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Digital maturity assessment models in public administration: a systematic review

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ABSTRACT

Digital transformation (DT) is accelerating societal change and creating major challenges for public organizations seeking to improve efficiency through digital technologies. However, its measurement remains a conceptual and methodological challenge. This study presents a systematic literature review (SLR), conducted under the PRISMA protocol and PICOC strategy, focusing on digital maturity models applied to public administration (PA) between 2020 and 2024. The review covers both scientific databases and institutional gray literature. Five critical aspects were analyzed: included dimensions, internal structural relationships, empirical validation, predictive capacity, and contextual conditions of applicability. Results reveal a recurrent set of dimensions—technology, processes, data, people, and governance—yet with high heterogeneity in levels and approaches. Only a minority of models incorporate causal structures, and fewer than half have been empirically validated. Predictive capacity is almost absent, except for one Bayesian network model. Institutional factors such as digital leadership, budget, and regulatory frameworks strongly influence applicability. Unlike previous reviews, this study integrates a bibliometric analysis and a critical synthesis of enablers and barriers. It concludes that current models are useful for diagnosis but require improvements in structure, validation, and anticipation, providing an updated reference framework for researchers and policymakers in digital governance.

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1. INTRODUCTION

Digital transformation (DT) has become a strategic priority for public administrations (PA) worldwide, reshaping how governments deliver services, coordinate institutions, manage data, and generate public value [1], [2]. To guide this transformation, governments increasingly rely on the concept of digital maturity as an operational lens for evaluating progress and identifying capability gaps [3]. Digital maturity thus links strategic DT objectives with the organizational capacity to integrate digital technologies in a strategic and adaptive manner, oriented toward public value [4], [5].

In the broader literature, maturity models span multiple domains, including process and project management, quality, IT infrastructure, and risk management [6]. Within this landscape, DT constitutes a specific subset, encompassing both multisectoral models and sector-specific frameworks for PA, as well as applications in areas such as health and education. Figure 1 illustrates this ecosystem hierarchically, situating digital maturity models for PA within the broader maturity-model landscape.

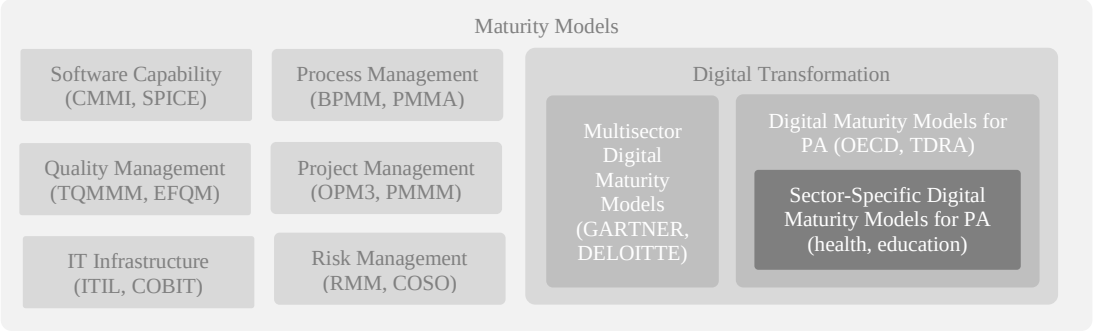

Figure 1. General ecosystem of maturity models and position of digital maturity models for PA

A persistent problem in the field is that most digital maturity models for the public sector are conceptually fragmented, presenting dimensions as flat lists without explicit internal relationships. This fragmentation limits their diagnostic capacity by preventing the analysis of interactions among technological, organizational, and cultural factors. In contrast, corporate and industrial maturity frameworks, such as the capability maturity model integration (CMMI) [7] and other digital capability models [5], tend to incorporate more structured and hierarchical compositions, sometimes supported by analytical mechanisms. Scholars argue that integrating internal relationships enhances explanatory power, supports maturity trajectories, and enables advanced approaches such as structural modeling, scenario simulation, or predictive analysis [8], [9]. However, many public-sector maturity models also show limited adaptation to institutional realities, often overlooking political, legislative, and social conditions that shape digital strategies, which reduces their relevance and strategic utility in real government environments [4], [10], [11].

Recent research published between 2020 and 2024 reflects a growing diversification in how PAs conceptualize and measure DT. Several studies have incorporated new analytical dimensions, including artificial intelligence readiness [12], cross-cutting data governance and cybersecurity capabilities [13], [14], [15], and institutional resilience in the aftermath of COVID-19 [16]. These developments highlight the increasing complexity of DT and the need for maturity frameworks that capture emerging policy priorities.

Other contributions have expanded maturity evaluation through sector-specific or multisectoral approaches, such as analytics-driven maturity models [17], holistic transformation frameworks [18], and models for digitally enabled health or service delivery systems [19]. Empirical studies have also introduced or validated maturity models tailored to PA, including digital service transformation [20], multilevel digitalization across PAs [21], municipal-level digital maturity [22], and public health agency maturity assessments [23]. Despite these advances, the literature remains heterogeneous in scope and methodological depth.

From a secondary literature perspective, several recent systematic reviews and mappings have examined digital maturity and e-government models in PA and related sectors. Table 1 synthesizes these reviews, showing that while prior studies have classified and compared models, they have rarely addressed three critical aspects jointly: structural relationships among dimensions, predictive capacity, and public-sector contextual conditions.

Table 1. Concise comparison of recent systematic reviews on digital maturity models in PA (2020–2024)

Review	Period	Scope	Key limitation	Difference with this systematic literature review (SLR)
[17]	2009-2024	Data and analytics	Coverage focused on analytics; does not address institutional contexts	Apply structural composition elements to the evaluation of digital maturity in PA
[18]	2000-2022	Multisector	Proposes a holistic model but without adaptation to the public context	Adapts findings to the particularities and constraints of PA
[19]	Hasta 2021	Public health	Sector-specific model; no generalization to other sectors	Extracts principles applicable and validable in PA models
[24]	2011–2022	Multisector	General methodological critique; not PA-specific	Adapt critique to PA context with empirical analysis
[25]	2010–2022	PA/e-Gov	No internal analysis or prediction	Includes structure and prediction
[26]	2000–2021	PA/e-Gov	Typology; no prediction or validation	Adds validation and PA context
[27]	2012-2025	PA/e-Gov	Private sector–oriented approach; does not address the public sector	Adds a citizen-centric perspective
[28]	2014-2019	Service sector	Private sector–oriented approach; does not address the public sector	Complements with enterprise architecture applicable to PA

While Table 1 summarizes the gaps identified in previous systematic reviews, this study examines a corpus of 21 digital maturity models applied in PA between 2020 and 2024. The empirical assessment confirms that these limitations persist, as fewer than 40% of models specify structural relationships and only one (~5%) incorporates a predictive mechanism, reflecting the continued predominance of static diagnostic approaches [9]. These findings highlight the need for a more integrative perspective that jointly considers structural composition, predictive capacity, and contextual conditions. Accordingly, this review aims to identify, compare, and synthesize the most relevant models to inform the development of more coherent and adaptable frameworks for PA.

2. METHOD

The methodological approach adopted for this review follows the PRISMA 2020 guidelines, ensuring transparency and rigor in the documentation of the review process and outcomes [29].

2.1. Research questions

To guide the systematic review, research questions were formulated using the PICOC framework, recommended for complex organizational studies [30], [31]. Unlike PICO, which focuses on clinical research, PICOC explicitly incorporates context, a key element when assessing the applicability of digital maturity models PA [32]. Other frameworks, such as SPIDER [33] or TAPUPAS [34], are valuable for qualitative evidence or evaluation but less operational for comparing conceptual models. Likewise, design-oriented approaches (e.g., [8]) are not intended for review questions. Therefore, PICOC was considered the most suitable framework, enabling examination of model components, structural relationships, and predictive applicability. Based on this rationale, the guiding questions were defined (Table 2).

Table 2. Research questions

Code	Question
P	How can the level of DT in public entities be measured through maturity models?
I	What dimensions and internal structural relationships characterize the reviewed digital maturity models?
C	What difference exist between theoretical digital maturity models and those validated empirically?
O	To what extent do the analyzed models project or anticipate the evolution of digital maturity over time?
C	What technical, institutional, or contextual conditions act as enablers or barriers to the implementation of these models in PA?

2.2. Eligibility criteria

For the development of this study, eligibility criteria were established and organized into inclusion criteria (Table 3) and exclusion criteria (Table 4), as detailed:

Table 3. Inclusion criteria

Code	Description
CI1	Articles related to digital maturity, maturity models, or levels of DT
CI2	Articles published between 2020 and 2024
CI3	Original research articles
CI4	Articles published in indexed journals, conference proceedings, or reports from consulting firms or government agencies

Table 4. Exclusion criteria

Code	Description
CE1	Application-focused articles that do not include components of a digital maturity model
CE2	Articles whose digital maturity models are not applied to public sector entities
CE3	Articles that are not available in full-text format
CE4	Articles published in languages other than English or Spanish

2.3. Information sources

As illustrated in Figure 2, academic sources were retrieved from Scopus and Web of Science (WoS), complemented with gray literature identified through Google. Priority was given to documents from governmental entities, multilateral organizations, and consulting firms, applying criteria of authority, timeliness, and thematic relevance; sources without authorship or methodological justification were excluded. Several reviewed models originate from institutional reports, including those of the OECD [16], World Bank [13], UNDP [35], and UAE Government [14], which provide policy-oriented frameworks for national digital capacity development.

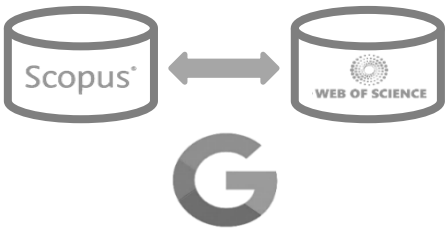

Figure 2. Information sources consulted in the systematic review

2.4. Search strategy

The search strategy was defined using the PICOC framework. Table 5 summarizes the search terms and synonyms associated with each PICOC component. Searches were conducted in Scopus and WoS between January 2020 and November 2024, restricted to peer-reviewed journal articles and conference papers in English or Spanish, and limited to Title, Abstract, and Keywords. To complement academic sources, institutional gray literature was also incorporated based on authority, thematic relevance, and methodological clarity.

Table 5. Search terms

Factor	Components	Search terms	Synonyms
(P) Problem	Level of DT	"digital transformation"	"e-government", "e-governance", "electronic government", "electronic governance", "digital government", "digital governance"
(I) Intervention	Digital maturity model	"digital maturity model"	"digital maturity", "maturity model"
(C) Comparison	Measurement and/or evaluation methods	"measurement"	"measure", "measuring", "evaluate", "evaluating", "evaluation", "assess", "assessing", "assessment"
(O) Outcome	Improve DT	"improve"	"improvement", "enhance"
(C) Context	Entities of PA	"public administration"	"public sector", "government", "public entities"

2.5. Study selection process

The study selection followed the PRISMA 2020 process, comprising identification, screening, and eligibility assessment. The predefined search strategy was applied to Scopus, WoS, and Google (for institutional gray literature), with inclusion and exclusion criteria applied at the title/abstract and full-text levels. Table 6 summarizes the operational search parameters, and Figure 3 presents the PRISMA flow diagram. A total of 210 records were initially retrieved. After duplicate removal and screening, 21 studies met the eligibility criteria and were included in the qualitative synthesis.

Table 6. Operational summary of the search

Database /source	Search string applied	Filters	Date range	Date of search	Records retrieved	Notes
Scopus	("digital maturity model" OR "digital maturity" OR "maturity model") AND ("measurement" OR "measure" OR "measuring" OR "evaluate" OR "evaluating" OR "evaluation" OR "assess" OR "assessing" OR "assessment") AND ("digital transformation" OR "e-government" OR "e-governance" OR "electronic government" OR "electronic governance" OR "digital government" OR "digital governance") AND ("public administration" OR "public sector" OR "government" OR "public entities")	Peer-reviewed, English/Spanish, title/abstract/ keywords	2020–2024	Nov 2024	163	Scientific literature
Web of Science	Same as Scopus	Peer-reviewed, English/Spanish, title/abstract/ keywords	2020–2024	Nov 2024	38	Scientific literature
Google Search	Keywords adapted from main search string	Reports from OECD, World Bank, UNDP	2020–2024	Nov 2024	9	Gray literature
Total					210	Before removing duplicates

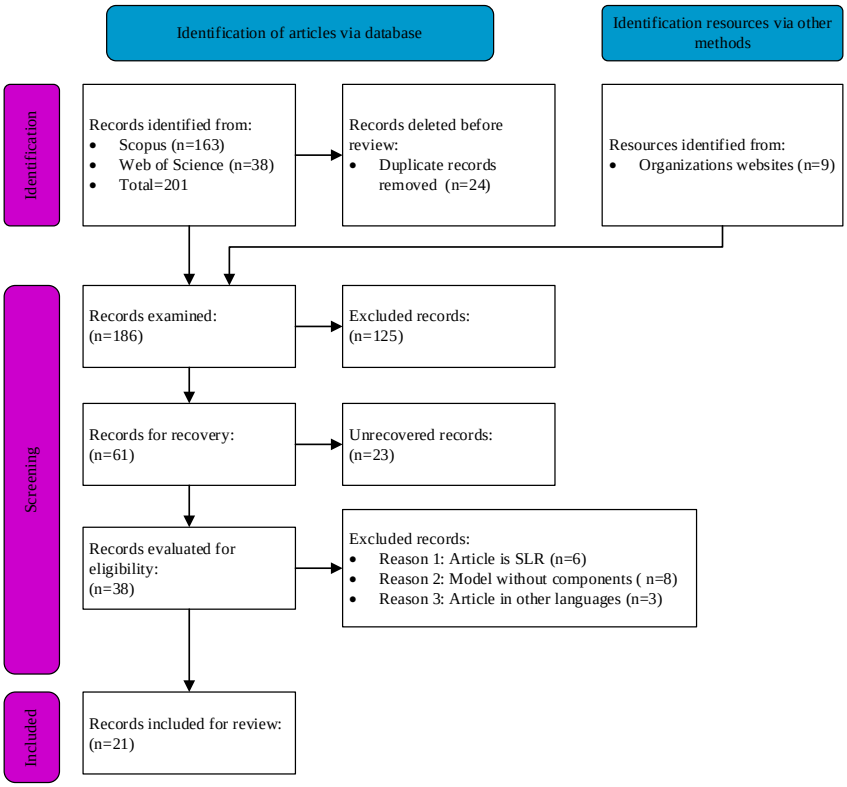

Figure 3. PRISMA 2020 flow diagram of identification, screening, eligibility, and inclusion

Screening and selection were carried out by a single reviewer following predefined criteria. To reduce bias, a pilot reading was performed on a random sample of studies to refine the interpretation of criteria, and all inclusion/exclusion decisions were documented to ensure process traceability and replicability. While this procedure followed PRISMA 2020 standards, it must be noted that relying on a single reviewer may still introduce some subjectivity, an aspect further addressed in the study limitations.

2.6. Data extraction and synthesis

Data extraction was conducted manually using a structured matrix in Microsoft Excel, recording key attributes of each study, including authorship, year, context, sector, model purpose, dimensions, internal relationships, empirical validation, and predictive mechanisms. The process followed the previously defined PICOC framework to ensure consistency and transparency, and the results were consolidated into synthesis tables to support cross-study comparison. The consolidated extraction and synthesis matrix is presented later, providing the empirical basis for the comparative analyses reported in the results section.

2.7. Publication bias control

To mitigate publication bias, the review extended beyond indexed databases to include gray literature, as many digital maturity models in PA are disseminated through technical reports and institutional guidelines rather than academic journals. Selection was conducted in a controlled manner based on institutional authority, thematic relevance, and methodological clarity. This multi-source strategy, combining Scopus and WoS with targeted searches of official portals and Google, aligns with established recommendations to reduce visibility bias and improve coverage in public policy and digital governance reviews [36], [37].

3. RESULTS AND DISCUSSION

This section presents the results obtained from the systematic review, along with the corresponding discussion of findings.

3.1. Article assignment

Based on the selected articles included in this study, a designation was made to identify which ones contribute to answering each research question. The relevance of each study to the research questions is summarized in Table 7.

Table 7. Article assignment

Questions	Number of studies	Designated studies
RQ1: how can the level of DT in public entities be measured through maturity models?	13	[15], [18], [20], [21], [23], [38]-[45]
RQ2: what dimensions and internal structural relationships characterize the reviewed digital maturity models?	16	[13], [14], [18], [20]-[23], [38]-[46]
RQ3: what difference exist between theoretical digital maturity models and those validated empirically?	14	[13], [14], [18], [20]-[22], [35], [38], [39], [42]-[46]
RQ4: to what extent do the analyzed models project or anticipate the evolution of digital maturity over time?	9	[13], [14], [18], [20], [21], [23], [38], [39], [46]
RQ5: what technical, institutional, or contextual conditions act as enablers or barriers to the implementation of these models in PA?	14	[13]-[16], [21], [23], [35], [39]-[41], [43], [44], [47], [48]

3.2. Review of digital maturity model components

Table 8 synthesizes the 21 digital maturity models identified, serving simultaneously as a data extraction and synthesis tool. By consistently organizing key information for each model, the table enables cross-comparison and highlights trends, commonalities, and gaps in the recent literature, providing the basis for subsequent analysis.

Table 8. Core components of digital maturity models: extraction and comparative synthesis

N°	Year	Country	Model	Dimensions	Levels	Validation
1	2020	Greece	Model for interoperability maturity of a public service [41]	Design, governance, policies, user interaction, reuse, change management	5	Yes (tool applied)
2	2021	Swiss	Digital maturity balance model for public organizations [38]	Data, IT governance, organization, processes, strategy	% balance	Yes (empirical)
3	2021	Indonesia	Model based on the Input, process, and output aspects of E-gov [42]	Vision, human capital, IT infrastructure, budget, standard procedure, integration	5	Yes (local PA)
4	2021	Ukraine	E-maturity model for program management system [43]	Based on PMBOK areas	7	No (conceptual)
5	2021	Sri Lanka	Digital maturity model for Sri Lanka Gov [44]	Customers, strategy, data and technology, operations, culture	5	Partial (application)
6	2022	Singapore	DT maturity model [16]	Service points, standards, competencies, governance	5	Partial (comparative)
7	2022	Brazil	Maturity model for public procurement processes [39]	Institutionalization, procurement, human resources, communication, accounting	5	Yes (case study)
8	2022	Greece	Model for assessment of organizational interoperability [40]	Design, governance, policies, user interaction, reuse, change management	5	Yes (qualitative)
9	2022	USA	GovTech maturity index [13]	Core government systems, services, participation, facilitators	4	Partial (comparative)
10	2022	Laos	Digital maturity assessment - lao PDR [35]	Skills, technology, policies, institutions, services, user focus	5	Partial (application)
11	2022	UK	Digital maturity framework MVP [47]	User design, culture, data-driven, technology, governance, capability	4	No (conceptual)
12	2022	Slovenia	Digital maturity of urban municipalities [22]	Public services, connectivity, open data management	-	Yes (comparative)
13	2023	Turkey	DT journey guidance [18]	Strategy, value, processes, data, technology, work, governance	5	No (conceptual)
14	2023	USA	Digital maturity model for public health agencies [23]	Strategy, staff, processes, IT, citizen, cooperation, data, interoperability, identity	5	Yes (application)
15	2023	Europe	DMA framework for EDIHs [45]	Strategy, readiness, human-centered, data, interoperability, green digital	4	No (normative)
16	2023	Tanzania	E-Gov. capability maturity framework [48]	Strategy, IT, services, innovation, integration, security, human resources	5	Partial (official use)
17	2023	Czech Republic	Enterprise architecture maturity [46]	Management, finance/resources, ICT capabilities	5	Yes (Bayesian)
18	2024	Indonesia	Maturity model for digital service transformation in PA [20]	Key process areas (KPA)	5	Yes (survey, PA entities)
19	2024	Slovenia	Model for assessing digitalization in PA [21]	Culture, processes, technology, structure, people	Indices	Yes (factor analysis)
20	2024	UAE	Digital maturity for government organizations [15]	Strategy, people, governance, technology, systems, user design	5	No (normative)
21	2024	UAE	Digital government maturity model [14]	Leadership, strategy, governance, legal, technology, cybersecurity	5	Partial (federal use)

As shown in Table 8, the models present marked heterogeneity in dimensions, maturity levels, and validation approaches, which reflects conceptual richness but also the lack of methodological consensus. Most contributions appeared between 2020 and 2022, with fewer but more specialized models in 2023–2024 (Figure 4). Geographically, Europe and Asia dominate, while Latin America and Africa remain underrepresented. This uneven distribution confirms that current frameworks are useful for diagnosis but fragmented, with limited transferability across contexts.

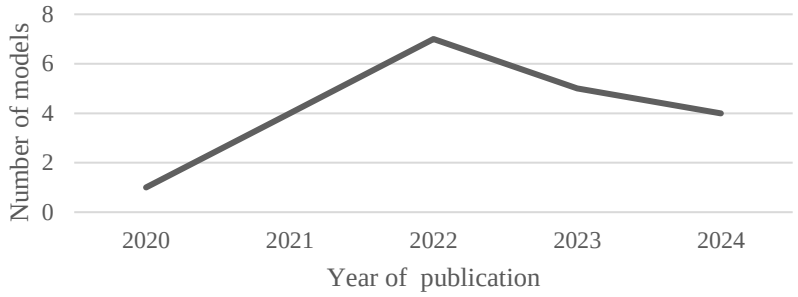

Figure 4. Temporal distribution of digital maturity models reviewed (2020–2024)

3.3. Quality appraisal of digital maturity models

To ensure comparability across models and account for methodological differences, a quality appraisal was conducted following established maturity model evaluation frameworks widely used in information systems and PA [6], [8], [9], [49]-[51]. Five criteria were assessed: i) formal design methodology, ii) clarity of purpose and scope, iii) definition of dimensions and levels, iv) empirical applicability, and v) integration of emerging priorities such as AI, cybersecurity, or resilience. Standardized checklists such as AMSTAR or TAPUPAS were not applied due to their focus on health sciences.

Each criterion was scored on a three-level scale (0=not addressed, 1=partially addressed, and 2=clearly addressed), yielding total scores from 0 to 10. Consistent with prior digital governance reviews, models scoring 6 or above were considered to exhibit acceptable methodological quality. Table 9 reports the detailed appraisal results for the 21 models. As noted in the limitations section, the assessment was conducted by a single reviewer using predefined criteria and a standardized protocol.

Table 9. Quality appraisal of digital maturity models

Nº	Model	Formal design methodology	Purpose and scope clarity	Dimensions and levels	Empirical applicability	Emerging priorities	Total score
1	[41]	2	2	2	2	0	8
2	[38]	1	2	1	2	0	6
3	[42]	1	2	2	2	0	7
4	[43]	0	1	2	0	0	3
5	[44]	1	2	2	1	0	6
6	[16]	0	1	2	1	0	4
7	[39]	1	2	2	2	0	7
8	[40]	2	2	2	2	0	8
9	[13]	1	2	2	1	0	6
10	[35]	1	2	2	1	0	6
11	[47]	0	1	2	0	0	3
12	[22]	1	2	1	2	0	6
13	[18]	0	1	2	0	0	3
14	[23]	2	2	2	2	0	8
15	[45]	0	2	2	0	1	5
16	[48]	1	2	2	1	0	6
17	[46]	2	2	2	2	1	9
18	[20]	1	2	2	2	0	7
19	[21]	2	2	1	2	0	7
20	[15]	0	1	2	1	0	4
21	[14]	1	2	2	1	1	7

As shown in Table 9, most models define dimensions, levels, and purpose, but few document formal design methodologies or robust empirical validation, constraining rigor and comparability. Emerging

priorities such as AI, data ethics, and resilience are rarely integrated. Models such as [23], [40], [41], [46] achieve the highest scores, reflecting stronger methodological grounding, whereas others (e.g., [18], [43], [47]) remain largely descriptive. Overall, the results indicate that many frameworks function primarily as diagnostic tools, reinforcing the need for more rigorous and forward-looking maturity models in PA.

3.4. Structural and predictive evaluation of the reviewed digital maturity models

Building on the quality appraisal, this section examines two attributes that define the analytical power of digital maturity models: i) explicit structural relationships among dimensions (e.g., causality or hierarchical links) and ii) mechanisms for projecting future maturity (predictive capacity). These elements are essential to move from static diagnostics to strategic planning tools. Table 10 summarizes how the 21 reviewed models address, or fail to address, these aspects, based on their methodological and conceptual foundations.

Table 10. Structural evaluation and predictive capacity of digital maturity models

N°	Model	Has structural relationships	Has predictive capability	General observation
1	[41]	Yes–hierarchical+scoring	No–diagnostic only	Strong validation, diagnostic focus
2	[38]	Yes–weighted balance	No–diagnostic only	Structural innovation, validated
3	[42]	Yes–input–process–output	No–no projection	Validated, clear causal logic
4	[43]	Yes–PMBOK structure	No–no projection	Analytical, static; no empirical validation
5	[44]	No–hierarchical but no causal links	No–comparative only	Normative, partial validation
6	[16]	No–principles, no causal links	No–static	Normative guide, partial validation
7	[39]	Yes–linked by maturity questions	No–diagnostic only	Validated case study, structural clarity
8	[40]	Yes–grouped/leveled	No–diagnostic only	Robust and validated
9	[13]	No–pillars, no causal links	No–comparative only	Index, partial validation
10	[35]	No–independent pillars	No–diagnostic only	Applied nationally, no structure/prediction
11	[47]	No–progressive interdependent levels	No–diagnostic only	Iterative model, useful for benchmarking
12	[22]	Yes–correlation-based	No–no forecasting	Empirical, useful for comparative analysis
13	[18]	No–independent list	No–static diagnostic	Conceptual, no validation
14	[23]	Yes–hierarchical practices	No–diagnostic only	Solid structure, validated; no prediction
15	[45]	No–no causal logic	No–diagnostic only	Normative EU guide, no validation
16	[48]	No–staged but no causal links	No–diagnostic only	Partial validation, diagnostic
17	[46]	Yes–Bayesian network	Yes–simulation	Predictive capacity, robust validation
18	[20]	No–dimensions independent	No–current state only	Applied/validated, no structure/prediction
19	[21]	No–no causal links	No–static	Robust content, empirical validation
20	[15]	No–capabilities listed	No–diagnostic only	Normative, no validation
21	[14]	No–progressive stages	No–diagnostic only	Institutional validation, descriptive

As shown in Table 10, only a few models specify internal structural links, and predictive capacity is almost absent—limited to a single Bayesian-based approach [46]. Most frameworks remain static diagnostic tools, reducing their utility for planning or scenario analysis. Three models stand out: [46], for incorporating prediction; [21], for robust empirical validation; and [38], for balancing dimensions. By contrast, models such as [15], [18] remain descriptive and unvalidated, suitable only for initial diagnostics. These contrasts highlight both the potential and the persistent limitations of digital maturity models in PA.

3.5. Most commonly used dimensions in digital maturity models

The reviewed literature shows considerable variation in the dimensions proposed by each digital maturity model. Table 11 organizes them by frequency across the 21 studies, allowing the identification of common patterns and thematic gaps. This synthesis provides a basis for more comprehensive frameworks that better reflect the specific needs of PA. Table 11 shows that technology and digital culture/skills dominate as core dimensions, while data management and digital strategy appear less consistently. In contrast, digital governance and citizen-centricity remain underrepresented, revealing a bias toward infrastructure and internal capacities over institutional and citizen-oriented aspects. Future models should move toward more balanced frameworks that integrate technical, organizational, and societal dimensions.

Table 11. Most common dimensions

N°	Dimension	Frequency	Studies
1	Technology	10	[14], [15], [18], [21], [23], [35], [42], [44], [47], [48]
2	Personnel and/or culture and/or digital skills	10	[15], [16], [18], [21], [23], [35], [42], [44], [47], [48]
3	Data management	9	[15], [16], [18], [23], [38], [42], [44], [45], [47]
4	Digital strategy	8	[14], [15], [18], [23], [38], [44], [45], [48]
5	Citizen centricity	8	[15], [16], [23], [35], [40], [44], [45], [47]
6	Digital governance	7	[14]-[16], [18], [38], [40], [47]
7	Processes	4	[18], [21], [23], [38]

3.6. Institutional applicability and implementation challenges of digital maturity models

Table 12 synthesizes the institutional applicability of the reviewed models, examining their contexts of origin, strengths, implementation challenges, and minimum requirements. This perspective complements the structural and predictive evaluation (Table 10) and highlights the practical feasibility of adopting these frameworks across diverse administrative settings.

Table 12. Institutional context for model application

N°	Model	Context	Strengths	Implementation challenges	Application requirements
1	[41]	Government digital services	Reference framework for interoperability	Lack of outcome evidence	Organizational capabilities oriented toward interoperability
2	[38]	Federal entities	Balance among key dimensions	Technically complex application	Availability of internal data and technical criteria for weighting
3	[42]	Local government	Coverage of multiple dimensions	Low replicability	Internal measurement of processes and outcomes
4	[43]	Municipal project management	PMBOK-oriented	Requires technology and budget	Skills in project management and quantitative analysis
5	[44]	National government	National strategic approach	Requires institutional leadership	Government with structured digital architecture
6	[16]	National administration	International institutional support	No field validation	Digital planning units and strategic leadership
7	[39]	Process transparency	Robust assessment instrument	Requires institutional training	Data availability and evaluation culture
8	[40]	Institutional interoperability	Interoperability evaluation	Integration challenges	Collaborative culture among organizational units
9	[13]	Intermediate governments	Regional comparability	High technical burden	Institutional monitoring capacity and open data
10	[35]	Emerging PA	Adaptability in developing countries	Organizational capacity varies	National digital strategy and self-assessment capabilities
11	[47]	UK governments	Citizen-centered design	Little evidence of impact	Basic digital maturity and willingness for improvement
12	[22]	Urban municipalities	Uses practical and comparable indicators	No causal modeling or prescriptive guidance	Depending on the availability of municipal data
13	[18]	General public organizations	Holistic and adaptable model	Lack of empirical validation	Basic analytical capacity and institutional adaptation
14	[23]	Public health agencies	Detail of operational dimensions	Requires sector-specific data	Institutional coordination and sectoral participation
15	[45]	European ecosystems	Aligned with innovation frameworks	Applicability depends on context	Environments with experience in digital self-assessment
16	[48]	National government	Technical and strategic coverage	Limited external validation	Basic institutional framework for DT
17	[46]	Central public organizations	Quantitative model with predictive insights	High technical complexity	Needs detailed data and staff trained in statistics
18	[20]	Public sector in general	Structure based on KPAs	Requires maturity experts	Digital service management and capability-based approach
19	[21]	National and municipal governments	Multilevel application with empirical evidence	Requires coordination across institutional	Access to institutional data and multilevel coordination
20	[15]	National entities and governmental agencies	Normative structure, institutional support	Lacks validation/self-assessment	Regulatory expertise, standards culture
21	[14]	National government	Validated institutional application	Requires digital governance	Consolidated digital governance and dedicated technical teams

As shown in Table 12, model applicability depends on institutional readiness and conceptual design: interoperability- or strategy-based frameworks are more transferable than normative or sector-specific ones, highlighting the need for flexible yet rigorous approaches in PA.

3.7. Barriers and enablers of digital transformation

Beyond institutional context, Table 13 shows that cross-cutting barriers and enablers shape the effectiveness of digital maturity models in PA, underscoring the need for frameworks that explicitly integrate both constraints and facilitating conditions.

In summary, Table 13 shows that barriers reflect structural and cultural obstacles, while enablers highlight conditions that can accelerate change. Yet most models address these factors only implicitly, reducing their practical relevance. Effective frameworks should therefore move beyond diagnosis and explicitly integrate barriers and enablers to capture the real conditions for advancing DT.

Overall, the analysis of the 21 models yields five key insights:

- Convergence with heterogeneity: core dimensions (technology, processes, data, people, governance) recur, but maturity levels, structures, and validation vary, limiting comparability.
- Weak methodological rigor: few models document formal design or robust validation, leaving most as descriptive frameworks.
- Low structural and predictive capacity: causal links are rare and forecasting mechanisms almost absent.
- Imbalanced coverage: technical and human factors prevail, while governance and citizen orientation remain underrepresented.
- Context-dependence: applicability is shaped by readiness, data availability, and institutional coordination.

Together, these findings confirm the structural and methodological gaps of current maturity models and set the stage for the critical discussion in section 3.9.

Table 13. Barriers and enablers of DT

Type	Description	Studies
Barriers	Low digital skills and competencies	[13], [15], [20], [21]
	Financial constraints	[15], [21], [43], [52]
	Digital and cultural gaps	[18], [43], [44]
	Lack of political support and will	[18], [52]
	Weak collaboration between IT and business processes	[18]
	Lack of interoperability	[16], [23], [40], [41]
	Geographical conditions	[43], [44]
Enablers	Security and privacy	[15], [20], [43]
	Process digitalization	[20], [21]
	Inter-agency collaboration	[13], [52]
	Citizen-centered approach	[15], [42]
	Laws and regulations	[13], [15], [35]
	Shared vision	[23]
	Citizen participation	[43]

3.8. Bibliometric analysis

Building on the synthesis from Tables 8–13, a complementary bibliometric analysis was conducted to situate the findings within the broader research landscape. This approach illustrates how the debate on digital maturity in PA has evolved thematically and temporally, highlighting drivers, blind spots, and research trajectories. The analysis covered 163 Scopus and 38 WoS articles, using VOSviewer and Bibliometrix in three steps: i) keyword clouds, ii) network maps, and iii) overlay visualizations.

3.8.1. Keyword cloud

Figures 5 and 6 display the keyword clouds generated with Bibliometrix. In Scopus (Figure 5), the most frequent terms were *"e-government"*, *"maturity model"*, *"digital transformation"*, and *"government data processing"*. In WoS (Figure 6), dominant terms included *"e-government"*, *"framework"*, *"model"*, and *"user acceptance"*. These findings confirm that the literature has prioritized digital maturity as an extension of e-government frameworks, while also showing a growing focus on broader DT processes.

Figure 5. Keyword cloud in Scopus

3.8.2. Network visualization

The next figures show the co-occurrence maps generated with VOSviewer. In Scopus (Figure 7), two main clusters emerged: i) the red node, strongly associated with *"digital transformation"*, *"assessment"*,

"e-government", and *"citizens"*; and ii) the green node, centered on *"benefit"*, *"success"*, and *"adoption"*. In WoS (Figure 8), three clusters appeared: i) the red cluster, dominated by *"digital transformation"* and *"digital maturity"*; ii) the green cluster, including *"maturity model"* and *"e-government"*; and iii) the blue cluster, with terms related to *"dimension"* and *"tool"*. These results reveal a certain conceptual fragmentation, with no clear consensus on the core structuring axes of digital maturity models.

Figure 6. Keyword cloud in WoS

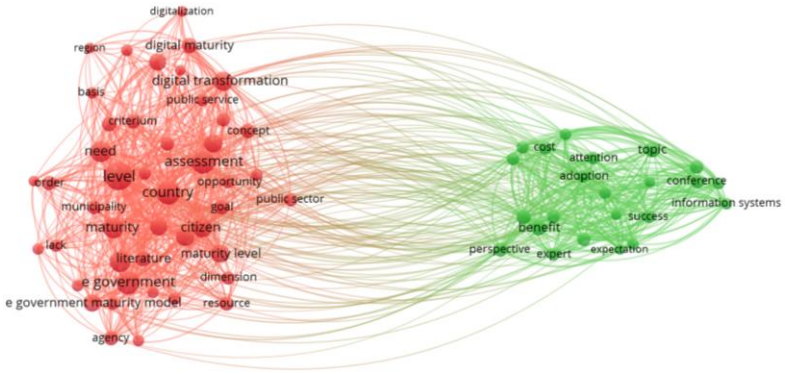

Figure 7. Network visualization of results in Scopus

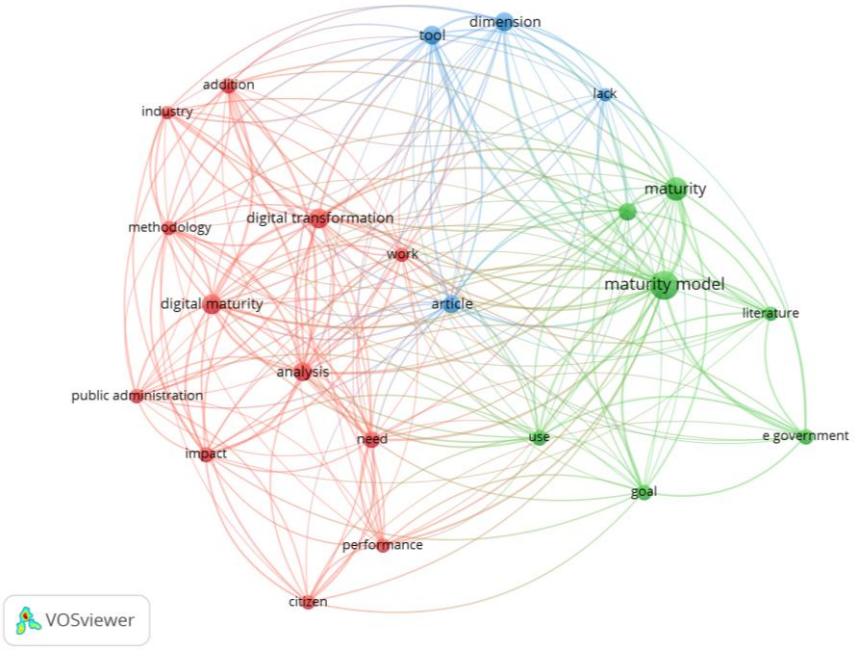

Figure 8. Network visualization of results in WoS

3.8.3. Overlay visualization

Figures 9 and 10 show the temporal evolution of terms. In Scopus (Figure 9), "e-government" and "maturity" dominated until 2018, with "digital maturity" gaining prominence by 2020, and "digital transformation," "digitalization," and "public service" emerging after 2022. In WoS (Figure 10), "maturity," "maturity model," and "e-government" prevailed until 2020, while from 2022 onward, "digital maturity" and "public administration" became central. This shift reflects a transition from e-government–focused approaches to broader perspectives of DT in PA.

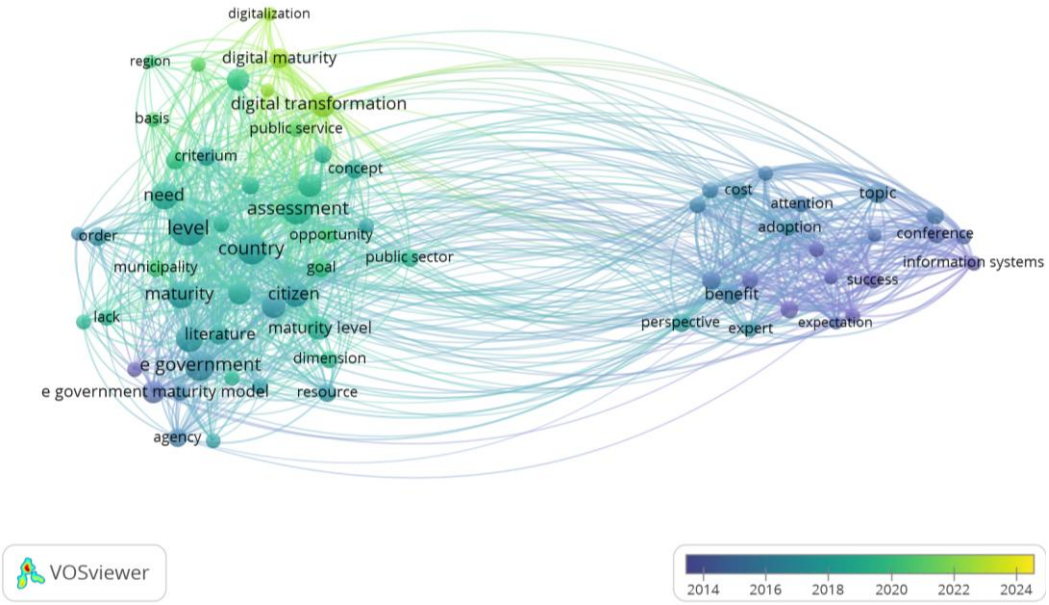

Figure 9. Overlay visualization of Scopus

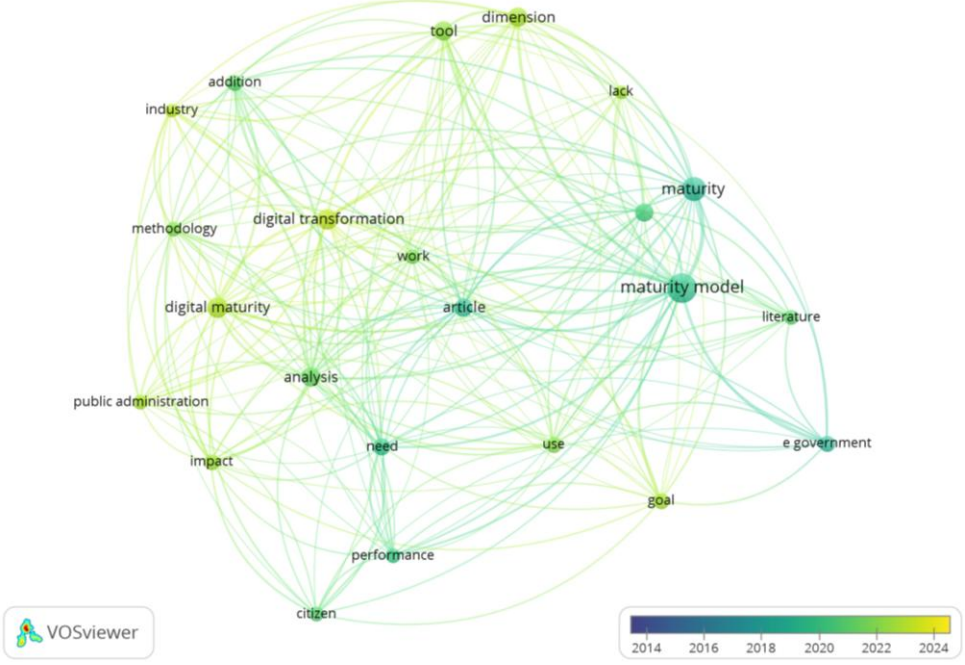

Figure 10. Overlay visualization of WoS

3.8.4. Bibliometric synthesis

In sum, the bibliometric findings complement the systematic review by reinforcing the evidence of methodological heterogeneity, limited predictive focus, and weak citizen integration. Rather than adding new patterns, they confirm and strengthen the five key insights identified in section 3.7, providing a consolidated basis for the discussion that follows.

3.9. Discussion

The systematic review, complemented by the bibliometric analysis, reveals notable progress in the development of digital maturity models for PA, but also persistent structural and methodological gaps that limit their role as strategic tools. Most studies remain focused on descriptive diagnostics, with limited attention to causal relationships or predictive capabilities. These findings are consistent with prior systematic reviews in digital governance, which report fragmented maturity constructs, inconsistent dimensional definitions, and weak empirical grounding across existing models [18], [25], [26], as well as sector-specific analyses highlighting the absence of predictive mechanisms and limited explanatory value [17], [19].

Building on this literature, the present review extends existing evidence by integrating a structured quality appraisal and a systematic evaluation of structural composition, predictive capacity, and contextual applicability. This approach provides a more comprehensive assessment of the methodological robustness and practical relevance of digital maturity models applied in PA. Accordingly, the discussion is structured around the five research questions guiding the review, examining how models define their components, structure dimensions, incorporate validation and prediction, and address institutional conditions of applicability.

3.9.1. RQ1: how can the level of digital transformation in public entities be measured through maturity models?

The reviewed models conceptualize DT primarily as organizational capabilities related to technology, processes, data, and digital skills, a functional perspective that dominates most frameworks ([18], [20], [23]). A smaller group extends this scope to include governance, citizen experience, or institutional innovation ([13], [14], [39]), meaning that digital maturity in PA is assessed mainly through operational metrics and, less frequently, through strategic or citizen-centered dimensions.

This heterogeneity also characterizes the methodological and conceptual design of the models. Some frameworks employ advanced approaches, such as Bayesian networks and simulations ([46]), whereas others rely on simple ordinal scales ([22]); likewise, the number of maturity levels varies, with most adopting five in line with CMMI traditions ([7]), and others proposing four or seven levels ([13], [43], [45], [47]). Terminological diversity further reflects this dispersion (e-maturity, digital maturity, DT maturity, and digital government maturity) although the bibliometric analysis shows that these concepts converge in similar diagnostic functions despite conceptual differences ([4], [5], [9], [13], [14], [20]). Overall, DT in PA can be measured through both functional and strategic dimensions, but existing models remain uneven in scope and rigor, enabling contextual adaptation while tending to privilege operational capabilities over integrated strategic governance.

3.9.2. RQ2: what dimensions and internal structural relationships characterize the reviewed digital maturity models?

The reviewed models converge around a common set of core dimensions—technology, processes, data, digital skills, strategy, governance, and citizen-centricity—present in more than 70% of cases ([13], [18], [20], [21], [23], [38], [40]). This reflects a broad functional consensus; however, most frameworks remain descriptive, listing dimensions without specifying explicit causal or hierarchical relationships, which limits their capacity to capture systemic dynamics ([15], [42], [43]).

Only a small subset of models advances structural integration. For example, [46] employs Bayesian networks to represent causal links, while [23] and [38] validate hierarchical structures through empirical or alignment-based approaches. Although these methods enable the analysis of dependencies and maturity trajectories, the quality appraisal (Table 9) indicates that few models provide a formal rationale for defining such relationships, raising concerns about robustness and transferability.

The bibliometric analysis reinforces this limitation, as concepts related to interactions among dimensions appear sporadically. This finding aligns with prior reviews ([9]), which report that most maturity models classify dimensions without examining interdependencies. While scholars emphasize the need for coherent and integrated frameworks ([6], [8], [9]), such approaches remain the exception rather than the rule.

Overall, although there is agreement on which dimensions matter, few models represent their interactions explicitly. This undermines their strategic value, as improvements in one dimension cannot be linked to others, resulting in only partial insights for policymakers.

3.9.3. RQ3: what differences exist between theoretical digital maturity models and those validated empirically?

A key distinction among the reviewed models lies in the degree of empirical validation. Of the 21 frameworks, 16 report some form of application, although with varying rigor. Models such as [20], [21], [23], [38], [46] were validated through surveys, confirmatory factor analysis, or Bayesian methods, strengthening their diagnostic reliability. In contrast, models grounded mainly in literature or normative frameworks ([15], [18], [43], [45], [47]) lack statistical validation and therefore capture institutional complexity only partially.

Empirically validated models also tend to incorporate structural relationships and, in rare cases, predictive mechanisms. Only [38] (partially) and [46] support scenario projection, whereas most theoretical models rely on flat dimensional structures. Institutional frameworks developed by [13], [14], [16], [35], [44] show broad operational use but depend primarily on normative or comparative validation. The bibliometric analysis reinforces this pattern, as references to validation remain marginal despite the prevalence of terms such as framework and model. Overall, this contrast highlights a persistent methodological gap [9], [53], as empirically validated models are more suitable for benchmarking and planning, while reliance on untested frameworks poses risks for evidence-based policy design.

3.9.4. RQ4: to what extent do the analyzed models project or anticipate the evolution of digital maturity over time?

Predictive capacity enables maturity models to move beyond static diagnosis and support forward-looking digital planning. However, this review shows that such capability is almost entirely absent. Only one model, [46], incorporates a formal predictive architecture based on Bayesian networks, enabling simulation of maturity trajectories under alternative conditions such as governance or interoperability.

Other frameworks, such as [38], propose improvement paths through multicriteria weighting but lack mechanisms for projection. The vast majority of models ([15], [18], [20], [23], [43]) remain static diagnostic instruments, unable to estimate future states or simulate scenarios. This limitation is reinforced by the bibliometric analysis, where terms related to prediction or simulation are largely absent.

The quality appraisal further explains this gap, as few models document formal design methodologies or causal logics—key prerequisites for predictive functions. Consistent with prior reviews [24] and methodological critiques [9], [53], these findings confirm that digital maturity models in PA rarely support anticipatory analysis. As a result, maturity frameworks remain limited as strategic tools, constraining policymakers to present-oriented diagnostics rather than evidence-based foresight.

3.9.5. RQ5: what technical, institutional, or contextual conditions act as enablers or barriers to the implementation of these models in public administration?

The applicability of digital maturity models in PA depends not only on conceptual design but also on technical, institutional, and contextual conditions. From a technical perspective, analytically demanding models ([21], [23], [46]) require advanced skills (e.g., Bayesian networks or CFA), which may limit adoption in less mature administrations. Simpler frameworks ([15], [45], [47]) are easier to apply but sacrifice precision, while pragmatic self-assessment approaches ([35]) illustrate how usability can facilitate uptake. Across models, interoperability, data quality, and cybersecurity emerge as recurrent technical prerequisites ([23], [40], [41]).

At the institutional level, governance arrangements, organizational culture, regulatory frameworks, and political commitment strongly influence implementation. Models developed by [14], [35] explicitly integrate these factors, enhancing alignment, whereas more standardized frameworks from [16], [13] often face contextual resistance. Adapted or localized models ([39], [44]) demonstrate greater institutional fit.

Contextual conditions such as budget constraints, organizational size, digital maturity, and fragmentation, are equally decisive. Empirical evidence ([22]) shows that such variables shape achievable maturity levels, yet many normative models overlook these constraints. This gap is reinforced by the quality appraisal and bibliometric analysis, which reveal limited attention to barriers despite an emphasis on adoption and benefits. Overall, the findings confirm that effective implementation depends less on technical sophistication than on contextual and institutional alignment, favoring flexible and adaptable maturity frameworks in PA.

3.9.6. Practical implications

The findings of this systematic review yield several implications for practice in PA. First, they confirm that digital maturity models, despite their heterogeneity, are useful for initial and comparative diagnostics when adapted to institutional development levels. However, the lack of empirical validation, clear structural logic, and predictive mechanisms in most models poses significant risks for policymakers, as reliance on static diagnostics constrains strategic planning, limits investment prioritization, and may lead to

misaligned digital strategies. Without the ability to anticipate maturity trajectories or assess the effects of interventions across governance, technology, data, and human-capital dimensions, decision-makers remain largely reactive.

Second, policymakers should prioritize maturity models that combine methodological rigor with adaptability, explicitly defined dimensions and levels, empirical validation in comparable public-sector contexts, and structured relationships among dimensions, making them more reliable for policy design and long-term planning.

Third, the growing importance of emerging priorities such as AI readiness, data governance, cybersecurity, and resilience requires moving beyond technology-centric frameworks toward models that also incorporate institutional, citizen-centered, and ethical dimensions of DT.

Finally, the diversity of dimensions across reviewed models highlights the need for contextualization. Governments at national, regional, and local levels should tailor maturity frameworks to institutional capacity, resource availability, and citizen demands, as flexible and context-sensitive models are more likely to support gradual, realistic, and sustainable DT in PA.

3.9.7. Limitations

This study has several limitations. First, the review was conducted by a single reviewer, which may introduce bias despite the use of predefined criteria and pilot screening. Second, the temporal scope (January 2020–November 2024) may exclude very recent studies. Third, although gray literature from major international organizations was included, local or non-indexed initiatives may have been overlooked. Fourth, while a quality appraisal was performed (Table 9), standardized instruments such as AMSTAR or TAPUPAS were not applied. Finally, the bibliometric analysis was limited to Scopus and WoS, which may not fully capture thematic developments present in other databases.

3.9.8. Future research

Future studies should deepen the methodological foundations of digital maturity models by developing architectures capable of representing causal dependencies and supporting dynamic analyses through advanced techniques such as structural equation modeling, bayesian networks, or system dynamics. Additionally, empirical validation remains an essential gap; multilevel and cross-country evaluations are needed to test the transferability of maturity constructs across diverse institutional ecosystems. While recent models have begun incorporating emerging priorities, such as data governance, cybersecurity, or AI readiness, more systematic integration is required to align maturity assessment with evolving digital policy agendas. Finally, subsequent systematic reviews should adopt multi-reviewer designs and standardized quality scoring schemes to enhance methodological transparency, reduce bias, and strengthen reproducibility.

4. CONCLUSION

This systematic review examined 21 digital maturity models applied in PA between 2020 and 2024, confirming the presence of a recurrent functional core (technology, processes, data, human capital, and governance) while revealing substantial heterogeneity in conceptual scope, structural depth, and methodological rigor. Although useful for diagnostic purposes, most models show limited empirical validation, lack formal design methodologies, and offer almost no predictive capacity, with only one incorporating Bayesian networks to anticipate maturity trajectories. By integrating structural, predictive, and contextual assessments, this review provides an updated synthesis that differentiates conceptual, empirical, and normative models, offering clearer guidance for researchers and policymakers seeking to select or adapt maturity frameworks in line with institutional capacities and emerging policy priorities. Future research should advance toward more robust and dynamic maturity models by strengthening empirical validation across diverse contexts, incorporating citizen-oriented and AI-readiness dimensions, and developing predictive mechanisms capable of supporting forward-looking digital governance.

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C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

The author declares no conflict of interest.

DATA AVAILABILITY

The data supporting this study are available in the publicly accessible sources cited in the article.

REFERENCES

[1] P. Farias *et al.*, "Governments that Serve: Innovations that Improve Service Delivery to Citizens," Inter-American Development Bank, Washington, Dec. 2016, doi: 10.18235/0012840.

[2] H. Bai, L. Huang, and Z. Wang, "Supply chain financing, digital financial inclusion and enterprise innovation: Evidence from China," *International Review of Financial Analysis*, vol. 91, p. 103044, Jan. 2024, doi: 10.1016/j.irfa.2023.103044.

[3] Y. Su and J. Wu, "Digital transformation and enterprise sustainable development," *Finance Research Letters*, vol. 60, p. 104902, Feb. 2024, doi: 10.1016/j.frl.2023.104902.

[4] Organization for Economic Cooperation and Development (OECD), "The OECD Digital Government Policy Framework: Six dimensions of a Digital Government," *OECD Public Governance Policy Papers*, Paris, Oct. 2020, doi: 10.1787/f64fed2a-en.

[5] S. Chanias and T. Hess, "How digital are we? Maturity models for the assessment of a company's status in the digital transformation," in *Management Report / Institut für Wirtschaftsinformatik und Neue Medien*, 2016, pp. 1–14.

[6] J. Becker, R. Knackstedt, and J. Pöppelbuß, "Developing Maturity Models for IT Management," *Business & Information Systems Engineering*, vol. 1, no. 3, pp. 213–222, Jun. 2009, doi: 10.1007/s12599-009-0044-5.

[7] M. C. Paulk, B. Curtis, M. B. Chrissis, and C. V Weber, "Capability Maturity Model for Software (Version 1.1)," Feb. 1993.

[8] T. de Bruin, R. Freeze, U. Kulkarni, and M. Rosemann, "Understanding the Main Phases of Developing a Maturity Assessment Model," in *ACIS 2005 Proceedings*, AIS Electronic Library (AISeL), Dec. 2005.

[9] T. Thordsen, M. Murawski, and M. Bick, "How to Measure Digitalization? A Critical Evaluation of Digital Maturity Models," in *Responsible Design, Implementation and Use of Information and Communication Technology*, Springer, Apr. 2020, pp. 358–369, doi: 10.1007/978-3-030-44999-5_30.

[10] L. F. Luna-Reyes and J. R. Gil-Garcia, "Digital government transformation and internet portals: The co-evolution of technology, organizations, and institutions," *Government Information Quarterly*, vol. 31, no. 4, pp. 545–555, Sep. 2014, doi: 10.1016/j.giq.2014.08.001.

[11] I. Mergel, N. Edelmann, and N. Haug, "Defining digital transformation: Results from expert interviews," *Government Information Quarterly*, vol. 36, no. 4, Oct. 2019, doi: 10.1016/j.giq.2019.06.002.

[12] P. Nettel *et al.*, "Government Al Readiness Index 2024," United Kingdom, Dec. 2024.

[13] World Bank, "WBG GovTech Maturity Index 2022 Update: Trends in Public Sector Digital Transformation," Washington, 2022.

[14] Telecommunications and Digital Government Regulatory Authority (TDRA), "Digital Government Maturity Model," UAE, 2024.

[15] British Standards Institute (BSI), "PAS 2009:2024. Digital maturity for government organizations - Guide," UAE, Feb. 2024.

[16] Organization for Economic Cooperation and Development (OECD), "Digital Transformation Maturity Model," Paris, Sep. 2022.

[17] B. Langer, "Understanding Data & Analytics Maturity: A Systematic Review of Maturity Model Composition," *Schmalenbach Journal of Business Research*, vol. 77, no. 2, pp. 205–227, Jun. 2025, doi: 10.1007/s41471-024-00205-2.

[18] A. Aras and G. Büyüközkan, "Digital Transformation Journey Guidance: A Holistic Digital Maturity Model Based on a Systematic Literature Review," *Systems*, vol. 11, no. 4, pp. 1-31, Apr. 2023, doi: 10.3390/systems11040213.

[19] R. Duncan, R. Eden, L. Woods, I. Wong, and C. Sullivan, "Synthesizing Dimensions of Digital Maturity in Hospitals: Systematic Review," *Journal of Medical Internet Research*, vol. 24, no. 3, Mar. 2022, doi: 10.2196/32994.

[20] N. F. Zakiuddin, S. M. Anggara, and Suhardi, "Developing Digital Service Transformation Maturity Model in Public Sector," *IEEE Access*, vol. 12, pp. 174491–174506, Sep. 2024, doi: 10.1109/ACCESS.2024.3468341.

[21] A. Aristovnik, D. Ravšelj, and E. Murko, "Decoding the Digital Landscape: An Empirically Validated Model for Assessing Digitalisation across Public Administration Levels," *Administrative Sciences*, vol. 14, no. 3, pp. 1-22, Feb. 2024, doi: 10.3390/admsci14030041.

[22] A. Debeljak and M. Dečman, "Digital Transformation of Slovenian Urban Municipalities: A Quantitative Report on the Impact of Municipality Population Size on Digital Maturity," *NISPAcee Journal of Public Administration and Policy*, vol. 15, no. 2, pp. 25–51, Dec. 2022, doi: 10.2478/nispa-2022-0012.

[23] E. Doctor *et al.*, "A Maturity Model for Assessing the Digitalization of Public Health Agencies," *Business and Information Systems Engineering*, vol. 65, no. 5, pp. 539–554, Oct. 2023, doi: 10.1007/s12599-023-00813-y.

[24] T. Thordsen and M. Bick, "A decade of digital maturity models: much ado about nothing?," *Information Systems and e-Business Management*, vol. 21, no. 4, pp. 947–976, Dec. 2023, doi: 10.1007/s10257-023-00656-w.
[25] A. A. Okan, "Exploring the Landscape of e-Government Maturity Models: Insights from Systematic Mapping Study and Comparative Analysis," *Digital Government: Research and Practice*, vol. 5, no. 2, Jun. 2024, doi: 10.1145/3656586.
[26] O. Hujran, A. Alarabiat, and M. AlSuwaidi, "Analysing e-government maturity models," *Electronic Government*, vol. 19, no. 1, pp. 1–21, Nov. 2022, doi: 10.1504/EG.2022.10040036.
[27] Å. Waara, "Examining Digital Government Maturity Models: Evaluating the Inclusion of Citizens," *Administrative Sciences*, vol. 15, no. 3, Feb. 2025, doi: 10.3390/admsci15030073.
[28] R. L. Ochoa-Urrego and J. I. Peña-Reyes, "Digital Maturity Models: A Systematic Literature Review," in *Digitalization: Approaches, Case Studies, and Tools for Strategy, Transformation and Implementation*, Springer International Publishing, 2021, pp. 71–85, doi: 10.1007/978-3-030-69380-0_5.
[29] M. J. Page *et al.*, "The PRISMA 2020 statement: an updated guideline for reporting systematic reviews," *BMJ*, vol. 372, no. 9, p. n71, Jan. 2021, doi: 10.1136/bmj.n71.
[30] P. Brereton, B. A. Kitchenham, D. Budgen, M. Turner, and M. Khalil, "Lessons from applying the systematic literature review process within the software engineering domain," *Journal of Systems and Software*, vol. 80, no. 4, pp. 571–583, Apr. 2007, doi: 10.1016/j.jss.2006.07.009.
[31] B. Kitchenham and S. Charters, "Guidelines for performing Systematic Literature Reviews in Software Engineering," 2007.
[32] M. Petticrew and H. Roberts, *Systematic Reviews in the Social Sciences: A Practical Guide*. United Kingdom: Blackwell Publishing Ltd, 2006, doi: 10.1002/9780470754887.
[33] A. Cooke, D. Smith, and A. Booth, "Beyond PICO: The SPIDER Tool for Qualitative Evidence Synthesis," *Qualitative Health Research*, vol. 22, no. 10, pp. 1435–1443, Jul. 2012, doi: 10.1177/1049732312452938.
[34] R. Pawson, A. Boaz, L. Grayson, A. Long, and C. Barnes, *Types and quality of knowledge in social care*. London: Social Care Institute for Excellence, 2003.
[35] P. Mukherji, R. Chatterjee, A. Sen, H. Kapoor, and A. Sambhar, "Digital Maturity Assessment - Lao PDR. Supporting Digital Government Transformation," Jul. 2022.
[36] A. Paez, "Gray literature: An important resource in systematic reviews," *Journal of Evidence-Based Medicine*, vol. 10, no. 3, pp. 233–240, Aug. 2017, doi: 10.1111/jebm.12266.
[37] N. R. Haddaway, A. M. Collins, D. Coughlin, and S. Kirk, "The role of google scholar in evidence reviews and its applicability to grey literature searching," *PLoS One*, vol. 10, no. 9, Sep. 2015, doi: 10.1371/journal.pone.0138237.
[38] M. Nerima and J. Ralyté, "Towards a Digital Maturity Balance Model for Public Organizations," in *Research Challenges in Information Science RCIS 2021*, Springer, May 2021, pp. 295–310, doi: 10.1007/978-3-030-75018-3_20.
[39] J. Hochstetter, J. Diaz, M. Dieguez, R. Espinosa, J. Arango, and C. Cares, "Assessing Transparency in eGovernment Electronic Processes," *IEEE Access*, vol. 10, pp. 3074–3087, Jan. 2022, doi: 10.1109/ACCESS.2021.3137799.
[40] V. Margariti, T. Stamati, D. Anagnostopoulos, M. Nikolaidou, and A. Papastilianou, "A holistic model for assessing organizational interoperability in public administration," *Government Information Quarterly*, vol. 39, no. 3, p. 101712, Jul. 2022, doi: 10.1016/j.giq.2022.101712.
[41] V. Margariti, D. Anagnostopoulos, A. Papastilianou, T. Stamati, and S. Angeli, "Assessment of organizational interoperability in e-Government," in *Proceedings of the 13th International Conference on Theory and Practice of Electronic Governance*, in ICEGOV '20. New York, NY, USA: ACM, Oct. 2020, pp. 298–308, doi: 10.1145/3428502.3428544.
[42] N. A. Wessiani, P. Suwignjo, A. A. Pratiwi, and T. W. Pramesti, "Development of a Maturity Model based on the Input, Process, and Output Aspects of E-government," in *Proceedings of the 11th Annual International Conference on Industrial Engineering and Operations Management*, IEOM Society, Mar. 2021, pp. 2414–2425.
[43] G. Fesenko, T. Fesenko, H. Fesenko, A. Shakhov, A. Yakunin, and V. Korzhenko, "Developing e-maturity model for municipal project and program management system," *Eastern-European Journal of Enterprise Technologies*, vol. 1, no. 3 (109), pp. 15–28, Feb. 2021, doi: 10.15587/1729-4061.2021.225278.
[44] Information and Communication Technology Agency of Sri Lanka (ICTA), "Digital Maturity Model for the Government of Sri Lanka," 2022.
[45] A. Kalpaka, G. Rissola, S. De Nigris, and D. Nepelski, "Digital Maturity Assessment (DMA) Framework and Questionnaires for SMEs/PSOs: A guidance document for EDIHs," 2023.
[46] M. Rod and J. Vomlel, "Improving Czech Digital Government Based on Quantified Maturity Model of Enterprise Architecture," in *Proceedings of the 25th International Conference on Enterprise Information Systems*, SCITEPRESS - Science and Technology Publications, 2023, pp. 600–607, doi: 10.5220/0011855300003467.
[47] Digital Government Exchange Working Group: Digital Maturity, "Digital Maturity Framework MVP," Feb. 2022.
[48] e-Government Authority - The United Republic of Tanzania, "e-Goverment Capability Maturity Framework," 2023.
[49] T. Mettler, "Maturity assessment models: a design science research approach," *International Journal of Society Systems Science (IJSSS)*, vol. 3, pp. 81–98, Mar. 2011, doi: 10.1504/IJSSS.2011.038934.
[50] R. Wendler, "The maturity of maturity model research: A systematic mapping study," *Information and Software Technology*, vol. 54, no. 12, pp. 1317–1339, Dec. 2012, doi: 10.1016/j.infsof.2012.07.007.
[51] M. Röglinger, J. Pöppelbuß, and J. Becker, "Maturity Models in Business Process Management," *Business Process Management Journal*, vol. 18, no. 2, Apr. 2012, doi: 10.1108/14637151211225225.
[52] L. Tangi, M. Gaeta, M. Benedetti, L. Gastaldi, and G. Noci, "Assessing the effect of organisational factors and ICT expenditures on e-maturity: empirical results in Italian municipalities," *Local Government Studies*, vol. 49, no. 6, pp. 1333–1358, Nov. 2023, doi: 10.1080/03003930.2022.2078807.
[53] C. A. Williams, D. Schallmo, K. Lang, C. Williams, and L. Boardman, "Digital Maturity Models for Small and Medium-sized Enterprises: A Systematic Literature Review," in *The ISPIM Innovation Conference – Celebrating Innovation: 500 Years Since daVinci*, Florence, Jun. 2019.

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