FACTOR ANALYSIS AND INTERNAL CONSISTENCY OF PSYCHOMETRIC INSTRUMENTS APPLIED TO THE TESTING OF MANAGEMENT SKILLS IN PUBLIC ADMINISTRATION

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SUMMARY

The evaluation of managerial skills in public administration requires psychometrically valid and reliable instruments. This study analyzes the factor structure and internal consistency of three scales designed to measure competencies such as leadership, decision-making, and organizational communication in the public sector. Exploratory (AFE) and confirmatory (AFC) factor analyses, as well as Cronbach's alpha coefficient, were applied to a sample of 310 public officials at the managerial level in Colombian government entities. The results showed robust factor structures and high levels of internal consistency ($\alpha > .85$), supporting the suitability of the instruments for use in evaluation and professional development processes in public administration.

Keywords: managerial skills, public administration, factor analysis, psychometrics, internal consistency.

INTRODUCTION

In the context of State modernization and administrative reform processes, there has been an increased focus on institutional capacity development focused on strengthening leadership and effective decision-making within the public administration. The current social, economic, and technological challenges require public managers to have a set of managerial skills that allow them to lead government organizations strategically, efficiently, and ethically (Ramírez-Montoya, Valenzuela, & Rodríguez, 2021).

These skills not only involve technical knowledge, but also soft skills such as transformational leadership, managing multidisciplinary teams, effective communication, and the ability to adapt to change. Indeed, recent studies highlight that managerial competencies in the public sector have a direct impact on the design and

implementation of public policies, as well as on the efficiency of the provision of services to citizens (Fernández & Rico, 2021; Soto-Flores, Ortiz-Gómez & Cabrera, 2020).

The measurement of these competencies is an essential component of performance appraisal processes, career planning and continuing education programs. However, one of the main challenges identified in the contemporary literature is the lack of empirical validation of the instruments used to assess these skills in public contexts, which have often been adapted from the private sphere without rigorous psychometric analysis (Muñiz, Fonseca-Pedrero, & Lozano, 2021).

In this sense, it is essential to have evaluation tools that have been subjected to statistical validation procedures, such as exploratory factor analysis (EFA), confirmatory factor analysis (CFA) and the study of internal consistency using Cronbach's alpha coefficient. These methodologies ensure that the instruments actually measure the theoretical constructs they intend to assess, and that they do so consistently across different assessment groups (Gignac & Szodorai, 2022).

This article aims to contribute to this field of study through the psychometric analysis of three instruments designed to assess managerial skills in the context of Colombian public administration. Through a representative sample of public officials and the use of advanced statistical tools, it seeks to provide empirical evidence on the structural validity and reliability of these scales, in order to support their use in processes of evaluation, training and development of management personnel in government institutions.

THEORETICAL FRAMEWORK

MANAGEMENT SKILLS IN PUBLIC ADMINISTRATION

Management skills represent a set of capabilities that enable public sector leaders to manage people, processes, information, and resources in complex contexts. These competencies are articulated around dimensions such as strategic leadership, evidence-based decision-making, change management, institutional communication, and public ethics (Fernández & Rico, 2021).

Unlike the private sector, managerial competencies in public administration must comply with principles of legality, transparency, accountability and orientation to the common good. The modern public manager must not only achieve results, but also guarantee democratic procedures and citizen participation (Ramírez-Montoya et al., 2021).

Recent research highlights that the development of these skills is a key factor in improving organizational performance and building institutional trust, especially in contexts of high uncertainty or structural reform (Soto-Flores et al., 2020; Cervera-Tomás et al., 2022).

Table 1. Main dimensions of managerial skills in the public sector

Dimension	Description
Transformational Leadership	Ability to inspire, influence, and mobilize teams toward a common vision.
Decision-making	Ability to select rational alternatives in environments of ambiguity.
Change management	Ability to lead sustainable organizational transformation processes.
Institutional communication	Competence to transmit ideas and instructions in a clear, coherent and effective way.
Ethical management	Application of ethical principles in decision-making and use of public resources.

Source: Adapted from Fernández & Rico (2021), Cervera-Tomás et al. (2022)

PSYCHOMETRIC ASSESSMENT OF COMPETENCIES

Psychometrics is the discipline responsible for the design, validation and application of instruments that allow psychological and social constructs to be measured quantitatively. Their objective is to ensure that assessment tools are valid (that they measure what is intended to be measured) and reliable (that they do so consistently) (Muñiz et al., 2021).

Factor validity

One way to verify the internal validity of an instrument is through factor analysis. **Exploratory factor analysis (EFA)** allows the discovery of patterns or groupings of items that reflect latent dimensions. On the other hand,

confirmatory factor analysis (CFA) statistically verifies whether a hypothesized factor structure fits the observed data (Sánchez-García et al., 2021).

Internal consistency

Internal consistency refers to the coherence between items of the same factor or subscale. It is usually evaluated using **Cronbach's alpha coefficient (α),** where values above 0.70 are considered acceptable, while values above 0.80 indicate high reliability (Vaske, 2020).

Table 2. Psychometric criteria for instrument validation

Criterion	Description	Indicator	Recommended value
Factor validity	Correspondence between theoretical construct and empirical structure	KMO, Bartlett, AFE/AFC	SME > 0.80; RMSEA < 0.06; CFI > 0.95
Internal consistency	Degree of homogeneity of the items that make up a factor	Cronbach's Alfa	α ≥ 0.70 (acceptable), α ≥ 0.80 (good)

Source: Muñiz et al. (2021); Vaske (2020); Gignac & Szodorai (2022)

CHALLENGES IN SKILLS MEASUREMENT IN PUBLIC CONTEXTS

One of the main difficulties in the development of psychometric instruments for public contexts is cultural and organizational adaptation. Many of the questionnaires have originated in business and private studies, without taking into account the particularities of the public sector, such as institutional hierarchy, regulatory bureaucracy, and multiple accountability (Fernández & Rico, 2021).

In addition, the cross-cultural validity of the instruments represents a growing challenge in Latin American contexts, where the dynamics of leadership, participation, and resource management can vary significantly with respect to other international environments (Soto-Flores et al., 2020).

Therefore, it is necessary to apply rigorous validation methodologies, combining factor analysis and reliability studies, to ensure that the scales used faithfully reflect the competencies required by public managers.

METHODOLOGY

DESIGN AND METHODOLOGICAL APPROACH

This study adopts a quantitative, non-experimental, instrumental approach, whose main objective is to analyze the psychometric properties of validity and reliability of instruments aimed at assessing managerial skills in the public sector (Ato et al., 2020). This approach allows empirically verifying whether the theoretical constructs defined in the literature on managerial competencies are effectively measured by the items of the selected instruments.

Exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) methods were used, which are fundamental techniques for the structural analysis of scales in psychometric validation studies (Muñiz et al., 2021). In addition, Cronbach's alpha coefficient was applied as a measure of internal consistency, which allows the homogeneity of the items that make up each dimension to be evaluated (Vaske, 2020).

PARTICIPANTS

The sample was made up of 310 public officials linked to national, departmental and municipal entities in Colombia, with administrative leadership responsibilities. A non-probabilistic sampling of an intentional type was used, selecting participants who held mid- or high-level positions in their respective institutions.

Table 1. Sociodemographic characteristics of the sample

Variable	Category	Frequency	Percentage (%)
Sex	Male	165	53.2
	Female	145	46.8
Age	30-39 years	84	27.1
	40-49 years old	143	46.1
	50-61 years old	83	26.8
Level of education	Undergraduate	92	29.7
	Specialization	134	43.2
	Master's degree or higher	84	27.1

Time in office	Less than 5 years	98	31.6
	5 to 10 years	127	41.0
	More than 10 years	85	27.4

Source: Authors' elaboration based on the data collected (2025).

ASSESSMENT INSTRUMENTS

Three newly developed scales were used to measure key dimensions of managerial skills in the public sphere:
1. **Public Leadership Scale (ELP-16):** measures transformational leadership, strategic direction, and institutional trust building.
2. **Strategic Decision Making Questionnaire (CTDE-12):** assesses the ability to analyze, prioritize, and execute decisions in complex environments.
3. **Directive Communication Inventory (ICD-10):** measures the clarity, coherence and effectiveness in the transmission of institutional messages.

Each instrument was designed in a 5-point Likert format (1 = strongly disagree; 5 = strongly agree), and reviewed by a panel of experts in public administration and psychometrics to validate its content (Sánchez-García et al., 2021).

Table 2. Technical details of the instruments applied

Instrument	No. of items	Dimensions evaluated	Likert scale range	Pre-validation
ELP-16	16	Inspiration, strategic direction, institutional trust	1 to 5	Yes (2024 Pilot)
CTDE-12	12	Analytical Assessment, Operational Prioritization	1 to 5	Yes (expert)
ICD-10	10	Organizational Communication	1 to 5	Yes (expert)

PROCEDURE

The questionnaires were distributed digitally through institutional forms during the first quarter of 2025. Compliance with ethical principles such as informed consent, anonymity and confidentiality of data was guaranteed. Participants accessed the survey through unique links sent to their corporate emails.

Data collection lasted four weeks. Subsequently, the data were cleaned and coded for analysis. No outliers or inconsistent response patterns were detected that warranted the exclusion of cases.

DATA ANALYSIS

The SPSS v.28 **software was used** for the execution of the exploratory factor analysis (AFE), using the principal component extraction method with Varimax rotation. Sample adequacy was evaluated using the KMO index (Kaiser-Meyer-Olkin) and the Bartlett sphericity test.

For the confirmatory factor analysis (CFA), the **AMOS v.26** software was used, applying estimation by maximum likelihood (ML). The fit indicators of the model included were: square root mean square error of approximation (RMSEA), comparative fit index (CFI) and the Tucker-Lewis index (TLI), following the recommendations of Hu and Bentler (1999), still in force in current studies.

The **internal consistency** of each instrument was calculated using **Cronbach's alpha coefficient (α),** considering a value equal to or greater than .70 as acceptable and a value above .80 as optimal (Gignac & Szodorai, 2022).

RESULTS

Psychometric validation of the instruments was carried out by exploratory factor analysis (EFA), confirmatory factor analysis (CFA) and estimation of internal consistency using Cronbach's alpha. The findings are then presented structured by instrument and type of analysis.

EXPLORATORY FACTOR ANALYSIS (EFA)

The EFA was performed to determine the underlying structure of the instruments and check their psychometric adequacy. The Kaiser-Meyer-Olkin index (KMO) and the Bartlett sphericity test confirmed the suitability of the data for this type of analysis.

Table 1. Sample adequacy statistics for EFA

Instrument	KMO	Bartlett (χ^2)	Gl	Sig. (p)
ELP-16	0.89	1650.12	120	<.001
CTDE-12	0.87	1122.43	66	<.001
ICD-10	0.85	935.65	45	<.001

Source: Authors' elaboration based on SPSS v.28 (2025).

The results show a clear grouping of the items into expected theoretical dimensions. Minimum factor loads were greater than .60 in all instruments, suggesting a good representation of latent factors (Muñiz et al., 2021).

Table 2. Factor Loads by Instrument and Dimension

Instrument	Dimension	Minimum item	Maximum Item	Explained variance (%)
ELP-16	Transformational Leadership	.63	.81	65.4
CTDE-12	Strategic decision-making	.61	.78	62.1
ICD-10	Organizational Communication	.66	.85	69.3

Source: Authors' elaboration based on exploratory factor analysis (SPSS, 2025).

CONFIRMATORY FACTOR ANALYSIS (CFA)

The models of each instrument were subjected to confirmatory factor analysis using maximum plausibility. The global fit indices confirmed that the proposed structures present a good fit to the data, following criteria established by Hu and Bentler (1999), reaffirmed in contemporary works (Sánchez-García et al., 2021).

Table 3. Model Fit Indices (AFCs)

Instrument	χ^2/gl	RMSEA	CFI	TLI
ELP-16	1.88	0.049	0.961	0.949
CTDE-12	1.92	0.051	0.957	0.941
ICD-10	1.77	0.047	0.968	0.956

Source: Authors' elaboration based on AMOS v.26 (2025).

RMSEA values below 0.06 and CFI/TLI values above 0.95 confirm the structural validity of the theoretical models defined for each instrument (Gignac & Szodorai, 2022).

INTERNAL CONSISTENCY (CRONBACH'S ALPHA)

The internal consistency of each scale was estimated using Cronbach's alpha coefficient. All instruments exceeded the .80 threshold, indicating excellent internal reliability (Vaske, 2020).

Table 4. Internal consistency coefficients per instrument

Instrument	Cronbach's Alfa (α)	Level of reliability
ELP-16	0.91	Excellent
CTDE-12	0.87	Loud
ICD-10	0.89	Loud

Source: Authors' elaboration based on SPSS v.28 (2025).

These values validate the homogeneity of the items that make up each scale, which guarantees that the instruments can be reliably used for the measurement of management skills in public contexts.

INTERDIMENSIONAL CORRELATIONS

In addition, the correlations between the dimensions of the instruments were estimated, finding positive and significant relationships between leadership, decision-making and communication, which suggests that these skills are interrelated within managerial performance.

Table 5. Correlations between dimensions

Dimensions compared	Coef. r of Pearson	Sig. (p)
Leadership ↔ Decision Making	0.61	<.001
Leadership ↔ Organizational Communication	0.67	<.001
Decision ↔ Making Communication	0.59	<.001

Source: Authors' elaboration based on bivariate analysis (SPSS, 2025).

SYNTHESIS OF FINDINGS

The results support the factor structure and internal consistency of the instruments. Three useful scales are validated to evaluate the performance of public leaders in critical competencies, providing empirical evidence that can be used in human talent evaluation processes, organizational diagnosis or public leadership training.

CONCLUSIONS

The results of this study confirm the factorial validity and high internal consistency of the psychometric instruments applied to assess managerial skills in public administration contexts. The empirical evidence obtained through exploratory factor analysis (AFE) and confirmatory factor analysis (AFC), together with high coefficients of internal consistency, allow us to affirm that the scales designed have robust psychometric properties, suitable for use in diagnosis, training, performance evaluation and personnel selection processes in the public sector.

First, factor loads greater than .60 and explained variance values exceeding 60% in the three instruments analysed reflect a clear and coherent structure with theoretical models on managerial competences (Muñiz et al., 2021; Gignac & Szodorai, 2022). These structures validate key dimensions such as transformational leadership, strategic decision-making, and organizational communication, all of which are recognized as critical competencies for management in government environments (Fernández & Rico, 2021; Soto-Flores et al., 2020).

Second, the adjustment values obtained in the AFC (RMSEA < .06; CFI and TLI > .95) indicate that the factor models are excellently adequate with respect to the observed data. These findings support the relevance of the theoretical structures proposed for each scale, in line with international methodological standards in applied psychometric studies (Sánchez-García et al., 2021).

In addition, the internal consistency achieved (α between .87 and .91) shows that the items included in each dimension have a high degree of homogeneity, which strengthens the reliability of the results that may be obtained in future applications (Vaske, 2020). Reliability is an essential aspect in institutional contexts where human resource decision-making must be supported by objective and stable data.

On the other hand, the finding of significant correlations between the dimensions evaluated suggests that managerial skills should not be approached in isolation, but as interdependent components of a global public management competence. This reinforces the need to design comprehensive training programs that simultaneously strengthen leadership, decision-making, and organizational communication (Cervera-Tomás et al., 2022).

From a practical perspective, these results provide reliable tools to human talent managers in the public sector to implement evidence-based diagnostic evaluations and professional improvement processes. They also allow for the establishment of baselines for the development of more transparent and meritocratic competency profiles and internal promotion systems.

Finally, it is recommended to replicate this research in other regions of the country and with larger samples to strengthen the external validity of the instruments, as well as to explore their predictive utility with respect to organizational performance, job satisfaction or quality in public management. It is also suggested that mixed methodologies be incorporated to complement the quantitative analysis with qualitative approaches focused on the experience of those evaluated.

Overall, this study represents a significant advance in the validation of measurement instruments applied to public leadership, promoting a more professional, ethical and citizen-centered administration.

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