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Intelligence as an Innovation in Public Management: Premises for Institutionalization

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ABSTRACT

Objective: Intelligence in public management is recognized as an innovative approach that leverages technologies to enhance decision-making processes and facilitate democratic planning by establishing formal structures, engaging public servants and managers, and fostering social involvement for efficient data and information management. Despite its innovative potential, intelligence in public management requires legitimacy within government spheres. The objective of this study is to validate a model for the institutionalization of intelligence in public management, grounded in a theoretical framework encompassing ten dimensions of intelligence categorized into organizational structure, technological infrastructure, human capital, and social engagement. **Methods:** Employing quantitative research, data were collected through a survey conducted among managers and civil servants in the Brazilian context. **Results:** The results demonstrate a positive impact of the analyzed categories on the institutionalization of intelligence in public management, with human capital emerging as the most influential factor. **Conclusions:** This study underscores the significance of adopting an institutional perspective in structuring intelligence processes within public management, thereby offering avenues for theoretical advancement in the field and suggesting pathways toward establishing legitimacy for intelligence activities within government frameworks.

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INTRODUCTION

Technological advancements in recent decades have precipitated a surge in data volumes, necessitating effective management and transformation into actionable information for shaping public policies and enhancing governmental decision-making processes through intelligence practices in public management. Within this milieu, Matas (2018) underscores the criticality of robust institutional quality and intelligence capacity for proficient administration. Similarly, Kim et al. (2022) emphasize the importance of recognizing how emerging technologies fundamentally reshape governmental work dynamics and necessitate the reinstitutionalization of decision-making processes.

Gartner's projections (2021) suggest that by 2023, approximately 50% of government entities are expected to implement formal accountability frameworks for data sharing, encompassing standards for data structure, quality, and opportunities. Moreover, it is anticipated that 30% of governments will employ engagement metrics to monitor citizen participation levels and quality in political and budgetary decision-making processes. Consequently, there arises an exigency to bolster data management and information processing capacities through intelligence initiatives in public management (Gil-Garcia et al., 2016).

These forecasts from consultancies align with the theoretical underpinnings regarding the significance of intelligence in public management. Smart government constitutes an innovation within information and communication technology (ICT), leveraging cutting-edge technologies to enhance decision-making and democratic planning processes (Hujran et al., 2021). Intelligence in public management is oriented toward citizen-centric outcomes, harnessing data, and information to enhance performance (Kankanhalli et al., 2019; Schedler et al., 2019). Additionally, it encompasses facets such as integration, evidence-based decision-making, citizen-centricity, resilience, interoperability, and data, information, and knowledge sharing (Chatfield & Reddick, 2019; Gil-Garcia et al., 2014). These delineated characteristics pertaining to intelligence activities in public management are designed to engage the public and place users at the forefront of service delivery processes (Hujran et al., 2021), thereby enhancing the quality of public services and governmental decision-making.

The concept of intelligence within the public sphere is multifaceted and diverse (Gil-Garcia et al., 2016). Hence, drawing upon Malomo and Sena (2017), Chen et al. (2014), Gil-Garcia et al. (2016), Gil-Garcia et al. (2014), Scholl and Scholl (2014), and Eom et al. (2016), this study conceives intelligence in public management as an innovative endeavor. This innovation harnesses technologies to support and refine decision-making processes and aids in the orchestration of public activities through the establishment of formal structures, active engagement of public servants and managers, and fostering social involvement to effectively manage environmental data and information.

According to Gil-Garcia et al. (2014), governments across various levels and branches are increasingly embracing tools and applications to swiftly adapt to rapid environmental changes, aiming to meet society's demands for qualified and effective services (Schaefer et al., 2017). Consequently, the transition and establishment of intelligence in public management are perceived to face fewer technological barriers and more institutional challenges (Halaweh, 2018; Salvador & Ramió, 2020; WeiWei & WeiDong, 2015). In this context, governments must enhance and structure internal organizational processes (Harrison & Luna-Reyes, 2020) pertinent to intelligence in public management, focusing on data and information management (Salvador & Ramió, 2020), participation and social engagement (Przeybilovicz et al., 2018), and the nurturing of human capital (Valle-Cruz & Sandoval-Almazan, 2018) to expedite decision-making in response to environmental shifts, as no singular organizational condition suffices to achieve elevated levels of intelligence in public management (Mu et al., 2022)

To consolidate the concept of intelligence in public management, Melati and Janissek-Muniz (2020) delineated ten dimensions of intelligence: utilization of external data and information (D01); fostering an intelligence-centric organizational culture (D02); adept utilization of technologies (big data; business intelligence) (D03); evidence-based decision-making (D04); fostering cross-departmental and interorganizational collaboration (D05); fostering innovation, co-creation, and collective intelligence (D06); enabling agile government (D07); enhancing management efficiency and effectiveness (D08); promoting social engagement (D09); and organizing and unifying databases (D10). These dimensions were correlated with four requisite categories for legitimizing intelligence in public management: organizational structure, technological infrastructure, human capital, and social engagement (Chen et al., 2014; Halaweh, 2018; Li & Liao, 2018; Malomo & Sena, 2017; Przeybilovicz et al., 2018; Santos, 2018; Valle-Cruz & Sandoval-Almazan, 2018; Vieira & Alvaro, 2018), as corroborated by Melati and Janissek-Muniz (2022).

From the establishment of theoretical relationships between intelligence dimensions and the premises of institutional theory (Dimaggio & Powell, 1983; Robbins

& Judge, 2012; Selznick, 1972; Tolbert & Zucker, 1999), it becomes evident that the institutionalization of intelligence can facilitate governmental action in addressing environmental uncertainties. Consequently, governmental innovation manifests through the formulation of public policy strategies and the enhancement of decision-making processes. Thus, the imperative lies in bridging the gap necessitating greater capacity to systematically manage data through the structuring and legitimization of internal intelligence processes in public management, thereby enabling future research to evaluate the efficacy of these processes within society.

Considering the aforementioned, regarding intelligence as an innovation demanding legitimacy within government, this study poses the following question: What influence do the dimensions of intelligence have on the institutionalization of intelligence in public management? Considering the aspects associated with the institutional barriers to structuring intelligence in public management and the theoretical premises related to the dimensions inherent in intelligent governance, this study seeks to validate a model for institutionalizing intelligence in public management. This model is delineated based on the theoretical correlation of ten intelligence dimensions, categorized into four primary domains: organizational structure, technological structure, human capital, and social engagement.

This study endeavors to contribute to the consolidation of a model delineating plausible avenues for surmounting the institutional barriers to establishing a smart government. It draws upon the outcomes of the analysis of the level of influence of the principal categories (organizational structure, technological structure, human capital, and social engagement) in the institutionalization of intelligence in public management, intertwined with the dimensions of intelligence (utilization of external data and information; fostering an intelligence-centric organizational culture; adept utilization of technologies; evidence-based decision-making; fostering cross-departmental and interorganizational collaboration; database organization and unification; enabling agile government; enhancing management efficiency and effectiveness; promoting social engagement; fostering innovation, co-creation, and collective intelligence). Furthermore, this study aims to facilitate the evolution of the intelligence process within public management, delineating potential paths to be pursued and refined by managerial oversight.

This article is structured into four sections following this introduction. It initiates with a theoretical discourse on the critical categories underpinning intelligence in public management, their interrelationship with the process dimensions, and the institutional foundations. Subsequently, the method section elucidates the research procedures employed. Finally, this study presents the outcomes of the methodological application and the concluding remarks.

THEORETICAL FRAMEWORK AND HYPOTHESES DEVELOPMENT

The theoretical foundations of this article substantiate the discourse on institutional aspects crucial for legitimizing intelligence in public management. The dimensions of intelligence within public management are delineated and categorized for analytical scrutiny. Consequently, hypotheses are formulated, and a research model is devised to gauge the impact of constructs on the institutionalization of intelligence in public management.

Institutionalization of intelligence in public management

The proliferation of information and communication technologies (ICT) has mandated governmental entities to grapple with an increased volume and diversity of data across various spheres of operation (Layne & Lee, 2001; Papadomichelaki & Mentzas, 2012). Governments and enterprises alike have recognized the inherent value of data and are now more attentive to fostering data management and utilization endeavors (Choi et al., 2021).

In this context, intelligence in public management emerges as a contemporary wave of modernization within the sector. It pledges to furnish citizens with guidance and information, facilitating effective administrative interventions through data-driven technologies (Chiusoli & Rezende, 2019; Schedler et al., 2019). Criado and Gil-Garcia (2019) encompass factors relating to ICT within the concept of smart government, transcending conventional and nascent trends to create value for both government entities and society. It is characterized as an innovation that amalgamates enhanced service provision modalities and operational methodologies (Gil-Garcia et al., 2016).

Hence, the perspective of intelligence in public management emerges as an innovation necessitating institutionalization, given that theoretical tenets advocate benefits for both administration and society, underscoring the imperative to develop and structure this activity within governmental frameworks. In this context, it is apt to adopt the institutionalization process model delineated by Tolbert and Zucker (1999), which commences with innovation and progresses through three stages to embed it within the organization: habitualization, objectification, and sedimentation. According to the authors, organizations engage in continual interactions with their environment, adapting to evolving circumstances.

Tolbert and Zucker (1999) posit 'habitualization' as the establishment of behavioral patterns aimed at resolving organizational challenges, thereby engendering the creation of new autonomous structures. In the 'objectification' phase, organizational actions assume societal significance, accentuating that broader dissemination of the structure enhances its perception as an optimal choice with reduced uncertainty. Consequently, this engenders mimetic isomorphism, wherein organizations emulate other entities in their domain perceived as legitimate or successful (Dimaggio & Powell, 1991). Interest groups within the structure undertake the responsibility of disseminating information regarding failures and discontent within certain organizations, endeavoring to diagnose and rectify organizational issues. Evidence may be gleaned from diverse sources (e.g., news, direct observations, competitor analyses), with theorization imparting normative and cognitive legitimacy to the structure (Tolbert & Zucker, 1999). 'Sedimentation' hinges on the structure's continuity and its endurance across generations. Full institutionalization necessitates a likely reliance on the confluence of factors including minimal resistance from opposing factions, sustained advocacy and cultural backing from proponent groups, and a positive correlation with desired outcomes (Tolbert & Zucker, 1999).

Table 1 delineates the stages of the institutionalization process proposed by Tolbert and Zucker (1999), grounded in a theoretical discourse on intelligence in public management, correlating them with intelligence dimensions:

Table 1. Theoretical relationships between stages of institutionalization and intelligence in public management.

Stages of the institutionalization process (Tolbert & Zucker, 1999)	Theoretical relationship	Dimensions of intelligence in public management
Habitualization	The understanding of public management regarding the importance of structuring intelligence, intensifying the use of data and information from the environment, and taking advantage of available technologies.	D01 — Use of external data and information D03 — Effective use of technologies (big data, business intelligence)
Objectification	Organization of the intelligence structure, aiming for normative and cognitive legitimacy. This activity comes to have a shared meaning with public management and society. With positive results, other public bodies see the dissemination of the structure as an optimal choice.	D04 — Evidence-based decision-making D05 — Cross-departmental and interorganizational collaboration D06 — Innovation, co-creation, and collective intelligence D10 — Database organization and unification
Sedimentation	Consolidation and continuity of intelligence through generations of members of the organization, which, in the case of public management, can be related to the sustainability of the process beyond government exchanges.	D02 — Organizational culture based on intelligence D06 — Innovation, co-creation, and collective intelligence D07 — Agile government D08 — Management efficiency and effectiveness D09 — Social engagement

Note. Stages of the institutionalization process proposed in Tolbert and Zucker's model (1999) and the dimensions of intelligence proposed by Melati and Janissek-Muniz (2020). Source: Developed by the authors.

It is essential to acknowledge that the institutionalization of intelligence in public management does not entail a linear and rigid process. Instead, as advocated by Lesca (2003) and Cainelli (2018), intelligence must encompass a continuous and iterative cycle, conceptualizing government as an open system per general systems theory (Von Bertalanffy, 1972). This theory posits constant adaptation to the environment to inform policymaking, fostering innovative solutions and strategies aimed at enhancing public value for both government entities and society (Bryson et al., 2015; Criado & Gil-Garcia, 2019; Moore, 1995).

Based on the established relationships concerning the institutionalization of intelligence in public management, the imperative to monitor the environment emerges as a pivotal determinant. It seeks to facilitate adaptations or reevaluations of activities to optimize governmental administration, augment decision-making efficacy, and enhance public service provision (Shan et al., 2021). Consequently, grounded in the theoretical premises of intelligence institutionalization in public management, the influence of four critical antecedents surfaces: organizational structure, technological infrastructure, human capital, and social engagement. The subsequent section will delineate these facets.

Intelligence in public management: Dimensions and categories

The concept of intelligence in public management is addressed comprehensively and diversely (Gil-Garcia et al., 2016). Drawing upon numerous studies (Eom et al., 2016; Gil-Garcia et al., 2014; Johnston & Hansen, 2011; Scholl & Scholl, 2014), intelligence in public management pertains to governmental responses to environmental uncertainties (Johnston & Hansen, 2011), entailing the formulation of new strategies in public policies through environmental surveillance (Gil-

Garcia et al., 2013), augmenting data and information processing capabilities through integrated systems (Gil-Garcia et al., 2014; Scholl & Scholl, 2014), and fostering collaboration between public servants and government and society (Malomo & Sena, 2017; Przeybilovicz et al., 2018). According to Melati and Janissek-Muniz (2020), there are ten dimensions underpinning the evolution of intelligence in public management (Table 2):

Table 2. Smart government dimensions.

Intelligence dimensions	Definition	Theoretical basis
Use of external data and information (D01)	The importance of using data and information that is latent in the crowd and can contribute to public management.	Gil-Garcia et al. (2013, 2016); Scholl and Scholl (2014)
Organizational culture based on intelligence (D02)	Encouraging a culture of alertness and information sharing through networks, collecting external data and information, and using information to develop the work and decision-making of public managers.	Lesca and Janissek-Muniz (2015); Schoemaker and Day (2009); Xu (2007)
Effective use of technologies (big data; business intelligence) (D03)	Information and communication technology (ICT) used in government to collect, process, and share data and information, which can then be used to make decisions and provide public services.	Gil-Garcia et al. (2013, 2016); Scholl and Scholl (2014); Johnston and Hansen (2011); Linders et al. (2015); Paula and Rover (2012); Wang et al. (2016)
Evidence-based decision-making (D04)	Decisions based on data and the intensification of its use through ubiquitous sensing, advanced measurement, and integrated applications allow the government to make more informed decisions.	Gil-Garcia et al. (2016); Scholl and Scholl (2014)
Cross-departmental and interorganizational collaboration (D05)	Sharing data and information between different public sector bodies through collaboration and developing unified public activities to better serve society.	Gil-Garcia et al. (2016); Liu and Zheng (2015)
Innovation, co-creation, and collective intelligence (D06)	Improving processes, insights for new public policies, new forms of communication between government and society, and sharing decisions by harnessing collective intelligence.	Eom et al. (2016); Gil-Garcia et al. (2016); Guenduez et al. (2018); Juniawan et al. (2017); Nam (2016)
Agile government (D07)	Speed up the provision of services to society by intensifying the use of ICT, the use of data and information, and society's participation.	Scholl and Scholl (2014); Johnston and Hansen (2011)
Management efficiency and effectiveness (D08)	Public management efficiency and effectiveness with effective use of ICT, data, and information and society's participation.	Scholl and Scholl (2014); Liu and Zheng (2015)
Social engagement (D09)	Effective participation of society in public management development.	Eom et al. (2016); Gil-Garcia et al. (2014); Gil-Garcia et al. (2013); Scholl and Scholl (2014); Johnston and Hansen (2011)
Database organization and unification (D10)	Unification of the most diverse databases and integration of government systems.	Melati and Janissek-Muniz (2020)

Note. Source: Developed by the authors.

Coupled with the mapping and validation of dimensions within smart government, investigations into intelligence in public management have facilitated the theoretical delineation of specific categories for legitimizing intelligence in public management: organizational structure, technological infrastructure, human capital, and social engagement (Chen et al., 2014; Halaweh, 2018; Li & Liao, 2018; Malomo & Sena, 2017; Przeybilovicz et al., 2018; Santos, 2018; Valle-Cruz & Sandoval-Almazan, 2018; Vieira & Alvaro, 2018). The association between these four categories and the ten dimensions of intelligence was conceptualized and validated based on extant theory (Table 3).

Table 3. Categories for institutionalizing intelligence in public management.

Categories	Definition	Intelligence dimensions
Organizational structure	Redesign of the technical structure through the centralization of information, new management and organizational culture mechanisms, engagement, and leadership, alongside definitions of intelligence processes.	D01 — Use of external data and information D02 — Organizational culture based on intelligence D05 — Cross-departmental and interorganizational collaboration D07 — Agile government D08 — Management efficiency and effectiveness
Technological structure	Practices and real effects of data and information technology in the development and legitimacy of intelligence in public management.	D03 — Effective use of technologies D06 — Innovation, co-creation, and collective intelligence D07 — Agile government D10 — Database organization and unification
Human capital	Training and human development aimed at increasing the analytical capacity of public servants. Incentives for public managers and servants focused on intelligence.	D02 — Organizational culture based on intelligence D04 — Evidence-based decision-making
Social engagement	Set up government and society co-creation processes. Implement an open data policy and interaction mechanisms with the business sector and other social actors.	D06 — Innovation, co-creation, and collective intelligence

Note. Source: Developed by the authors.

Through the amalgamation of intelligence dimensions with categories aimed at institutionalizing intelligence in public management, four constructs emerged, forming the basis for proposing hypotheses, as presented below.

The 'Organizational Structure' pertains to the establishment of an intelligence-centric organizational culture within public management, entailing the structuring and standardization of intelligence processes and the adoption of organizational mechanisms to enhance data and information monitoring, utilization, and sharing through cross-departmental and interorganizational collaboration, as well as the engagement of leadership in the process (Halaweh, 2018; Vieira & Alvaro, 2018; WeiWei & WeiDong, 2015).

H1: Organizational structure influences the institutionalization of intelligence in public management.

The 'Technological Structure' underscores the significance of various information and communication technologies as facilitating tools for data collection and management to inform public policy development and governmental decision-making. Digital platforms play a crucial role in fostering increased societal participation in public management and in unifying databases and enhancing information system interoperability (Chen et al., 2014; Santos, 2018).

H2: The technological structure influences the institutionalization of intelligence in public management.

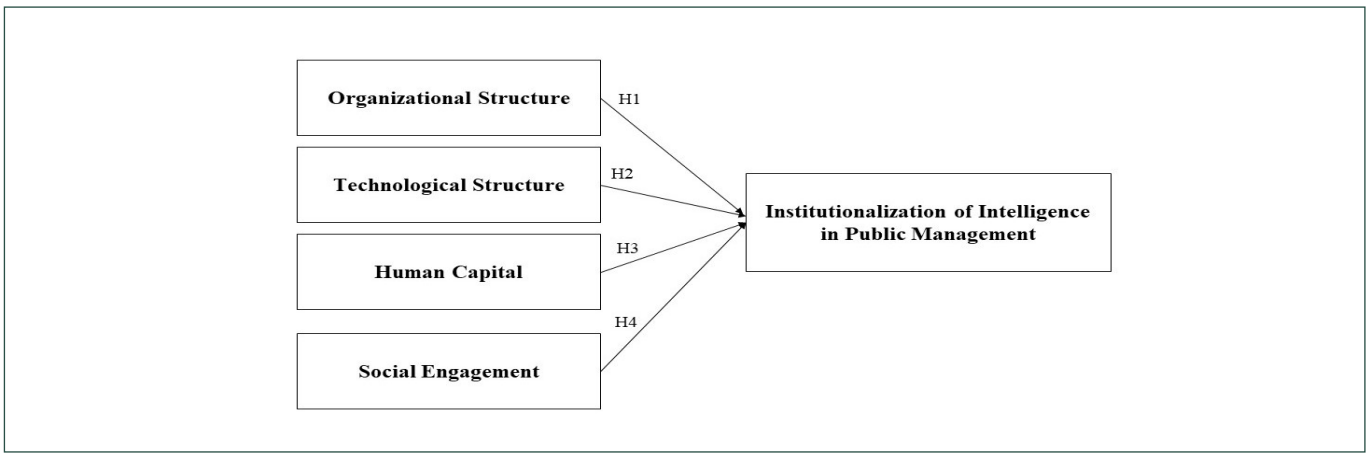
The Human Capital construct emphasizes the need to train public servants to develop analytical skills and foster intelligence. It also pertains to the development of data intelligence-focused training programs for public leaders, seeking to establish intelligence communities and teams within public management (Bojovic et al., 2017; Malomo & Sena, 2017; Smith, 2008; Valle-Cruz & Sandoval-Almazan, 2018).

H3: Human capital influences the institutionalization of intelligence in public management.

Social Engagement underscores the importance of legitimizing intelligence in public management, necessitating active societal participation in governmental processes and co-creation endeavors. It aims to harness collective intelligence to innovate and enhance management processes and to formulate new public policies (Algebri, et al., 2017; Bernardes et al., 2017; Calof, 2017; Hidayat & Kurniawan, 2017; Kumar & Sharma, 2017; Li & Liao, 2018; McBride et al., 2018; Przeybilovicz et al., 2018).

H4: Social engagement influences the institutionalization of intelligence in public management.

This study endeavors to measure the influence of the four categories on the institutionalization of intelligence in public management, grounded in a theoretical understanding of the four categories inherent to intelligence development in public management. It considers the theoretical discourse on the process of institutionalizing innovations within organizations alongside the theoretical premise that the barriers to transitioning and structuring a smart government appear less technological and more institutional (Halaweh, 2018; Salvador & Ramió, 2020; WeiWei & WeiDong, 2015). Figure 1 illustrates the research model, proposing categories (comprising intelligence dimensions) influencing the institutionalization of intelligence in public management.



Source: Developed by the authors.

Figure 1. Measurement model for institutionalizing intelligence in public management.

Through the validation of this model, the study aims to delineate the influence of the constructs on the institutionalization of intelligence in public management, shedding light on managerial pathways and enhancements concerning organizational structure, technology, human capital, and social engagement.

METHODOLOGICAL PROCEDURES

To validate the proposed research model for the institutionalization of intelligence in public management, this study employed quantitative research conducted through an electronic survey to validate the influence of four main categories on the institutionalization of intelligence. According to Hair et al. (2005), a survey is a procedure for collecting primary data from individuals and can be characterized as exploratory (Marconi & Lakatos, 2017). It is employed to develop new concepts, which is suitable for this study since the topic under investigation lacks a referential model.

The survey is a method whereby information on the researched topics is structured and standardized, predominantly in questionnaires with predefined questions (Hair, Black et al., 2014). The questionnaire items were developed based on a literature review on intelligence in public management, its dimensions and categories, and the premises of institutional theory. A five-point Likert scale was utilized to measure the items, ranging from one (totally disagree) to five (totally agree).

The G*Power 3.1 software was utilized to determine the sample size. The minimum sample size was calculated by assessing the construct or latent variable with the highest number of predictors as a reference for determining the sample size (Ringle et al., 2014). Following Hair, Sarstedt et al. (2014), a test power of 0.80 and an effect size (f^2) of 0.15 were considered. Based on these parameters, the minimum number of respondents required for the survey was determined to be 85.

Initially, for the face and content validity of the research instrument, two doctors and two public managers qualitatively analyzed the questionnaire, proposing adjustments to the wording of the items to enhance respondent comprehension. Subsequently, the pre-test stage was conducted, with the questionnaire made available to 95 public servants selected through accessibility. They were administered online via an instant messaging application containing the access link. Seventy-three questionnaires were returned.

Upon tabulating the responses in an electronic spreadsheet, the sample was refined, excluding three incomplete questionnaires and an additional 24 with 80% or more of the answers in the same item or responses to only two items (Hair et al., 2016). For the final analysis of the pre-test, a sample of 46 valid questionnaires was considered. The results of this stage facilitated improvements to the questionnaire for the final study. Responses obtained during the pre-test stage were not included in the final analysis due to changes in the wording of the statements aimed at refining the questionnaire.

Following refinement and finalization of the questionnaire, an electronic survey was administered on the Survey Monkey platform, widely used in academic studies (Chopdar & Sivakumar, 2019). The survey was distributed to public servants and managers across several Brazilian states between August and September 2021, with respondents guaranteed anonymity. The decision to distribute the survey to the broader public of public servants, regardless of their managerial status, was made to obtain a comprehensive organizational perspective on the influence of each category of analysis.

After 30 days of data collection, 344 questionnaires were obtained, of which 43 were incomplete, and an additional 90 were excluded for having 80% or more of the answers in the same item or responses to only two items (Hair et al., 2016). Following exclusions, analysis procedures were conducted considering 211 responses, surpassing the minimum calculated sample size (85 respondents).

The collected data were analyzed using statistical techniques employing SPSS software for reliability and exploratory data analysis. Subsequently, to test the model and conduct hypothesis testing, this study utilized the latent structural equation modeling technique — partial least squares (PLS), with SmartPLS 3.0 software, which is suitable when the study aims to predict and develop theory (Hair et al., 2016).

RESULTS PRESENTATION AND DISCUSSION

Based on the survey, the respondents, the quantitative analysis, and the discussion of the results are presented, followed by indications of actions to help public management structure intelligence. Table 4 displays the characteristics of the respondents, such as age, education level, length of time in public service, and position held, along with the work environment, identifying the state, public sphere, and authority (executive, legislative, and/or judiciary).

Table 4. Categories for institutionalizing intelligence in public management.

Characteristics	Category	Frequency	%
Age	18-30 years old	9	4.27%
	31-40 years old	86	40.76%
	41-50 years old	68	32.23%
	51-60 years old	29	13.74%
	over 60 years old	19	9.00%
Education level	High school/Technical	10	4.74%
	Higher education	51	24.17%
	Specialization	104	49.29%
	Master's degree	33	15.64%
	Doctorate degree	13	6.16%
Length of service in the public sector	Up to 1 year	3	1.42%
	From 1 to 5 years	29	13.74%
	From 6 to 10 years	53	25.12%
	From 11 to 15 years	48	22.75%
	More than 15 years	78	36.97%
Position	Management	49	23.22%
	Direction	21	9.95%
	Technician/Analyst	141	66.82%
Public sphere of action	Municipal	24	11.37%
	State	156	73.93%
	Federal	31	14.69%
Public power of action	Executive	178	84.36%
	Legislative	14	6.64%
	Judiciary	19	9.00%
State of operation	Acre	0	0.00%
	Alagoas	0	0.00%
	Amapá	0	0.00%
	Amazonas	0	0.00%
	Bahia	0	0.00%
	Ceará	0	0.00%
	Distrito Federal	6	2.84%
	Espírito Santo	0	0.00%
	Goiás	0	0.00%
	Maranhão	0	0.00%
	Mato Grosso	0	0.00%
	Mato Grosso do Sul	1	0.47%
	Minas Gerais	0	0.00%
	Pará	1	0.47%
	Paraíba	3	1.42%
	Paraná	3	1.42%
	Pernambuco	1	0.47%
	Piauí	1	0.47%
	Rio de Janeiro	6	2.84%
	Rio Grande do Norte	0	0.00%
	Rio Grande do Sul	174	82.46%
	Rondônia	2	0.95%
	Roraima	0	0.00%
	Santa Catarina	2	0.95%
	São Paulo	7	3.32%
	Sergipe	4	1.90%
	Tocantins	0	0.00%

Note. Source: Developed by the authors.

The analysis in Table 4 suggests the technical qualifications of the respondents, with approximately 79% possessing at least specialist training. Respondents exhibit extensive experience in public management, with around 60% having worked in the public sector for over ten years. Regarding their work environment, there was a predominance of respondents from the state of Rio Grande do Sul, accounting for over 80% of the responses obtained (due to proximity, convenience, and access to the executive power of Rio Grande do Sul, which is considered a limitation of this study). However, public servants from 12 other Brazilian states also participated. Concerning the sphere and authority, approximately 74% are from the state sphere and 85% from the executive branch.

Reliability analysis and exploratory factor analysis (EFA)

Cronbach's alpha was utilized to analyze the reliability of the instrument and its respective factors, aiming

to measure the internal consistency of the instrument. According to Hair et al. (2016), the coefficient values range from 0 to 1, with values above 0.70 indicating acceptable reliability. Table 5 presents Cronbach's alpha for the factors in this study, showing that all factors in the model have values above 0.70, with most exceeding 0.80.

Table 5. Cronbach's alpha.

Factor	Cronbach's alpha	Number of items
Human Capital (HC)	0.713	6
Organizational Structure (OS)	0.799	8
Technological Structure (TS)	0.802	7
Social Engagement (SE)	0.820	5
Institutionalization of Intelligence in Public Management (INST)	0.842	11

Note. Source: Developed by the authors.

To assess the unidimensionality of the item set within each factor, exploratory factor analysis (EFA) was conducted, calculating the Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity. These tests helped determine the suitability of the data for factor analysis, examining whether items within a factor converge in a direction indicating association (Hair, Black et al., 2014). According to Hair et al. (1987), KMO values above 0.5 and a significant Bartlett's test (p-value < 0.05) indicate sample suitability for factor analysis (Table 6).

Table 6. Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity.

Factor	KMO	Bartlett's test of sphericity (significance)
Human Capital (HC)	0.776	0.000
Social Engagement (SE)	0.813	0.000
Organizational Structure (OS)	0.792	0.000
Technological Structure (TS)	0.850	0.000
Institutionalization of Intelligence in Public Management (INST)	0.873	0.000

Note. Source: Developed by the authors.

Considering the data in Table 6, the samples are suitable for factor analysis, as KMO values for all factors exceed 0.5, and Bartlett's test shows a significant sample, as shown in exploratory factor analysis (Table 7). The analysis aims to assess unidimensionality within the item set of each factor, ensuring that items converge in a single direction and exhibit association. The suggested minimum value for this analysis is 0.40 (Koufteros, 1999; Lewis & Byrd, 2003). Table 7 indicates that most items in the model have factor loadings above the recommended minimum of 0.40, with particular attention to items with results below 0.40.

Table 7. Exploratory factor analysis in the blocks.

Items	HC	Items	SE	Items	OS	Items	TS	Items	INST
HC01	0.447	SE01	0.679	OS01	0.688	TS01	0.513	INST01	0.563
HC02	0.722	SE02	0.811	OS02	0.755	TS02	0.724	INST02	0.688
HC03	0.677	SE03	0.850	OS03	0.661	TS03	0.678	INST03	0.701
HC04	0.743	SE04	0.733	OS04	0.750	TS04	0.752	INST04	0.399
HC05	0.814	SE05	0.737	OS05	0.735	TS05	0.793	INST05	0.696
HC06	0.407			OS06	0.296	TS06	0.611	INST06	0.694
				OS07	0.578	TS07	0.655	INST07	0.629
				OS08	0.654			INST08	0.469
								INST09	0.716
								INST10	0.726
								INST11	0.544

Note. HC — Human Capital. SE — Social Engagement. OS — Organizational Structure. TS — Technological Structure. INST — Institutionalization of Intelligence in Public Management. Source: Developed by the authors.

Regarding items with values lower than the recommended minimum, EO06, 'The standardization of intelligence activity in the organization — through normative instructions, work instructions, and others, is decisive for the effective use of data and information in public management,' and INST04 'Standardizing the intelligence

activity in public management through normative instructions, work instructions, and other work regulations provides effective monitoring, use, and dissemination of data and information, validating the intelligence process in government,' will be excluded from subsequent analyses. It is noteworthy that, unlike the pre-test, which saw seven indicators fall below the minimum value (0.40), there was an increased convergence of items within the latent constructs after refinement of the survey instrument post-pre-test and a significant rise in respondents.

Measurement model

The evaluation of the measurement model aims to analyze its reliability and validity. According to Hair et al. (2011), the assessment should consider (a) individual external loadings of the survey items, (b) composite reliability (CR), (c) convergent validity (average variance extracted — AVE), and (d) discriminant validity (Fornell-Larcker criteria and heterotrait-monotrait ratio — HTMT).

The initial step involved examining the individual outer loadings of the survey items constituting each construct, which should ideally exceed the minimum acceptable level (0.4) and approach the preferred level (0.7) (Hair et al., 2011; Lin et al., 2015). Four items with external loadings far from the preferred level were identified, resulting in their exclusion along with their respective values: HC01 (0.416), HC06 (0.359), TS01 (0.487), and INST08 (0.473), leading to a notable improvement in composite reliability and AVE (Hair et al., 2011). Notably, HC06 and TS01 had previously shown lower external loadings during the pre-test stage. Items HC01 and INST08 pertained to issues regarding the training and development of public servants. The analysis indicates that these indicators lack significant association with the constructs they are intended to represent, namely Human Capital for HC01 and HC06, Technological Structure for TS01, and Institutionalization of Intelligence in Public Management for INST08.

Subsequently, other items with values below the preferred level of 0.7 (SE01, OS01, OS03, OS07, OS08, TS03, TS06, TS07, INST01, INST05, INST06, INST07, and INST11) were assessed, and it was decided to retain them as their exclusion would not enhance the model's composite reliability. To analyze the model's internal consistency, Cronbach's alpha and composite reliability values were calculated, both of which surpassed the recommended threshold of 0.7 (Hair et al., 2011). Table 8 presents the research model's quality based on the resulting analysis.

Table 8. External loads, Cronbach's alpha, composite reliability, and AVE.

Factor	Items	External loads	Cronbach's alpha	Composite reliability	AVE
Human Capital	HC02	0.770	0.759	0.847	0.581
	HC03	0.711			
	HC04	0.763			
	HC05	0.802			
Social Engagement	SE01	0.677	0.820	0.874	0.583
	SE02	0.780			
	SE03	0.851			
	SE04	0.766			
	SE05	0.731			
Organizational Structure	OS01	0.679	0.818	0.864	0.477
	OS02	0.729			
	OS03	0.647			
	OS04	0.730			
	OS05	0.739			
	OS06	Excluded (Table 7)			
	OS07	0.620			
	OS08	0.683			
Technological Structure	TS02	0.714	0.804	0.860	0.507
	TS03	0.689			
	TS04	0.771			
	TS05	0.791			
	TS06	0.631			
	TS07	0.664			
Institutionalization of Intelligence in Public Management	INST01	0.589	0.845	0.879	0.450
	INST02	0.709			
	INST03	0.720			
	INST04	Excluded (Table 7)			
	INST05	0.695			
	INST06	0.694			
	INST07	0.628			
	INST09	0.713			
	INST10	0.723			
	INST11	0.536			

Note. Source: Developed by the authors.

Regarding convergent validity, calculated from the AVE, the ideal values exceeding 0.50 suggest that the construct explains at least 50% of the variance in its items (Hair et al., 2016). Most constructs in the model meet the recommended level of 0.50, except for Organizational Structure with AVE = 0.477 and Institutionalization of Intelligence in Public Management with AVE = 0.450. This outcome may stem from factors related to organizational structure being intricately linked to the institutionalization of intelligence in public management.

Lastly, the discriminant validity analysis, as per the Fornell-Larcker criterion (Fornell & Larcker, 1981), evaluates the extent to which a construct differs from others in the structural model (Hair, Sarstedt et al., 2014). It stipulates that the square root of the AVE of each construct should surpass the estimated correlations with other constructs (Fornell & Larcker, 1981). Examination of the discriminant validity matrix reveals that all shared variances are lower than the variance extracted by the items measuring the constructs, indicating satisfactory discriminant validity, except for the HC/INST[1] correlation, where a minor difference is noted, justified by the conceptual similarity between a latent variable and a dependent variable.

Table 9. Discriminant: Fornell-Larcker criterion.

Factor	HC	SE	OS	TS	INST
Human Capital (HC)	0.762				
Social Engagement (SE)	0.466	0.763			
Organizational Structure (OS)	0.484	0.402	0.691		
Technological Structure (TS)	0.561	0.368	0.608	0.712	
Institutionalization of Intelligence in Public Management (INST)	0.683	0.505	0.603	0.622	0.670

Note. Source: Developed by the authors.

Having scrutinized and validated the criteria pertaining to the measurement model, the subsequent section presents the outcomes concerning the structural model and hypothesis test.

Structural model and hypothesis testing

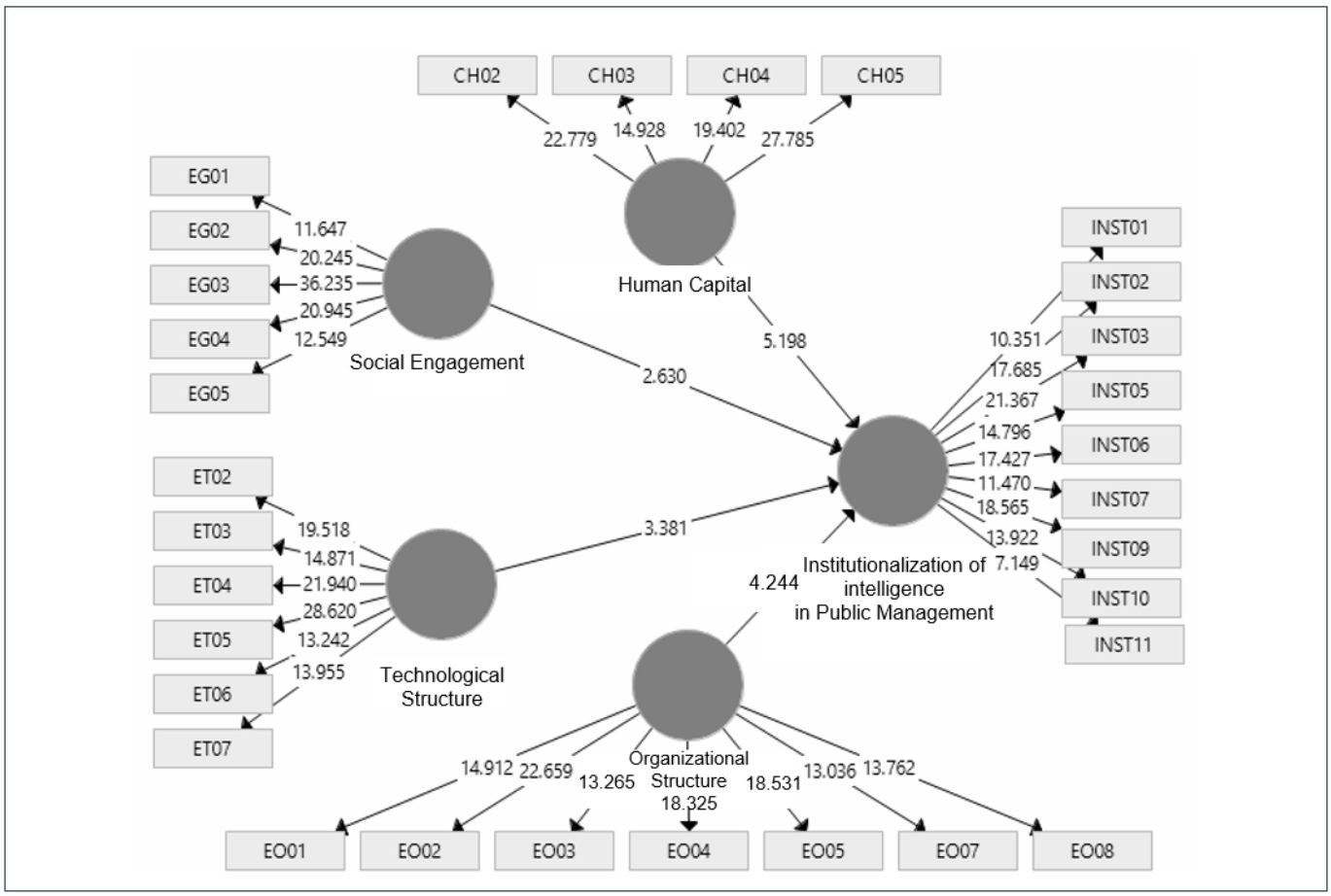
The steps outlined by Hair et al. (2016) were employed to assess the structural model and conduct hypothesis testing. Initially, a collinearity analysis was conducted to ascertain if the constructs exhibited similarity. This involved using the variable inflation factor (VIF) criterion, which should be greater than 0.20 yet less than 5.00. Table 10 reveals no collinearity issues, with values ranging from 1.351 to 1.865.

Table 10. Collinearity test.

Factor	VIF (factors)	VIF (items)
Human Capital (HC)	1.686	1.357 – 1.618
Social Engagement (SE)	1.351	1.561 – 2.201
Organizational Structure (OS)	1.722	1.299 – 2.234
Technological Structure (TS)	1.865	1.316 – 1.810
Institutionalization of Intelligence in Public Management (INST)	-	1.299 – 1.903

Note. Source: Developed by the authors.

To evaluate the structural model, the bootstrapping technique was employed, with 5,000 samples utilized to ensure stability in determining standardized errors (Hair et al., 2011). The results obtained enabled the estimation of the significance between the relationships of the constructs in the analysis (Figure 2).



Source: Developed by the authors.

Figure 2. Bootstrapping analysis.

Significance of the relationships in the model was analyzed using the Student t-test calculation. According to Hair et al. (2016), for a relationship to be considered significant, the t values must exceed 1.96, with the p-value being lower than 0.05. All categories of analysis exhibited positive significance, thereby supporting all hypotheses. In other words, organizational structure, technological structure, human capital, and social engagement positively impacted the institutionalization of intelligence in public management (Table 11).

Table 11. Hypothesis testing.

Hypothesis	Relationship	Values of t	Significance (p-value)	Evaluation
H1	OS → INST	4.244	0.000	Supported
H2	TS → INST	3.381	0.001	Supported
H3	HC → INST	5.198	0.000	Supported
H4	SE → INST	2.630	0.009	Supported

Note. Source: Developed by the authors.

Following hypothesis testing, in accordance with the procedures of Hair et al. (2016), the coefficient of determination R^2, effect size f^2, and predictive power Q^2 were analyzed. The R^2 assesses the portion of the variance of the endogenous variables explained by the structural model (Ringle et al., 2014). In this study, the R^2 value for the factor Institutionalization of Intelligence in Public Management is 0.609, indicating a strong correlation with the predictor variables explaining 61% of the dependent variable (Cohen, 1988).

Regarding the analysis of the effect size f^2, which gauges the 'usefulness' of each construct for the model's fit (Ringle et al., 2014), the reference values of 0.02 for low impact, 0.15 for medium impact, and

0.35 for high impact (Hair, Sarstedt et al., 2014) were considered. Table 12 displays the f^2 effect level results, showing 'Organizational Structure', 'Technological Structure', and 'Social Engagement' with low impact on the Institutionalization of Intelligence in Public Management, while Human Capital has a medium impact on the dependent variable.

Table 12. F^2 effect level.

Relationship between variables	f^2
OS → INST	0.076
TS → INST	0.062
HC → INST	0.222
SE → INST	0.046
H4	SE → INST

Note. Source: Developed by the authors.

Finally, the predictive quality of the model, or the accuracy of the adjusted model, was assessed using the Stone-Geisser indicator (Ringle et al., 2014). Values greater than zero are indicative of a favorable evaluation criterion (Hair et al., 2016). The analysis of this study yields a Q^2 of 0.261 for Institutionalization of Intelligence in Public Management, indicating that the exogenous constructs have predictive capacity and relevance for the endogenous construct under consideration.

The analysis reveals significant paths within the model, and the R^2, f^2, and Q^2 values underscore the model's predictive capacity, thereby supporting the hypotheses. From a quantitative standpoint, the research outcomes confirm the four hypotheses posited by the developed model: organizational structure, technological structure, human capital, and social engagement positively influence the institutionalization of intelligence in public management. Nevertheless, it is noteworthy that the impact of each construct on the institutionalization of intelligence in public management varies. To elucidate potential pathways for enhancement to be undertaken and refined by public management, we endeavor to discuss conceivable theoretical factors contributing to such differentiation in impact.

Regarding the predominant impact of the 'human capital' factor compared to the other factors, this finding aligns with pertinent theory on the subject. It validates the imperative of cultivating public servants' capacity to analyze data and information sourced from the external environment and diverse organizational systems within government (Bojovic et al., 2017; Malomo & Sena, 2017; Smith, 2008; Valle-Cruz & Sandoval-Almazan, 2018). The human capital factor directly correlates with nurturing public leaders who foster the structuring and endorsement of intelligence in public management as an essential managerial mechanism for crafting new public policies and enhancing decision-making.

Concerning the 'technological structure' factor, although it holds significance when considered alongside the other three predictors for institutionalizing intelligence, its individual impact is modest. This observation aligns with the notion that technology no longer poses a barrier to intelligence legitimacy since the utilization of information and communication technologies (ICTs) permeates public administration and forms part of its organizational culture. Consequently, it can be inferred that there is a necessity to enhance public servants' capacities in leveraging IT to optimize data and information management for public administration.

Conversely, in the case of the 'organizational structure' factor, the relevance of institutionalizing intelligence in public management is not tied to normative and legal aspects. Instead, it revolves around structuring organizational processes and galvanizing leaders for significant shifts in organizational culture associated with the importance of structuring intelligence processes and fostering interdepartmental collaboration in data and information sharing and management.

Meanwhile, when scrutinized individually, the 'social engagement' factor appears to exert the least impact on the institutionalization of intelligence in public management. This outcome may be attributed to the fact that, among the four constructs analyzed, it is the only one linked to an external issue beyond the organization's purview. Given its association with society's effective participation in processes with public administration, it constitutes an uncontrollable external factor. Although it is theoretically understood that for a government to evolve into a smart entity, it must institute processes of government and society co-creation, implement an open data policy, and devise mechanisms for interaction with the business sector and other societal stakeholders, in the context under scrutiny, society still is not effectively engaged in shaping and refining public management.

Based on the understanding that these categories positively impact the institutionalization of intelligence in public management, coupled with the theoretical discourse underpinning the validated model, Table 13 delineates potential organizational actions for public management to consolidate these constructs, thereby facilitating the legitimization of intelligence in public management:

Table 13. Proposed organizational actions.

Constructs of institutionalization of intelligence in public management	Proposed organizational actions
Organizational Structure	Formalization of intelligence processes; Qualification of the information flow in the organization between sectors; Improved data and information management; Development of an organizational culture focused on data intelligence; Structuring projects to involve society.
Technological Structure	Develop interoperability of government systems; Government database organization and unification; Effective use of technologies for managing large amounts of data; Developing tools that help social participation for co-creation, innovation, and harnessing collective intelligence.
Human Capital	Development of training trails in data science; Development of training trails on public data and information management; Leadership development aimed at structuring and encouraging a culture of intelligence in government.
Social Engagement	Develop mechanisms to encourage social participation; Set up government-society co-creation processes; Making effective use of collective intelligence.

Note. Source: Developed by the authors.

Table 13 illustrates numerous conceivable actions that public administration could undertake to solidify and legitimize intelligence endeavors in public administration. The proposition aims to elucidate avenues through which governments can foster and reinforce intelligence as a means of enhancing public decision-making and policy development.

CONCLUDING REMARKS

This study aimed to validate a theoretical model for the institutionalization of intelligence in public management. It analyzed the level of influence of four main categories (organizational structure, technological structure, human capital, and social engagement) to contribute to the consolidation of potential approaches to overcoming the institutional barriers to establishing a smart government. Through a quantitative approach, it was possible to confirm that the hypotheses of the developed model (organizational structure, technological structure, human capital, and social engagement) positively influenced the institutionalization of intelligence in public management. The validation of the model offers significant theoretical insights, outlining an initial pathway for structuring intelligence in public management.

Regarding the practical implications of the study, we emphasize the delineation of a plausible pathway for public management based on the validation of the four essential constructs for the institutionalization of intelligence in public management. We propose actions to enhance these constructs within government spheres. As a limitation of the research, we acknowledge the predominance of respondents from a single Brazilian state, potentially leading to a biased perspective of responses, given the context in which they operate. Consequently, the findings may not be readily generalizable. For future studies, we recommend examining the constructs within concrete public management cases in organizations already engaged in structured and entrenched intelligence activities within their organizational culture to ascertain how each construct manifests in intelligence practices. Another limitation lies in the study's focus on four specific categories of analysis, encompassing the ten dimensions of intelligence defined at the time. However, considering the dynamic nature of the subject, future research could broaden this scope by identifying new dimensions inherent to intelligence activities in the public domain.

The development of the analytical model based on institutional theory assumptions presents itself as a promising avenue for future research aimed at understanding the establishment of a process for institutionalizing management innovations within the framework of public organizations. We also recommend analyzing the four constructs (organizational structure, technological structure, human capital, and social engagement) in concrete cases involving public bodies already engaged in structured and entrenched intelligence activities within their organizational culture to ascertain the establishment of such structures and to devise specific models for adoption across various government spheres.

Lastly, it is crucial to emphasize that the confirmation and theoretical analysis of the proposed model for the institutionalization of intelligence in public management do not imply a rigid pathway but rather an initial exploration of potential management strategies to overcome institutional barriers to intelligence implementation in public management. Leveraging data and information to enhance the development of public policies and decision-making by public managers can generate public value across different activity levels.

NOTE

1. In the case of the HC/INST correlation, it is worth noting that this issue was the subject of a consultation through personal communication with Professor Joe Hair. He indicated that this small variation should be seen positively, given that a predictive relationship between the latent variable and the dependent variable is favorable for forecasting purposes. Professor Antônio Carlos Gastaud Maçada also helped with the analysis.

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