individual-level acceptance of technology, they do not fully address the broader organizational and contextual factors that influence e-SCM adoption within a complex industry like aviation. They are useful for understanding the individual's intention to use a technology, but not necessarily the actual adoption within an organization.

In contrast, the Diffusion of Innovation (DoI) Theory (Rogers, 2003), offers a more holistic perspective on the adoption process. It not only considers the characteristics of the innovation (relative advantage, compatibility, complexity, trialability, observability), which are similar to TAM's focus on usefulness and ease of use, but also incorporates adopter characteristics (innovativeness, risk aversion) and the crucial role of communication channels and the social system akin to the 'Promotion' in the 7Ps. In the context of e-SCM adoption within ZACL, understanding how information about e-SCM is disseminated, the influence of industry norms and competitive pressures, and the characteristics of the organization itself are all critical factors that DOI addresses. DOI's focus on the diffusion of innovation, rather than just individual acceptance, makes it particularly relevant to understanding how e-SCM spreads within and across organizations in the aviation industry. It provides a framework for examining the different stages of the adoption process, from initial awareness to eventual implementation.

Therefore, while acknowledging the contributions of the 7Ps, UTAUT, and TAM, this study utilizes the DoI theory as its overarching theoretical framework. DOI's comprehensive approach, encompassing innovation characteristics, adopter attributes, communication channels, and the social system, provides the most relevant and robust lens through which to examine the complex factors influencing e-SCM adoption within the Zambian aviation industry.

2.2 Empirical Review: A Synthesis of Adoption Factors

The adoption of e-SCM is a multifaceted phenomenon influenced by a confluence of factors. The empirical literature, when viewed from both the global perspective and the local perspective, provides evidence of both universal principles and context-specific adoption factors.

The Predominance of Perceived Innovation Characteristics

The cornerstone of DOI theory is that the characteristics of an innovation, as perceived by potential adopters, are powerful determinants of its diffusion. Rogers (2003) identifies five key attributes: relative advantage, compatibility, complexity, trialability, and observability. From a global perspective, the literature provides strong, consistent support for these attributes. A systematic review by Lewis, Mettert, and Lyon (2021) confirms that a clear relative advantage, such as improved efficiency or cost savings, is a primary driver of adoption across industries. This is echoed in studies on cloud-based ERP systems, where enhanced information sharing and integration are cited as strong motivators. Compatibility with existing practices is often an even stronger predictor. For example, a large-scale European study by Zhu (2006) found compatibility to be the most significant factor in successful post-adoption digital transformation, outweighing other variables. Conversely, as shown in a meta-analysis by Lee et al. (2024), perceived complexity acts as a potent barrier, with a strong negative correlation to adoption intention. To mitigate this, trialability and observability become crucial. As Cheng (2010) found, offering software trials significantly increases adoption by reducing uncertainty, while McCann et

al. (2015) demonstrated that innovations with visible results (observability) are more readily adopted.
Transitioning to the African perspective, these core principles are adapted by local realities. As Flight et al. (2011) suggest, the relative importance of these characteristics varies across cultures. For instance, "relative advantage" in Africa is often defined by affordability and accessibility, not just efficiency gains, as noted by Barrett (2022). Compatibility extends beyond workflow integration to include alignment with social and cultural norms, a critical factor identified by Meijer et al. (2015) in the uptake of agroforestry innovations. The barrier of complexity is often magnified by lower average digital literacy in the region, a point supported by a longitudinal survey in South Africa by Bornman (2016). In this context of heightened skepticism, the roles of trialability and observability are amplified, as seen in the successful diffusion of mobile money, where demonstrations and peer observation were key drivers, according to David-West, Oni, & Ashiru (2022). Specific research on e-SCM in Africa is emerging, with studies like Simano (2023) in Ethiopia finding that while basic IT tools are adopted, more complex systems face significant hurdles.
At the local level in Zambia, direct research on e-SCM in the aviation sector is notably absent. However, a synthesis of related technology adoption studies, such as those on mobile money by Munganzi (2024) and Imwiko (2024), reveals a similar emphasis on perceived relative advantage and compatibility, suggesting these DOI constructs are highly relevant in the Zambian context.

The Influence of Key Adopter Characteristics

Beyond the innovation itself, the characteristics of the adopting entity are critical. Globally, a systematic review by Kim and Chung (2017) shows that organizations with a culture of innovation and adaptability are more receptive to new technologies. The critical role of leadership support and top management commitment is a consistent theme, as highlighted by Cardoso & Pedron (2013). Furthermore, as Parasuraman & Colby (2015) note, an organization's technological readiness is essential for successful implementation. This covers both infrastructure and internal expertise.
In the African context, these characteristics are often viewed through the lens of capacity and resource constraints. Studies by Oke et al. (2014) and Barrett (2022) emphasize that limited financial resources and inadequate infrastructure can be significant barriers. The availability of a skilled workforce is another crucial factor; as Mwangi & Kariuki (2015) point out, a shortage of IT professionals can severely hinder adoption efforts across the continent.
This narrative extends to Zambia, where research echoes the broader Sub-Saharan African trends. Studies by Ngwira (2024) show that managerial attitudes and leadership commitment are key predictors of technology adoption. Similarly, research by Kala (2023) highlights that limited access to capital and a shortage of skilled professionals pose significant challenges for Zambian businesses seeking to innovate.

The Role of Innovation Communication Channels

The process of diffusion is fundamentally driven by communication. Globally, empirical studies have long demonstrated that a multi-channel communication approach is most effective. As Lin (2017) explains, mass media channels are useful for creating broad awareness, while interpersonal communication with peers and experts is more influential in shaping perceptions and final adoption decisions.
In Africa, the importance of understanding the local communication landscape is paramount. Research by Mandari, Chong, & Wye (2017) and others shows that formal mass media can be less effective than local networks and community-based communication. As Meijer et al. (2015) found, trust in local leaders and influential community figures can significantly impact adoption decisions, making it crucial to leverage these existing social structures. This principle is also highly applicable to the Zambian context, where community networks and trust in local figures likely play a crucial role in disseminating information and influencing behavior, mirroring the broader trends across the region.

2.3 The Research Gap

This synthesis of the literature, moving from a global to a local focus, reveals a clear and compelling research gap. While the factors influencing technology adoption are well-studied in a general sense, these studies are often generalized across industries, with scant attention paid to the unique operational complexities of the aviation sector. Furthermore, direct empirical research on e-SCM adoption within Zambia's rapidly expanding aviation industry is extremely limited. The absence of literature specifically investigating the impact of perceived innovation characteristics on e-SCM adoption within this high-stakes context is a critical void. This study was therefore designed to bridge this gap by providing a focused empirical investigation of these factors within ZACL.

2.4 Conceptual Framework and Hypotheses

Grounded in DOI theory and informed by the empirical literature, this study's conceptual framework posits that the adoption of e-SCM innovations is influenced by three primary independent variables: perceived innovation characteristics, key adopter characteristics, and innovation communication channels. These three factors are hypothesized to directly influence the dependent variable, the Adoption of e-SCM Innovation.

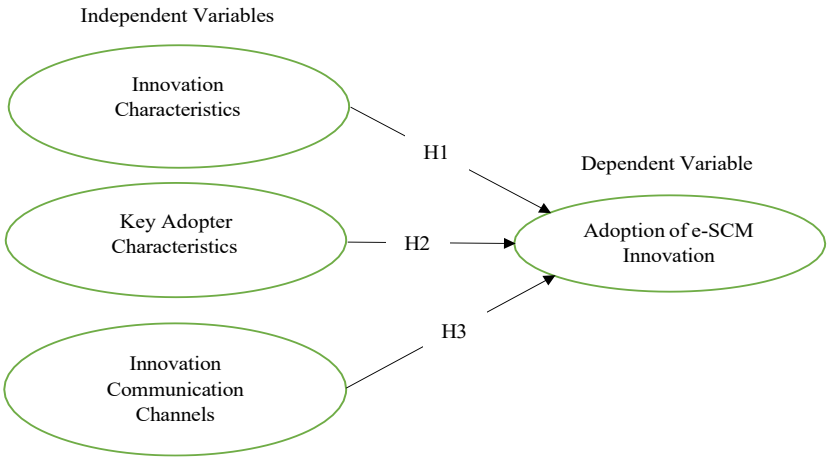

Figure 1: Conceptual Framework

Based on this framework, the following hypotheses were formulated for testing:

$H1_1$: Perceived Innovation Characteristics have a significant relationship with Adoption of e- SCM Innovations in the aviation industry in Zambia.

$H1_0$: Perceived Innovation Characteristics have no significant relationship with Adoption of e- SCM Innovations in the aviation industry in Zambia.

$H2_1$: Key Adopter Characteristics have a significant influence on the Adoption of e-SCM Innovations in the aviation industry in Zambia.

$H2_0$: Key Adopter Characteristics have no significant influence on the Adoption of e-SCM Innovations in the aviation industry in Zambia.

$H3_1$: Innovation Communication Channels have a significant effect on the Adoption of e-SCM Innovations within the aviation industry in Zambia.

$H3_0$: Innovation Communication Channels have no significant influence on the Adoption of e- SCM Innovations within the aviation industry in Zambia.

3. Research Methods

3.1 Research Strategy

This study adopted a positivist research philosophy, which assumes that knowledge can be objectively measured through empirical observation and statistical analysis. In line with this paradigm, a quantitative research approach with a deductive strategy was employed. This involved developing hypotheses based on existing theories, specifically the Diffusion of Innovation (DOI) theory, and testing them with empirical data. A cross-sectional survey research design was utilized, which is suitable for obtaining quantitative data from a large population within a specific timeframe. This design allows for the efficient collection of standardized, self-reported data on perceptions and behaviours related to e-SCM adoption, making it ideal for understanding broad trends within ZACL.

3.2 Population, Sample, and Sampling Technique

The target population for this study comprised all 1,221 employees of the Zambia Airports Corporation Limited (ZACL), as all are involved in or impacted by the organization's supply chain processes. To determine an appropriate sample size, Yamane's formula was used, which yielded a target of 301 participants. Data was successfully collected from 252 employees, representing a high response rate of 83.72%.

To ensure a representative sample from the diverse departments within ZACL, a stratified random sampling technique was employed. This probability sampling method involves dividing the population into homogeneous subgroups, or 'strata' (in this case, by department), and then drawing a random sample from each stratum proportional to its size in the overall population. This method is consistent with best practices in research and allowed for the proportional allocation of the sample across each department, enhancing the generalizability of the findings.

3.3 Data Collection and Analysis

Data was collected using a structured questionnaire as the primary instrument. The questionnaire was divided into sections to capture demographic information, as well as measures for the independent variables (perceived characteristics of e-SCM, adopter characteristics, and innovation communication channels) and the dependent variable (e-SCM innovation adoption). A five-point Likert scale, ranging from "Strongly Disagree" to "Strongly Agree," was used to quantify respondents' perceptions.

Data analysis was conducted using SPSS statistical software. To examine the relationships between variables and test the

study's hypotheses, inferential statistics were employed. Specifically, Pearson correlation analysis was used to assess the strength and direction of the linear relationships between the variables. Meanwhile, multiple regression analysis was used to determine the predictive power of the independent variables on e-SCM adoption.

3.4 Validity, Reliability, and Ethical Considerations

To ensure the validity of the research instrument, this study employed face validity, as recommended by Creswell (2014). This was achieved through a pilot test of the questionnaire with a representative sample of the target population to ensure the questions were clear, relevant, and accurately measured the intended constructs. Reliability, which refers to the consistency of a measurement instrument, is crucial for ensuring reproducible findings. In this study, reliability was assessed by examining the internal consistency of the survey items using Cronbach's alpha within SPSS, ensuring that the items for each construct were consistently measuring the same underlying concept.

The study was conducted in accordance with strict ethical guidelines. Formal ethical clearance was obtained from the Humanities and Social Sciences Research Committee (HHRSC) at the University of Zambia prior to data collection. All participants were fully informed about the study's purpose, and their participation was voluntary. Anonymity and confidentiality of responses were assured, with no identifying information collected. All data were aggregated for analysis, and all referenced works were properly attributed to maintain academic integrity, following the guidelines on research ethics outlined by Creswell (2014).

4 Results and Discussion

4.1 Demographic Profile

The demographic results showed that most respondents (61 percent) fell within the 30–45 age range. This indicates a predominantly mid-career workforce at Zambia Airports Corporation Limited (ZACL). Younger employees (below 30) were underrepresented, while a significant minority were above 45, suggesting a relatively stable workforce with long-term institutional experience. In terms of education, the findings revealed that over 70 percent of respondents possessed at least a bachelor's degree, and 14 percent had postgraduate qualifications. This relatively high educational profile demonstrates that ZACL employs a professional cadre of staff with the academic background necessary to appreciate and engage with advanced technologies. Moreover, more than half of the respondents reported over five years of work experience.

From a theoretical perspective, Rogers' Diffusion of Innovation (DOI) model suggests that individuals with higher education and professional experience often act as early adopters due to greater cognitive readiness and openness to new ideas (Rogers, 2003). However, the Zambian context complicates this assumption. While respondents were well-educated and experienced, this did not translate into straightforward support for adoption. Instead, findings showed a negative influence of adopter characteristics, suggesting that experience may sometimes entrench employees in existing practices, thereby resisting innovation rather than facilitating it. This reflects what Bwalya (2010) described as "path dependence" in African organizations, where institutional inertia slows down technological transformation.

4.2 Validity and Reliability

Instrument reliability was confirmed through Cronbach's Alpha values for all constructs, with scores ranging between .802 and .886, comfortably above the recommended 0.70 threshold (Nunnally, 1978). This suggests that the measures used to capture perceived innovation characteristics, adopter characteristics, communication channels, and adoption outcomes were internally consistent. The validation of these constructs is important because they operationalize key elements of DOI theory. Reliable measurement ensures that the observed relationships reflect true patterns rather than measurement error, thereby lending credibility to the empirical results.

4.3 Correlation Analysis

Pearson correlation coefficients were computed to examine preliminary relationships between the study variables. Table 1 presents the results.

Table 1: Correlation Analysis

Variable	1	2	3	4
1. Perceived Innovation Characteristics	1			
2. Adopter Characteristics	–.221**	1		
3. Communication Channels	.454**	–.188*	1	
4. e-SCM Adoption	.691**	–.276**	.462**	1

The results show that perceived innovation characteristics and communication channels were both strongly and positively correlated with e-SCM adoption ($r = .691$ and $r = .462$, $p < .01$). Conversely, adopter characteristics were negatively correlated with adoption ($r = –.276$, $p < .01$). This outcome underscores a nuanced application of DOI theory. While innovation attributes and communication behave as Rogers (2003) predicts, adopter characteristics deviate from the

theoretical expectation. Normally, variables such as education, skills, and managerial support enhance adoption (Liu & Wu, 2015). Yet, in ZACL, these traits appear to hinder rather than facilitate uptake.

4.4 Assumption Tests

Prior to regression analysis, key assumptions were assessed. Normality of residuals was confirmed through Kolmogorov–Smirnov and Shapiro–Wilk tests ($p > .05$). Multicollinearity was tested using Variance Inflation Factor (VIF) values, which ranged from 1.32 to 2.05, well below the recommended cutoff of 10 (Hair et al., 2010). Homoscedasticity and linearity were confirmed through scatterplots of standardized residuals. Together, these results validated the data for regression analysis.

4.5 Regression Analysis

A multiple regression analysis was conducted to determine the predictive power of perceived innovation characteristics, adopter characteristics, and communication channels on e-SCM adoption. The model was statistically significant, $F(3, 248) = 97.11$, $p < .001$, explaining 52.8 percent of the variance in adoption (Adjusted $R^2 = .528$).

Table 2: Regression Analysis Results

Predictor	B	Std. Error	t	p-value
Perceived Innovation Characteristics	.682	.055	12.45	< .001
Adopter Characteristics	–.145	.066	–2.20	.029
Communication Channels	.244	.056	4.39	< .001
Model Fit	$R^2 = .543$, Adjusted $R^2 = .528$	$F(3, 248) = 97.11$, $p < .001$		

The results indicate that perceived innovation characteristics were the strongest predictor of adoption, followed by communication channels. Unexpectedly, adopter characteristics had a significant negative effect.

4.6 Hypotheses Testing and Theoretical Insights

H1: Perceived innovation characteristics positively influence e-SCM adoption

Supported. Employees who perceived e-SCM as offering relative advantage (improving speed, reducing errors), compatibility (fitting existing work processes), and ease of use were more likely to adopt. This aligns with the Technology Acceptance Model (Venkatesh et al., 2003) and DOI theory, both of which stress perceived usefulness and simplicity as key drivers of uptake.

H2: Adopter characteristics positively influence e-SCM adoption

Not supported. Instead, adopter characteristics showed a negative influence. This finding contradicts Rogers' (2003) assumption that educated, experienced employees act as adoption champions. In the Zambian context, employees with longer tenure or higher qualifications may resist change because they are invested in legacy systems or skeptical of new technologies. This echoes Kala's (2023) finding that in African contexts, professional expertise can sometimes reinforce inertia, especially if individuals perceive innovations as threatening job security or professional autonomy.

H3: Communication channels positively influence e-SCM adoption.

Supported. Effective communication reduced uncertainty and built trust in the system, in line with DOI theory. Peer-to-peer discussions, management briefings, and structured training sessions were critical. This finding resonates with African studies that emphasize the role of advocacy and awareness campaigns in fostering acceptance of digital systems (Akanbi et al., 2020).

4.7 Contradictory Insights and Implications

The most compelling insight from this study lies in the contradiction between theory and context. While DOI predicts that adopter characteristics facilitate innovation uptake, this study found the opposite in Zambia's aviation sector. The contradiction highlights the limits of applying Western-derived theories without contextual adaptation. Education and experience, though beneficial in principle, may in practice reinforce organizational inertia when not accompanied by incentives, adequate ICT training, and cultural transformation.

This suggests that ZACL's challenge is less about the technology itself and more about the human and organizational environment into which it is introduced. Training and awareness alone are insufficient; management must address deeper cultural resistance and align digital adoption with employees' personal and professional incentives. Without tackling these contextual factors, even theoretically sound innovations may face slow or reluctant adoption.

5 Conclusion and Recommendations

5.1 Conclusion

This study examined factors influencing the adoption of Electronic Supply Chain Management (e-SCM) within Zambia Airports Corporation Limited (ZACL), applying Rogers' Diffusion of Innovation (DOI) theory as the guiding framework. Three dimensions were tested: perceived innovation characteristics, adopter characteristics, and communication channels. The findings revealed that perceived innovation characteristics were the strongest driver of adoption. Employees who recognized e-SCM as advantageous, compatible with work processes, and easy to use were significantly more inclined to adopt the system. Communication channels also positively influenced adoption, emphasizing the importance of structured training, management briefings, and peer-to-peer discussions in reducing uncertainty and building trust. Unexpectedly, adopter characteristics exerted a negative influence on adoption. Contrary to DOI theory and evidence from developed economies (Liu & Wu, 2015; Christopher, 2016), higher education and longer experience did not promote adoption. Instead, entrenched practices, skepticism toward digital systems, and concerns about job displacement appeared to hinder uptake. This contradiction highlights the importance of contextualizing Western-derived theories when applied in African settings. Overall, the model explained 52.8 percent of the variance in e-SCM adoption, demonstrating that innovation perceptions and communication are critical, but organizational culture and human readiness remain significant barriers. The study concludes that successful adoption in Zambia's aviation industry is less about the technology itself and more about aligning organizational structures, employee mindsets, and incentive systems with digital transformation goals.

5.2 Recommendations for ZACL Management

- Management should actively demonstrate the operational advantages of e-SCM, such as reducing procurement delays, improving transparency, and enhancing customer service. Pilot projects, case studies, and performance dashboards can be used to showcase tangible improvements.
- Change management programs should target long-serving and highly qualified staff who may be resistant to innovation. Creating "innovation champions" among staff can encourage peer influence.
- Regular ICT training programs must go beyond basic technical skills to include scenario-based learning that shows employees how e-SCM integrates with daily operations.
- Linking adoption to performance appraisals, promotions, or recognition awards could align employee interests with organizational digital goals.

For Policymakers and Regulators

- Government and regulators should ensure robust ICT infrastructure in the aviation sector, particularly reliable internet connectivity, data security, and integration frameworks.
- Policies that reward organizations investing in digital supply chain solutions could encourage wider adoption. These could include tax rebates, subsidies, or recognition programs.
- Collaborations between government, technology providers, and industry stakeholders can help build affordable and context-specific e-SCM platforms.

For Future Research

- Future studies should examine adoption across other industries in Zambia and Sub- Saharan Africa to explore whether the negative role of adopter characteristics is sector- specific or widespread.
- Since this study was cross-sectional, future research could adopt longitudinal designs to track adoption behavior over time and assess how perceptions and resistance evolve.
- Researchers may consider integrating DOI with other models such as the Technology Acceptance Model (TAM) or Unified Theory of Acceptance and Use of Technology (UTAUT) to provide deeper explanatory power.

Declaration of Competing Interests

The authors declare that they have no conflicting interests.

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Data Availability statement

The data used to support the findings of this study are available from the corresponding author upon request.

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Ethical considerations

The article followed all ethical standards appropriate as provided for by the University of Zambia.

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