

Authentic Leadership and Employee Innovative Work Behaviour: A Multi-Wave Study of the Enugu State Waste Management Authority (Eswama), Nigeria

Syed Ahmed Salman¹

Associate Professor and Head of Department, Business and Management, Lincoln University College, Petaling Jaya, Malaysia.

Harrison Churchill Chukwuebuka^{2*}

School of Business and Management, Lincoln University College, Petaling Jaya, Malaysia.

Sebastine Chukwuebuka Okafor³

Department of Mass Communication, Enugu State University of Science and Technology (ESUT), Enugu, Nigeria.

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Abstract: *This study examines whether authentic leadership predicts employee innovative work behaviour (IWB) in the Enugu State Waste Management Authority (ESWAMA), a Nigerian public-sector environmental services organisation, and evaluates the psychometric adequacy of the Authentic Leadership Inventory (ALI) in this setting. The study responds to the scarcity of time-lagged evidence on authentic leadership and IWB from African public-sector organisations, where existing evidence is limited and mixed. Design: A two-wave time-lagged survey was conducted, with authentic leadership and control variables measured at Time 1 and IWB measured eight weeks later at Time 2. Stratified random sampling by department and grade level produced a matched analytical sample of 351 employees from 410 Time 1 respondents, an 85.6 per cent retention rate. Sample size was determined a priori through statistical power analysis. Authentic leadership was measured with the 16-item ALI and IWB with the nine-item Janssen scale. Data were analysed using partial least squares structural equation modelling (PLS-SEM) with bootstrapped confidence intervals. Findings: The measurement model showed satisfactory reliability (Cronbach's alpha of at least 0.71 and composite reliability of at least 0.82 for all constructs), convergent validity (AVE 0.54 to 0.69) and discriminant validity (maximum HTMT below 0.85). Authentic leadership had a positive and statistically significant effect on IWB ($\beta = 0.326$, $t = 6.41$, $p < 0.001$, 95% bootstrap CI [0.225, 0.426]), explaining 11.4 per cent of the variance in IWB. Common method bias diagnostics indicated no pervasive threat. Originality: The study provides time-lagged, power-justified evidence on the authentic leadership and IWB relationship from a Nigerian public-sector environmental services organisation and re-examines the psychometric performance of the ALI in Nigeria, where earlier evidence was weak. Implications: The findings suggest that developing authentic leadership behaviours among supervisors is a promising, though not sufficient, route to stimulating employee innovation in public-sector waste management. The moderate variance explained indicates that other antecedents and mechanisms should be examined in future research.*

Keywords: authentic leadership; innovative work behaviour; public sector; time-lagged design; PLS-SEM; Nigeria.

INTRODUCTION

Background and rationale

Innovative work behaviour (IWB) is widely regarded as a prerequisite for organisational adaptation, service improvement and long-term effectiveness, including within public-sector organisations that face mounting pressure to modernise service delivery (Ferdian et al., 2025; Wahyuni et al., 2023). In Nigerian public administration, innovation is particularly salient in environmental service organisations such as the Enugu State Waste Management Authority (ESWAMA), where outdated work practices, infrastructural deficits and rising urban waste generation demand creative problem solving at the level of individual employees (Chilota, 2026; ESWAMA, 2024). Although the scholarly literature has identified leadership as a key antecedent of IWB, much of this evidence is drawn from cross-sectional surveys conducted in private-sector or Western settings, leaving the leadership and innovation nexus comparatively under-examined in African public-sector contexts.

The rationale for this study rests on three considerations. First, innovation in ESWAMA is a service-delivery concern rather than an abstract managerial aspiration. The authority is responsible for waste collection, sanitation enforcement, recycling and environmental education across Enugu State (ESWAMA, 2024). Frontline and administrative employees plausibly hold detailed knowledge of collection routes, equipment failure and community response, so their ideas for improving routines are a practical source of service improvement where capital investment is constrained. Second, public-sector employees work within hierarchical, procedure-bound structures that can discourage experimentation (Ferdian et al., 2025). This places unusual weight on the behaviour of immediate supervisors in signalling whether new ideas are welcome and safe to voice. Authentic leadership, with its emphasis on transparency, openness to dissenting views and consistent ethical conduct, is therefore a theoretically plausible enabler of IWB in this setting. Studies of local government staff in Nigeria and Ghana likewise suggest that leadership matters for public servants' innovative behaviour (Abdulkareem et al., 2025; Baafi et al., 2021). Third, ESWAMA and comparable agencies face a practical question: whether investing in supervisors' leadership development is likely to yield more innovative employee behaviour. Answering it requires evidence that is contextually relevant and less exposed to the biases of single-occasion surveys.

Among the contemporary positive leadership constructs, authentic leadership has attracted sustained scholarly interest because of its emphasis on self-awareness, relational transparency, balanced processing and an internalised moral perspective (Avolio et al., 2004; Walumbwa et al., 2008). Empirical work in recent years has reported a positive association between authentic leadership and follower innovation (Bai & Wang, 2022; Siswanti & Muafi, 2025). Further recent studies in varied settings, including service firms, small and medium enterprises and public-sector organisations, report similar associations (Gelaidan et al., 2024; Kafeel et al., 2024; Khan et al., 2024; Ullah et al., 2025), and the evidence has been reviewed systematically (Lewicka & Rehman, 2024). Whether this evidence transfers to Nigerian public-sector organisations is, however, uncertain.

Research Gap

Three gaps motivate the study. First, the evidence base is contextually narrow: studies of authentic leadership and IWB come predominantly from private-sector and non-African settings, and the Nigerian public-sector evidence we could identify is limited and inconsistent with the wider literature (Ibrahim & Daniel, 2023). Second, the dominant design remains cross-sectional and single-occasion,

which inflates the risk of common method bias and weakens temporal ordering (Kock et al., 2021; Podsakoff et al., 2003). A recent review of leadership and IWB research likewise found that most studies used quantitative cross-sectional designs (Peerzadah, 2024). Third, the psychometric performance of the ALI in Nigeria has been questioned on the basis of a single banking sample, with weak reliability for two subscales and discriminant validity not achieved for two dimensions (Balogun et al., 2020), and it has not been re-examined in public-sector samples. Section 2.5 develops these gaps in detail.

Purpose of the Study

The purpose of this study is to examine whether authentic leadership, measured at Time 1, predicts employee IWB measured eight weeks later at Time 2 among employees of ESWAMA. The study addresses one research question: To what extent does perceived authentic leadership predict IWB among ESWAMA employees? It pursues two objectives: (1) to estimate the effect of authentic leadership on IWB using a two-wave time-lagged design, with statistical controls for tenure, age, education and supervisory position; and (2) to evaluate the reliability and validity of the ALI and the Janssen IWB scale in this Nigerian public-sector setting.

The study makes theoretical, methodological and practical contributions, which are set out in Section 7 after the presentation of results. In brief, it extends the authentic leadership and IWB relationship to an under-examined public-sector context, offers a time-lagged and power-justified test that strengthens temporal ordering relative to cross-sectional work, provides evidence on the ALI's measurement performance in Nigeria, and yields guidance for leadership development and innovation management in ESWAMA and comparable organisations.

Structure of the Paper

The remainder of the article is structured as follows. Section 2 reviews the relevant literature, develops the theoretical framework and sets out the research gap. Section 3 derives the hypothesis. Section 4 sets out the research methodology, including sampling, power analysis, measurement and ethics. Section 5 presents the results. Section 6 discusses the findings. Section 7 states the novelty and contribution of the study, and Sections 8 and 9 present its theoretical and practical implications. Section 10 discusses limitations and directions for future research, and Section 11 concludes.

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

Authentic leadership: conceptualisation and measurement

Authentic leadership is defined as a pattern of leader behaviour that draws upon and promotes both positive psychological capacities and a positive ethical climate, fostering greater self-awareness, an internalised moral perspective, balanced processing of information and relational transparency on the part of leaders working with followers (Walumbwa et al., 2008). This four-component definition has become the dominant conceptualisation in the literature and distinguishes authentic leadership from related constructs. Self-awareness refers to a leader's ongoing examination of their own values, identity, strengths and weaknesses. Relational transparency describes the open sharing of one's authentic self, including the disclosure of feelings and the admission of mistakes. Balanced processing involves soliciting and objectively evaluating diverse viewpoints before reaching decisions.

Internalised moral perspective reflects behaviour guided by internal ethical standards rather than external pressures (Avolio & Gardner, 2005; Gardner et al., 2011).

Authentic leadership is conceptually and empirically distinct from transformational, ethical and servant leadership, although the boundaries have been debated (Banks et al., 2016). A meta-analytic review confirmed that authentic leadership explains variance in follower outcomes beyond transformational leadership, supporting its construct independence rather than treating it as redundant (Banks et al., 2016). Whereas transformational leadership centres on inspirational motivation and visionary appeal, authentic leadership emphasises the alignment between leaders' values, actions and disclosures. Ethical leadership foregrounds moral management and normatively appropriate behaviour, while servant leadership prioritises follower growth and stewardship. Authentic leadership integrates these elements through the mechanism of self-concordance and transparent self-regulation (Avolio & Gardner, 2005; Gardner et al., 2011).

Two principal instruments measure authentic leadership: the Authentic Leadership Questionnaire (ALQ) developed by Walumbwa et al. (2008) and the Authentic Leadership Inventory (ALI) developed by Neider and Schriesheim (2011). The ALI was constructed to address concerns about the ALQ, particularly regarding item availability and content validity, and comprises 16 items equally distributed across the four dimensions. The ALI has demonstrated acceptable psychometric properties in Western samples (Neider & Schriesheim, 2011) and has been used extensively in leadership research.

In the Nigerian context, however, the psychometric evidence warrants caution. Balogun et al. (2020), using a sample of 213 Nigerian bank employees, found that the ALI exhibited reasonable fit across first-order, second-order and bi-factor measurement models, but reported reliability coefficients below 0.70 for the relational transparency and internalised moral perspective subscales. More critically, discriminant validity between self-awareness and internalised moral perspective was not achieved, and average variance extracted values fell below the conventional 0.50 threshold for all four subscales. Comparable concerns have been documented in South African samples (Stander et al., 2015). These findings imply that researchers using the ALI in Nigeria must rigorously test the measurement model rather than assuming that the four-dimensional structure will replicate cleanly, a methodological issue that the present study actively addresses.

Innovative Work Behaviour: Definition and Measurement

Innovative work behaviour refers to the intentional generation, promotion and realisation of new and useful ideas within a work role (Janssen, 2000). The construct is conceptually narrower than organisational innovation, which is an organisational-level outcome, and broader than employee creativity, which is typically confined to idea generation. Following Janssen (2000), IWB is operationalised as a three-stage process comprising idea generation (the creation of novel ideas), idea promotion (the active championing of ideas to potential allies) and idea realisation (the implementation of ideas into practice). De Jong and Den Hartog (2010) extended this framework to a four-stage conception that includes opportunity exploration, but empirical work has frequently supported the parsimony of the three-factor model (Dahiya et al., 2022; Salessi & Roldán, 2020).

IWB is distinguished from general job performance because it is discretionary, episodic and frequently extra-role in nature. Employees may generate and promote ideas that fall outside their formal job description, and the realisation stage often requires sponsorship, resources and protection against

organisational resistance (Wahyuni et al., 2023). Public-sector IWB presents additional challenges: employees operate within hierarchical authority structures, formalised procedures and risk-averse cultures that may discourage the experimentation and tolerance of failure on which innovation depends (Ferdian et al., 2025). Understanding the leadership antecedents of IWB in such settings is therefore of both theoretical and practical importance.

Authentic leadership and innovative work behaviour: empirical evidence

A growing body of empirical work links authentic leadership with follower innovation. Bai and Wang (2022), drawing on a sample of 311 employees in Chinese high-tech manufacturing firms, reported a positive and significant direct effect of authentic leadership on IWB, mediated through proactive personality and work engagement. Siswanti and Muafi (2025) found that authentic leadership positively influenced both employee creativity and IWB, with motivating language serving as a moderator, reinforcing the view that the authentic leadership and innovation relationship is robust across cultural settings. Earlier evidence likewise supported a positive association between authentic leadership and creativity or innovation (Müceldili et al., 2013).

Evidence from African and Nigerian organisational contexts, although thinner, is less consistent with these findings. Ibrahim and Daniel (2023) examined authentic leadership and creativity in a Nigerian public-sector healthcare setting using PLS-SEM and found that the direct effect of authentic leadership on creativity was not significant, becoming significant only through the mediation of job thriving. This finding is important because it suggests that the authentic leadership and innovation relationship may not translate automatically to public-sector African contexts and may require enabling mechanisms. The divergence from Chinese and Western evidence highlights the need for context-sensitive examination rather than treating existing findings as conclusive. Within the public-sector literature more broadly, Ferdian et al. (2025) identified leadership as one of three factor clusters (personal, team and organisational) influencing IWB, while Wahyuni et al. (2023) synthesised evidence showing that leadership, organisational culture and human resource management practices shape innovative behaviour in public organisations.

Theoretical Framework

This study draws on Social Exchange Theory (SET; Blau, 1964) and Self-Determination Theory (SDT; Ryan & Deci, 2000) to explain why authentic leadership should foster IWB. SET posits that social behaviour arises from reciprocal exchanges of material and non-material resources, with trust and obligation emerging when such exchanges are perceived as fair. Authentic leaders, through relational transparency and balanced processing, signal trustworthiness and respect, which followers reciprocate through discretionary behaviours that benefit the leader and the organisation, including the generation and promotion of new ideas (Bai & Wang, 2022). Authentic leadership thus establishes the relational and psychological conditions under which the social exchange logic of innovation can operate.

SDT complements SET by specifying the motivational mechanisms through which authentic leadership influences innovation. SDT identifies three basic psychological needs: autonomy, competence and relatedness (Ryan & Deci, 2000). Authentic leaders support follower autonomy by soliciting diverse perspectives and avoiding coercive control; they foster competence through balanced feedback and acknowledgement of follower capabilities; and they cultivate relatedness through relational transparency and ethical consistency. When these needs are satisfied, followers exhibit higher intrinsic motivation and engagement, which manifest as the proactive, idea-oriented behaviours

captured by IWB (Siswanti & Muafi, 2025). The two theories together suggest that authentic leadership operates through both relational (exchange-based) and motivational (need-satisfaction) pathways, providing a coherent theoretical rationale for the hypothesised positive effect on IWB.

Research Gap and Study Rationale

Synthesising the preceding review, the study addresses three interrelated gaps. The first is a contextual gap. Evidence linking authentic leadership to IWB derives predominantly from private-sector and non-African settings, such as the Chinese high-tech manufacturing sample of Bai and Wang (2022). The African public-sector studies that we identified examined other leadership styles, namely transformational, transactional and inclusive leadership (Abdulkareem et al., 2025; Baafi et al., 2021). The Nigerian public-sector evidence on authentic leadership that we could identify diverges from the wider literature: Ibrahim and Daniel (2023) found no significant direct effect of authentic leadership on creativity in a public healthcare setting. Whether authentic leadership predicts IWB directly in a Nigerian environmental services agency, where work is operational, procedure-bound and visible to the public, is therefore an open empirical question.

The second is a design gap. Most of the evidence is cross-sectional and self-reported at a single occasion. Such designs cannot separate the effect of leadership from respondents' tendency to answer consistently across predictor and outcome items, and they offer little basis for temporal ordering (Kock et al., 2021; Podsakoff et al., 2003). A time-lagged design does not remove these problems, but it reduces the risk of consistency-driven inflation and ensures that the predictor is measured before the outcome. A hybrid review of leadership and IWB studies published between 2008 and 2021 reports that the majority adopted quantitative cross-sectional designs (Peerzadah, 2024).

The third is a measurement gap. The ALI is widely used, yet the only Nigerian evaluation we identified (Balogun et al., 2020) reported low reliability and weak discriminant validity for some subscales in a banking sample. It is not known whether these problems recur in public-sector samples or reflect that particular sample. A full measurement-model evaluation therefore serves both as a test of the ALI's transferability and as a precondition for a credible structural estimate.

Beyond these three scholarly gaps, the study also responds to the practical need noted in Section 1.1: ESWAMA and comparable agencies lack context-specific evidence on whether investing in supervisors' leadership development is likely to yield more innovative employee behaviour. Taken together, these gaps and this practical need justify the research question posed in Section 1.3. Section 7 sets out how the study addresses each of them and what it contributes.

Hypothesis Development

Drawing on SET and SDT, authentic leadership is expected to enhance employee IWB through several interrelated mechanisms. Relational transparency fosters psychological safety, which lowers the perceived risk of proposing novel ideas and encourages idea generation and promotion. Balanced processing signals that divergent viewpoints are valued, motivating employees to think creatively and voice suggestions. Self-awareness enables leaders to model self-concordant behaviour, which followers may emulate in approaching their own work tasks. An internalised moral perspective builds trust that idea implementation will be governed by ethical and consistent standards, reducing the political risk of innovation. The empirical evidence reviewed above, while contextually variable, predominantly supports a positive association (Bai & Wang, 2022; Siswanti & Muafi, 2025). However,

the Nigerian public-sector evidence is mixed (Ibrahim & Daniel, 2023), which warrants further empirical examination rather than assuming the relationship will replicate.

Accordingly, the central hypothesis is stated as follows:

H1. Authentic leadership has a positive and significant effect on employee innovative work behaviour at the Enugu State Waste Management Authority.

The conceptual model is intentionally parsimonious, comprising authentic leadership as the exogenous construct and IWB as the endogenous construct, with controls for tenure, age, education and supervisory position. Additional mediators or moderators are not introduced because, although theoretically plausible, they would compound model complexity without a defensible empirical or contextual justification specific to ESWAMA at this stage of investigation.

METHODOLOGY

Research design and rationale for a multi-wave approach

The study employs a quantitative, two-wave time-lagged survey design. Authentic leadership and demographic control variables were measured at Time 1 (T1), and employee IWB was measured eight weeks later at Time 2 (T2). Temporal separation was selected over a cross-sectional design for three methodologically defensible reasons. First, separating the measurement of the predictor and outcome across time reduces the risk that respondents infer and report a consistent relationship between the two sets of items, a major source of common method bias in single-source, single-occasion studies (Kock et al., 2021; Podsakoff et al., 2003). Second, the temporal interval of eight weeks is long enough to attenuate consistency effects yet short enough to avoid substantial organisational or personnel change that would confound the predictor-outcome relationship. Third, the time-lagged design strengthens the causal-ordering argument that authentic leadership precedes IWB in time, although it does not establish full causality in the experimental sense (Kock et al., 2021).

A third wave was considered but not introduced. A three-wave design would have permitted the inclusion of a mediator, but the conceptual model intentionally retains a parsimonious direct-effect specification to preserve statistical power within the achievable ESWAMA sample. A two-wave design with statistical controls for tenure, age, education and supervisory position, together with a marker variable at T2, offers a methodologically appropriate balance between rigour and feasibility. Respondents were matched across waves using an anonymous self-generated code comprising the last two letters of their mother's first name, the day of their birth and the first letter of their department head's first name. This procedure permitted matching without collecting personally identifiable information that could compromise confidentiality or induce response bias.

Research Setting and Population

The research setting is the Enugu State Waste Management Authority (ESWAMA), a parastatal of the Enugu State Government established by Law No. 8 of 2004 with the support of the British Department for International Development (ESWAMA, 2024; Onyenekenwa, 2013). ESWAMA is responsible for waste collection, sanitation enforcement, recycling initiatives and environmental education across Enugu State. Operational departments include waste collection, sanitation and enforcement, recycling and environmental services, finance and administration, and planning, research and statistics. Staff are distributed across the State Secretariat Complex and zonal offices at Thinkers Corner, Emene and

Abakpa (ESWAMA, 2024). The authority operates within the broader Nigerian civil-service grade structure, with employees drawn from grade levels ranging from junior field operations staff to senior administrative officers.

The target population comprises all permanent employees of ESWAMA. The accessible population comprises permanent employees stationed at the Enugu State Secretariat Complex and the three principal zonal offices who hold at least a senior secondary school certificate and who report directly to a designated supervisor. The sampling frame is the official ESWAMA employee register maintained by the Department of Administration and Human Resources, which lists each employee by staff identification number, name, department, grade level and duty station. The register was obtained officially from the authority through its Public Relations Office.

The unit of analysis is the individual employee, who is also the sampling unit. Inclusion criteria require that the employee has occupied their current position for at least six months (to ensure exposure to the supervisor rated on authentic leadership), reports to a designated supervisor, is willing to participate in both waves and provides informed consent. Exclusion criteria cover employees on extended leave, contract or ad-hoc personnel without a designated supervisor, and senior executives whose leadership role would confound the supervisor-rating logic of the ALI.

Sampling Strategy

A proportionate stratified random sampling procedure was employed. Two stratification variables were used: operational department (waste collection; sanitation and enforcement; recycling and environmental services; finance and administration; planning, research and statistics) and grade-level band (junior, grade levels 2 to 6; intermediate, grade levels 7 to 12; senior, grade levels 13 and above). Proportionate allocation was chosen over equal allocation because the strata differ markedly in size, with waste collection and sanitation and enforcement expected to contain the largest share of ESWAMA staff. Proportionate allocation preserves the population distribution within the sample and supports more accurate population estimates than equal allocation (Hair et al., 2022).

Within each stratum, employees were selected by simple random sampling using computer-generated random numbers applied to the stratified frame. A small number of substitutes, drawn from the same stratum, were identified in advance to replace selected employees who declined to participate or were unavailable, ensuring that stratum proportions were preserved. Because the sampling procedure drew directly from the authoritative ESWAMA register using probability methods and proportionate allocation, the resulting sample should be broadly representative of the accessible ESWAMA population on the stratification variables, subject to non-response patterns.

A Priori Statistical Power and Sample Size

The sample size was determined through an a priori statistical power analysis rather than a rule-of-thumb formula such as the Yamane (1967) equation or the Krejcie and Morgan (1970) table, which are insensitive to effect size, model complexity and statistical power. Following the approach recommended by Hair et al. (2022) and the G*Power 3.1 procedure (Faul et al., 2009) for multiple regression with five predictors (authentic leadership plus four controls), an anticipated medium effect size of $f^2 = 0.15$ (Cohen, 1988), a significance level of $\alpha = 0.05$ and a desired statistical power of 0.80 yielded a minimum required sample of approximately 92 cases. Because the structural model uses PLS-SEM with a latent endogenous variable, the PLS-SEM-specific inverse square root criterion

recommended by Kock and Hadaya (2018) was also applied as a cross-check. For a minimum path coefficient of 0.30 (medium effect) at $\alpha = 0.05$ and power = 0.80, this criterion yields a minimum of approximately 69 cases; the larger G*Power estimate of 92 cases was therefore treated as the binding minimum.

To account for anticipated non-response, incomplete questionnaires, respondent attrition between waves, unusable responses and failed respondent matching, the recruitment target was set well above these minima, at 410 employees at Time 1. This figure comfortably exceeds both the rule-of-thumb minimum of ten times the largest number of structural paths pointing at a latent construct and the power-based estimates, while remaining feasible within ESWAMA. The achieved matched analytical sample comprises 351 employees, with a retention rate of 85.6 per cent between T1 and T2 (59 cases attrited, 14.4 per cent).

Measurement instruments

Authentic leadership was measured with the 16-item Authentic Leadership Inventory (ALI) developed by Neider and Schriesheim (2011). The ALI comprises four subscales of four items each, assessing self-awareness, relational transparency, internalised moral perspective and balanced processing. Respondents rate their immediate supervisor on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The ALI was selected over the ALQ because it offers comparable or superior psychometric performance and overcomes concerns regarding the commercial availability of the ALQ (Neider & Schriesheim, 2011). Given the Nigerian psychometric evidence (Balogun et al., 2020), the measurement model was tested rigorously, and item-level diagnostics were used to assess the adequacy of each subscale rather than mechanically accepting the four-factor structure.

Innovative work behaviour was measured with the nine-item Janssen (2000) scale, comprising three subscales of three items each (idea generation, idea promotion and idea realisation). Respondents indicate the frequency of each behaviour on a five-point Likert scale ranging from 1 (never) to 5 (very often). The Janssen scale was selected because it is the most widely used and validated measure of IWB in the literature, with established reliability and construct validity across multiple national contexts, including emerging economies (Dahiya et al., 2022; Saleesi & Roldán, 2020).

Four marker items measuring television-watching frequency, which are theoretically unrelated to authentic leadership or IWB, were embedded in the T2 questionnaire to permit a marker-variable assessment of common method bias (Kock et al., 2021; Lindell & Whitney, 2001). Control variables comprised organisational tenure (in years), age (in years), highest educational qualification (coded 1 to 4 from senior secondary to postgraduate) and supervisory position (0 = non-supervisory, 1 = supervisory). All instruments were used in their original English form, the official language of ESWAMA operations and Nigerian public administration, and no translation was therefore required. Two senior ESWAMA managers and two academic experts reviewed the instruments for face and content validity prior to administration.

Data Collection Procedure

Data collection was conducted in two waves over eight weeks. At T1, questionnaires were administered in sealed envelopes to selected employees through departmental liaison officers, who were not informed of the research hypothesis. Respondents returned completed questionnaires in sealed envelopes to a designated drop-box at each duty station. Each respondent generated an

anonymous identification code at T1 and was instructed to retain and reuse the same code at T2. At T2, eight weeks later, the IWB and marker-variable items were administered through the same procedure. The two waves were matched by the self-generated codes. The dataset was stored on a password-protected device accessible only to the principal investigator.

Common Method Bias

Common method bias was addressed through a combination of procedural and statistical remedies. Procedurally, the two-wave temporal separation of predictor and outcome, the use of a marker variable, the assurance of anonymity, the randomisation of item order within scales and the use of different response anchors for the predictor (agreement) and outcome (frequency) scales were intended to attenuate method variance (Kock et al., 2021; MacKenzie & Podsakoff, 2012; Podsakoff et al., 2003). Statistically, Harman's single-factor test was conducted on all substantive items, the marker-variable technique was applied, and the full collinearity variance inflation factor (VIF) approach recommended by Kock (2015) for PLS-SEM was examined. No single statistical test was treated as conclusively establishing the absence of common method bias, in line with current methodological guidance (Kock et al., 2021).

Data Analysis

Data were screened for missing values, outliers, inattentive responses and distributional assumptions before analysis. A small proportion of missing values (below 5 per cent per item) was imputed using the expectation-maximisation algorithm. Responses with identical values across all items or with completion times below an implausible threshold were flagged and excluded. The measurement model was evaluated for internal consistency reliability (Cronbach's alpha, composite reliability and rho_A), convergent validity (standardised loadings and average variance extracted) and discriminant validity (the Fornell and Larcker [1981] criterion, cross-loadings and the heterotrait-monotrait ratio [HTMT] of Henseler et al. [2015] with bootstrapped confidence intervals).

PLS-SEM was selected as the analytical technique because the study's objective is the prediction of an endogenous construct (IWB) from an exogenous construct (authentic leadership) within a relatively simple structural model, and because PLS-SEM is appropriate for theory development and prediction-oriented research in contexts where the construct measurement model is still being refined (Hair et al., 2022; Henseler et al., 2015). Covariance-based SEM was considered but not adopted because it requires larger samples for stable parameter estimation and is better suited to confirmatory testing of established theories. The structural model was evaluated through the standardised path coefficient, its standard error, the t-statistic, the 95 per cent bootstrap confidence interval (5,000 resamples), the coefficient of determination (R^2), the effect size (f^2) and predictive relevance (Q^2) using blindfolding. Collinearity was assessed through VIF values.

Research Ethics

The study was conducted in accordance with the ethical principles of respect for persons, beneficence and justice. Institutional ethical approval was obtained from the relevant university research ethics committee prior to fieldwork. Organisational permission was sought and obtained from the ESWAMA management, on the explicit understanding that participation by individual employees would be entirely voluntary and that the authority would not have access to individual responses. Informed consent was obtained in writing from each respondent at T1 and reaffirmed at T2. Respondents were

assured of anonymity and confidentiality, the right to withdraw at any point without penalty and the secure storage of all data on encrypted, password-protected devices.

Because the study concerns employees within a public organisation, particular attention was paid to the risk that employees might feel pressured to participate or might fear that unfavourable responses could affect their employment. To mitigate this risk, recruitment was conducted through independent departmental liaison officers rather than line managers, the self-generated matching code protected respondent identity, all materials were returned in sealed envelopes directly to a neutral drop-box, and the cover letter explicitly stated that responses would not be shared with supervisors, the ESWAMA management or any other party. The supervisor-rating logic of the ALI was explained in general terms without revealing the research hypothesis. These procedures were designed to minimise the risk of coercive participation and supervisor retaliation.

RESULTS

Sample characteristics and attrition analysis

Of the 410 employees who consented to participate and completed the Time 1 questionnaire, 351 completed the Time 2 questionnaire and were successfully matched, yielding a retention rate of 85.6 per cent. The 59 cases lost between waves correspond to an attrition rate of 14.4 per cent. Attrition was not significantly related to Time 1 authentic leadership scores ($t = 0.507$, $p = 0.614$), suggesting that attrition did not systematically bias the predictor measurement. The final matched analytical sample ($N = 351$) comprised 53.8 per cent male and 46.2 per cent female employees, with a mean age of 39.05 years ($SD = 7.96$) and a mean organisational tenure of 7.36 years ($SD = 4.47$). Supervisory positions were held by 22.8 per cent of respondents.

Descriptive Statistics

Descriptive statistics for the construct scores are summarised in Table 1. Mean scores for the four authentic leadership dimensions ranged from 2.98 to 3.07 on the five-point scale, indicating that, on average, respondents perceived their supervisors as moderately authentic. The three IWB dimensions ranged from 2.94 to 3.03, suggesting moderate levels of innovative behaviour. All skewness and kurtosis values fell within the acceptable range of plus or minus two, indicating no substantial departure from normality.

Table 1. Descriptive statistics for construct dimensions (N = 351)

Construct	Items	Mean	SD	Skew / Kurt
Self-awareness	4	3.04	0.85	-0.09 / -0.51
Relational transparency	4	3.07	0.92	-0.05 / -0.74
Internalised moral perspective	4	3.00	0.89	-0.00 / -0.59
Balanced processing	4	2.98	0.85	0.01 / -0.49
Authentic leadership (overall)	16	3.02	0.66	-0.02 / -0.48
IWB - Idea generation	3	2.94	0.97	0.15 / -0.69
IWB - Idea promotion	3	2.99	0.93	-0.05 / -0.67
IWB - Idea realisation	3	3.03	0.99	0.02 / -0.84
IWB (overall)	9	2.98	0.81	0.12 / -0.58

Measurement model evaluation

Reliability and convergent validity were assessed through Cronbach's alpha, composite reliability (CR) and average variance extracted (AVE). As Table 2 shows, Cronbach's alpha values for the seven substantive dimensions ranged from 0.711 to 0.779, all exceeding the 0.70 threshold. Composite reliability values ranged from 0.822 to 0.872, exceeding the 0.70 benchmark, and AVE values ranged from 0.536 to 0.693, exceeding the 0.50 threshold. Standardised loadings ranged from 0.69 to 0.84, exceeding the 0.70 benchmark with two exceptions at 0.69, which were retained on theoretical grounds because their constructs met the AVE and CR criteria.

These results contrast favourably with the Nigerian ALI evidence reported by Balogun et al. (2020), who found that two subscales fell below the 0.70 alpha threshold and that AVE values fell below 0.50 for all four subscales. The present study's measurement model demonstrates stronger psychometric performance in a larger, probability-based sample. The difference is interpreted cautiously: it indicates that the ALI can function adequately in the ESWAMA setting, but the two studies differ in sector, sample size and sampling procedure, so the source of the difference cannot be identified.

Table 2. Reliability and convergent validity (N = 351)

Construct	Alpha	CR	AVE	Loadings (range)
Self-awareness	0.711	0.822	0.536	0.69 to 0.76
Relational transparency	0.761	0.848	0.583	0.73 to 0.80
Internalised moral perspective	0.759	0.847	0.582	0.69 to 0.82
Balanced processing	0.757	0.846	0.580	0.74 to 0.79
IWB - Idea generation	0.747	0.856	0.664	0.80 to 0.83
IWB - Idea promotion	0.754	0.859	0.671	0.81 to 0.84
IWB - Idea realisation	0.779	0.872	0.693	0.83 to 0.84
Authentic leadership (overall)	0.860	–	0.570	–

Note. For the overall authentic leadership construct, AVE is the mean of the four dimension AVEs; composite reliability is reported at the dimension level only.

Discriminant validity was assessed using the Fornell and Larcker (1981) criterion and the heterotrait-monotrait ratio (HTMT) of Henseler et al. (2015). As Table 3 shows, the square root of the AVE for each construct exceeded the construct's correlations with all other constructs, satisfying the Fornell and Larcker criterion. All HTMT values were below the conservative 0.85 threshold, with a maximum of 0.765 observed between idea promotion and idea realisation. This value is acceptable and reflects the conceptual proximity of the IWB dimensions rather than a measurement failure. Crucially, the discriminant validity between self-awareness and internalised moral perspective, which Balogun et al. (2020) found to be compromised in their Nigerian banking sample, was achieved in the present study, which may reflect differences in sample size, sector or workforce composition.

Table 3. Fornell and Larcker criterion and HTMT summary

Construct	SA	RT	IMP	BP	IWB (max)
SA	0.732	0.418	0.408	0.424	0.231
RT	0.418	0.764	0.468	0.346	0.272
IMP	0.408	0.468	0.763	0.468	0.196
BP	0.424	0.346	0.468	0.762	0.235

Note. Diagonal entries show the square root of AVE. Off-diagonal entries show inter-construct correlations. IWB (max) = the highest correlation between each authentic leadership dimension and any of the three IWB dimensions. The square roots of AVE for the IWB

dimensions (idea generation 0.815, idea promotion 0.819, idea realisation 0.832; derived from Table 2) exceed all of these correlations. Maximum HTMT value = 0.765, below the 0.85 threshold.

Common Method Bias

Harman's single-factor test on the 25 substantive items produced a first factor accounting for 25.69 per cent of total variance, well below the 50 per cent threshold, suggesting that a single factor does not account for the majority of the variance. The marker variable exhibited negligible correlations with authentic leadership ($r = -0.072$) and IWB ($r = -0.036$), supporting the interpretation that substantive correlations were not substantially inflated by method variance. Full collinearity VIF values for the structural model ranged from 1.002 to 1.010, well below the conservative 3.3 threshold proposed by Kock (2015), indicating that collinearity did not pose a common method bias threat. Although no statistical test conclusively establishes the absence of common method bias, the convergence of procedural and statistical diagnostics provides reasonable confidence that common method bias does not materially threaten the inferences drawn.

Structural Model and Hypothesis Testing

The structural model was evaluated through the standardised path coefficient from authentic leadership to IWB, with controls for tenure, age, education and supervisory position. Authentic leadership exerted a positive and statistically significant effect on IWB ($\beta = 0.326$, $SE = 0.051$, $t = 6.41$, $p < 0.001$). The 95 per cent bootstrap confidence interval [0.225, 0.426] excluded zero. The model explained 11.4 per cent of the variance in IWB (adjusted $R^2 = 10.1$ per cent). The effect size $f^2 = 0.119$ is in the small-to-medium range according to Cohen's (1988) conventions, and the predictive relevance $Q^2 = 0.073$ is positive, indicating that the model has predictive relevance for IWB. The control variables were not significantly associated with IWB (Table 4). H1 is therefore supported.

Table 4. Structural model results ($N = 351$)

Path	β	SE	t	95% CI (boot)	Decision
AL $\rightarrow$ IWB	0.326	0.051	6.41	[0.225, 0.426]	H1 supported
Tenure $\rightarrow$ IWB	0.014	—	—	—	n.s.
Age $\rightarrow$ IWB	0.076	—	—	—	n.s.
Education $\rightarrow$ IWB	0.034	—	—	—	n.s.
Supervisor $\rightarrow$ IWB	-0.032	—	—	—	n.s.

Note. $R^2 = 0.114$; adjusted $R^2 = 0.101$; $f^2 = 0.119$; $Q^2 = 0.073$; all VIF values below 1.05. n.s. = not significant. Bootstrap based on 5,000 resamples. Standard errors, t-values and confidence intervals are reported for the hypothesised path only; full statistics for the control variables are available from the corresponding author on request.

DISCUSSION

The purpose of this study was to examine whether authentic leadership predicts employee IWB at ESWAMA. The findings indicate that authentic leadership positively and significantly influences

employee IWB at ESWAMA ($\beta = 0.326$, $p < 0.001$), explaining approximately 11 per cent of variance in IWB after controlling for tenure, age, education and supervisory position, a result consistent with H1. The effect size is in the small-to-medium range, so authentic leadership is one antecedent among several, and most of the variance in IWB is attributable to other factors.

The result converges with the Chinese high-tech manufacturing evidence of Bai and Wang (2022) and the broader cross-cultural findings of Siswanti and Muafi (2025), both of whom reported a positive direct effect of authentic leadership on IWB. More recent studies in other settings report the same direction of association (Gelaidan et al., 2024; Kafeel et al., 2024; Ullah et al., 2025). The convergence is theoretically meaningful because it suggests that the authentic leadership and innovation relationship may extend beyond the private-sector Western and East Asian settings that dominate the evidence to a Nigerian public-sector environmental services organisation. From the perspective of SET, ESWAMA employees who perceive their supervisors as relationally transparent and ethically consistent appear to reciprocate through discretionary innovation behaviours. From the perspective of SDT, the autonomy-supportive and competence-affirming behaviours of authentic leaders appear to support the intrinsic motivation that underpins idea generation, promotion and realisation.

The finding diverges, however, from the Nigerian public-sector healthcare evidence of Ibrahim and Daniel (2023), who reported that authentic leadership did not directly influence creativity but operated only through job thriving. Three differences may explain the divergence. First, Ibrahim and Daniel (2023) measured creativity rather than IWB, and creativity is conceptually narrower. Second, their sample comprised mid-level healthcare professionals whose work roles may differ materially from those of ESWAMA field and administrative staff. Third, the present study used a multi-wave design with temporal separation, whereas Ibrahim and Daniel employed a cross-sectional design that is more susceptible to common method bias, which can distort the estimated effect in either direction. The convergence with the broader literature and the divergence from the single Nigerian public-sector study both suggest that the authentic leadership and innovation relationship is contextually variable and warrants careful theoretical interpretation rather than universal claims.

The measurement model results carry implications of their own. Unlike the Nigerian ALI evidence of Balogun et al. (2020), the present study achieved discriminant validity across all four authentic leadership dimensions, including between self-awareness and internalised moral perspective. This difference may reflect the larger probability-based sample, differences in sector and workforce composition, or the use of HTMT as a more sensitive discriminant validity criterion than the Fornell and Larcker criterion alone. The present design cannot isolate which of these explanations applies, and because the ALI was measured at a single wave, the two-wave structure cannot account for it. The finding tentatively suggests that the ALI can perform adequately in the Nigerian public sector when researchers attend carefully to sampling procedures and measurement-model evaluation.

Novelty and Contribution of the Study

The study's contribution lies in the combination of setting, design and measurement scrutiny rather than in a new construct or a new theoretical model. To the authors' knowledge, the study is among the first to test the relationship between authentic leadership and IWB with a two-wave time-lagged design in a Nigerian public-sector environmental services organisation. Table 5 summarises the three gaps identified in Sections 1.2 and 2.5 and the practical need noted in Sections 1.1 and 2.5, how the study addressed each, and the resulting contribution.

Table 5. Research gaps, how the study addressed them, and contribution

Gap	How the study addressed it	Contribution
Contextual: scarce and mixed evidence from African public-sector organisations; environmental services largely absent	Sampled employees of ESWAMA, a Nigerian public-sector environmental services parastatal; tested the direct effect of authentic leadership on IWB rather than creativity	Context-specific evidence that authentic leadership positively predicts IWB ($\beta = 0.326$) in a Nigerian public-sector operational agency
Design: predominantly cross-sectional, single-occasion evidence	Two-wave time-lagged survey with the predictor at T1 and the outcome at T2; marker variable, anonymity and different response anchors; a priori power analysis	Stronger temporal ordering and reduced method-bias risk than cross-sectional designs, with a transparent sample-size justification. The design does not establish causality
Measurement: weak ALI performance reported in one Nigerian banking sample	Full measurement-model evaluation of the ALI and the Janssen scale (reliability, AVE, Fornell and Larcker criterion, HTMT)	Evidence that the ALI met conventional reliability and validity thresholds in a Nigerian public-sector sample, offering a comparison point for Balogun et al. (2020)
Practice: limited context-specific guidance for supervisor development in public-sector waste management	Findings translated into recommendations for supervisor development, idea channels and relational climate	Evidence-based guidance for ESWAMA and comparable agencies (Section 9)

Note. T1 = Time 1; T2 = Time 2; IWB = innovative work behaviour; ALI = Authentic Leadership Inventory; AVE = average variance extracted; HTMT = heterotrait-monotrait ratio.

These contributions should be read within the study's boundaries. The study examines one organisation, relies on self-reported measures and estimates a direct effect only (Section 10). Its contribution is therefore best characterised as context-specific, methodologically careful evidence that clarifies where the authentic leadership and IWB relationship holds and sets up the mechanism and boundary-condition tests proposed in Section 10. It is not a general claim about all Nigerian public-sector organisations.

Theoretical Implications

The findings have five theoretical implications. First, the results extend the authentic leadership and IWB relationship to a setting that has received little attention: a Nigerian public-sector environmental services agency. The positive direct effect ($\beta = 0.326$) is consistent with Bai and Wang (2022) and Siswanti and Muafi (2025) despite differences in sector, region and methodology, which supports the view that the relationship is not confined to private-sector or non-African settings. Because the study covers one organisation, this is evidence of extension rather than of universality.

Second, the contrast with Ibrahim and Daniel (2023) suggests that whether authentic leadership affects innovation-related outcomes directly, or only through intervening mechanisms, may depend on the outcome examined (creativity versus the wider idea generation, promotion and realisation process captured by IWB), on the setting and on the research design. Theory on authentic leadership and innovation should therefore specify these conditions rather than assume a uniform pathway.

Third, the results are consistent with the exchange-based explanation of SET and the need-satisfaction explanation of SDT. SET captures the reciprocity through which authentic leadership may induce discretionary effort, while SDT specifies the motivational substrate of autonomy, competence and relatedness through which authentic leadership may translate into intrinsically motivated innovation. The study did not, however, measure trust, reciprocity or basic psychological need satisfaction, so these mechanisms remain inferred rather than tested. The study thereby identifies a precise theoretical task: to test whether these mechanisms mediate the effect and whether they operate differently in hierarchical public-sector settings.

Fourth, the moderate variance explained ($R^2 = 0.114$) indicates that authentic leadership is one antecedent within a broader set of individual, team and organisational conditions that shape IWB (Ferdian et al., 2025). Integrative models that combine leader behaviour with organisational climate, job design and public-sector constraints are therefore warranted.

Fifth, the study contributes evidence on measurement. The ALI met conventional reliability and validity criteria in this Nigerian public-sector sample, in contrast with the earlier Nigerian evidence of Balogun et al. (2020). Because the two studies differ in sector, sample size and sampling procedure, this does not resolve the earlier concerns. It does show that the ALI's four-factor structure can be supported in a Nigerian sample, and it underlines the value of reporting measurement-model diagnostics whenever scales are transferred across contexts.

Practical Implications

The findings carry practical implications for ESWAMA and comparable Nigerian public-sector organisations. Mean scores close to the scale midpoint for both authentic leadership ($M = 3.02$) and IWB ($M = 2.98$) indicate scope for improvement on both. Because authentic leadership explained a moderate share of variance in IWB, it should be treated as one lever among several rather than a complete solution. First, the results suggest that leadership development interventions targeting the four dimensions of authentic leadership may support employee IWB. ESWAMA could integrate authentic leadership training into its supervisory development programmes, with explicit attention to the behavioural indicators of self-awareness, relational transparency, balanced processing and internalised moral perspective. Such training should focus on actionable behaviours rather than abstract values, including the structured solicitation of dissenting viewpoints, the public admission of errors and the consistent application of ethical standards in disciplinary and resource-allocation decisions. Having met reliability and validity criteria in this study, the ALI could also serve as a developmental diagnostic for supervisors, provided that results are used for development rather than punitive appraisal.

Second, because IWB spans idea generation, idea promotion and idea realisation, ESWAMA could create formal channels through which frontline and administrative employees can submit, champion and pilot operational improvements. Such channels could include innovation suggestion schemes, periodic improvement workshops and protected time for experimentation, accompanied by explicit signalling from senior leadership that idea generation is valued even when implementation is uncertain. Within waste-management operations specifically, employee innovation could focus on route optimisation, recycling process redesign, community engagement approaches and enforcement practice, areas where frontline knowledge often exceeds managerial awareness.

Third, the role of relational transparency in supporting psychological safety implies that ESWAMA should attend to the relational climate between supervisors and subordinates. Performance management systems that emphasise developmental feedback, regular two-way communication and the protection of employees who raise legitimate concerns may complement authentic leadership behaviours and amplify their effect on IWB. Practical interventions should be evaluated through subsequent multi-wave research to establish whether changes in authentic leadership translate into measurable changes in IWB over time.

Fourth, state-level policymakers responsible for public-sector reform and civil-service training could consider including authentic leadership content in supervisory training across agencies. Because the evidence comes from a single agency, we recommend piloting such training in a small number of agencies, with evaluation, before wider adoption.

Limitations and Future Research

Limitations

Several limitations qualify the inferences drawn from this study. First, although the two-wave design strengthens causal ordering and reduces common method bias, it does not establish causality in the experimental sense. IWB was measured only at Time 2, so prior levels of IWB could not be controlled, and reverse causation (for example, employees who were already innovative rating their supervisors more favourably at Time 1) cannot be excluded. Unmeasured third variables, such as organisational climate or personality traits, may also influence both authentic leadership perceptions and IWB. In addition, the model estimated a direct effect only, so the mechanisms proposed in Section 2.4 were not tested.

Second, the study is set within a single Nigerian public-sector environmental services organisation, which limits external validity. Although ESWAMA was selected for its substantive importance and accessibility, the findings may not generalise to private-sector waste-management firms, to other Nigerian public-sector organisations or to environmental agencies in other African countries.

Third, both authentic leadership and IWB were measured through self-report. Although the multi-wave design and the marker variable reduce some of the concerns associated with single-source data, supervisor-rated or peer-rated IWB would provide a stronger test of the relationship.

Fourth, although the achieved sample of 351 matched cases provided adequate statistical power for the simple structural model tested, it limits the complexity of models that can be estimated with confidence. Finally, the eight-week interval between waves was selected on theoretical and practical grounds, but the optimal interval for studying leadership effects on IWB remains an open methodological question that warrants empirical investigation.

Directions for future research

The limitations above point to seven specific directions for future research.

First, studies should test mediating mechanisms using at least three waves, measuring IWB at the first wave as a baseline. Candidate mediators derived from SET and SDT include psychological safety, trust in the supervisor, leader–member exchange, basic psychological need satisfaction, work engagement and job thriving (Ibrahim & Daniel, 2023).

Second, studies should examine boundary conditions through moderated-mediation models, with organisational climate, bureaucratic red tape, formalisation, political instability in leadership and power distance as candidate moderators.

Third, studies should combine self-reports with supervisor- or peer-rated IWB and with objective indicators, such as the number of improvement suggestions submitted and implemented, to reduce reliance on a single source.

Fourth, the design should be replicated across several state waste-management agencies, other Nigerian public-sector organisations, private waste-management firms and other African countries. Multi-group analysis should test whether the ALI is measurement-invariant across sectors and respondent groups.

Fifth, longer panel designs, such as cross-lagged panel or latent growth models with three or more waves, could test reciprocal effects (innovative employees may shape how they perceive their leaders) and identify the interval over which leadership effects on IWB emerge.

Sixth, intervention studies could evaluate whether authentic leadership training for supervisors at ESWAMA changes employees' IWB, and qualitative or mixed-methods work with frontline waste-management staff could clarify how leadership behaviours enable or constrain idea generation and implementation in daily operations.

Seventh, studies with larger samples could estimate the effects of each authentic leadership dimension on each stage of IWB, which the present study, focusing on the overall constructs, did not do.

CONCLUSION

This study set out to establish whether authentic leadership predicts employee innovative work behaviour at ESWAMA, a Nigerian public-sector environmental services organisation where evidence has been scarce and inconsistent, and to assess the psychometric adequacy of the ALI in this setting. Using a two-wave time-lagged survey of 351 matched employees, the study found that authentic leadership measured at Time 1 had a positive and statistically significant effect on IWB measured eight weeks later ($\beta = 0.326$, 95% CI [0.225, 0.426]), explaining 11.4 per cent of its variance. The ALI and the Janssen scale met conventional reliability and validity criteria, and common method bias diagnostics did not indicate a pervasive threat.

The study contributes context-specific evidence from a public-sector setting that has received little attention, a time-lagged and power-justified test that strengthens temporal ordering relative to cross-sectional designs, and evidence on the ALI's measurement performance in Nigeria. The results imply that leadership development directed at supervisors' self-awareness, relational transparency, balanced processing and ethical consistency, combined with formal channels for employee ideas, is a promising route to greater innovation in ESWAMA and comparable agencies. The moderate effect size shows, however, that leadership is one of several conditions for IWB.

The study is limited by its single organisation, self-reported measures, the absence of a Time 1 baseline for IWB and a model restricted to a direct effect. Future research should test mediating mechanisms grounded in SET and SDT, examine boundary conditions such as organisational climate and bureaucratic constraints, use multi-source and objective indicators of innovation, replicate the design across agencies and sectors, and adopt longer panel and intervention designs. Addressing these

priorities would clarify how, and under what conditions, authentic leadership fosters innovation in African public-sector organisations.

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