

Supplementary Materials

REVISION COLOUR KEY: Blue text indicates changes made in response to the latest reviewer comments. Existing pale blue/pale green table fills continue to denote audit provenance as originally defined.

Measuring ICT Governance Compliance in South Africa's Public Service: A Systematic Multivocal Review and Conceptual Framework

These supplementary materials report the final review procedures and results under the amended protocol. All sources proceeding to quality appraisal were assessed within one integrated appraisal using the same source-appropriate six-criterion rubrics, the same 18/30 retention threshold, and the same totals-based hybrid reconciliation procedure. Pale blue and pale green are used only to preserve audit provenance within the appraisal tables; they do not indicate different analytical treatment.

Table S1. Full academic database search strategies and records retrieved

Database	Date last searched	Search string	Records
Scopus	25 May 2026	TITLE-ABS-KEY(("ICT governance" OR "IT governance" OR "information technology governance" OR "corporate governance of ICT") AND (compliance OR "governance compliance" OR assessment OR evaluation OR measurement OR "compliance measurement" OR indicator* OR metric* OR framework* OR maturity OR "maturity model*" OR capability OR "capability model*" OR audit OR monitoring OR implementation) AND ("public sector" OR government OR "public administration" OR "government agency*" OR "government department*" OR municipal* OR ministr* OR "public organisation*" OR "public organization*" OR e-government OR "digital government"))	428
Web Of Science	26 May 2026	TS=(("ICT governance" OR "IT governance" OR "information technology governance" OR "corporate governance of ICT" OR "information systems governance" OR ISG) AND (compliance OR "governance compliance" OR assessment OR evaluation OR measurement OR "compliance measurement" OR indicator* OR metric* OR framework* OR maturity OR "maturity model*" OR capability OR "capability model*" OR audit OR monitoring OR implementation OR COBIT OR "ISO/IEC 38500" OR ITIL) AND ("public sector" OR government OR "public administration" OR "government agency*" OR "government department*" OR municipal* OR ministr* OR "public organisation*" OR "public organization*" OR e-government OR "digital government"))	64
IEEE Xplore	26 May 2026	(("ICT governance" OR "IT governance" OR "information technology governance" OR "corporate governance of ICT" OR "information systems governance" OR ISG) AND (compliance OR "governance compliance" OR assessment OR evaluation OR measurement OR "compliance measurement" OR indicator* OR metric* OR framework* OR maturity OR "maturity model*" OR capability OR "capability model*" OR audit OR monitoring OR implementation OR COBIT OR "ISO/IEC 38500" OR ITIL) AND ("public sector" OR government OR "public administration" OR "government agency" OR "government agencies" OR "government department" OR "government departments" OR municipal* OR ministr* OR "public organisation*" OR "public organization*" OR e-government OR "digital government"))	281
EBSCOhost Web	25 May 2026	TX (("ICT governance" OR "IT governance" OR "information technology governance" OR "corporate governance of ICT" OR "information systems governance" OR ISG) AND (compliance OR "governance compliance" OR assessment OR evaluation OR measurement OR "compliance measurement" OR indicator* OR metric* OR framework* OR maturity OR "maturity model*" OR capability OR "capability model*" OR audit OR monitoring OR implementation OR COBIT OR "ISO/IEC 38500" OR ITIL) AND ("public sector" OR government OR "public administration" OR "government agency*" OR "government department*" OR municipal* OR ministr* OR "public organisation*" OR "public organization*" OR e-government OR "digital government"))	373
Google Scholar	27 May 2026	("ICT governance" OR "IT governance" OR "information technology governance") AND (compliance OR assessment OR measurement OR evaluation OR framework) AND ("public sector" OR government OR "public administration")	200
Total			1346

Table S2. Grey-literature search routes

Organisation/source	Date last searched	Repository/search route	Search terms/strategy	Records/documents identified
Auditor-General South Africa (AGSA)	6 May 2026	AGSA official website; PFMA general reports; targeted website and Google site search	"ICT governance", "ICT controls", "information technology" AND governance, "PFMA" AND ICT, "ICT controls" AND audit, site:agsa.co.za PFMA ICT governance	4
Department of Public Service and Administration (DPSA)	8 May 2026	DPSA official website; governance of ICT policy and directive repositories; targeted document search	"corporate governance of ICT", "CGICTPF", "ICT governance implementation", "CGICTPF assessment", "governance of ICT directive", site:dpsa.gov.za CGICTPF	5
Institute of Directors South Africa (IoDSA)	11 May 2026	IoDSA official website and corporate-governance publications	"King IV" AND technology, "technology and information governance", "ICT governance" AND King IV, site:iodsa.co.za King IV technology information	3
International Organization for Standardization (ISO/IEC)	13 May 2026	ISO catalogue; ISO/IEC standards search; title and standards-family searching	"governance of IT", "ISO 38500", "assessment governance IT", "IT-enabled investment governance", "ISO/IEC 38503", "ISO/IEC 38506"	4
ISACA	15 May 2026	ISACA/COBIT official repository; COBIT publications and supporting guidance	"COBIT 2019 governance", "COBIT governance objectives", "COBIT design factors", "COBIT measurement", "COBIT performance management"	4

Organisation/source	Date last searched	Repository/search route	Search terms/strategy	Records/documents identified
National Institute of Standards and Technology (NIST)	17 May 2026	NIST publications and Cybersecurity Framework repository	"Cybersecurity Framework 2.0", "CSF governance", "GOVERN function", "cybersecurity governance", "supply-chain risk governance"	2
Organisation for Economic Co-operation and Development (OECD)	17 May 2026	OECD iLibrary; OECD digital-government publications	"digital government governance", "digital government policy framework", "ICT governance public sector", "E-Leaders governance", "digital government measurement"	3
United Nations Department of Economic and Social Affairs (UN DESA)	13 May 2026	UN E-Government Knowledgebase; UN DESA publications	"E-Government Survey", "digital government index", "government digital governance", "e-government measurement"	4
World Bank	18 May 2026	World Bank GovTech repository and publications database	"GovTech Maturity Index", "government technology maturity", "digital government indicators", "public sector digital governance"	5
Total				34

Table S3. Final full-text exclusions and reasons (n = 39)

Full-text exclusions are reported against the final eligibility criteria. Domain-specific evidence was not excluded merely because it addressed a single governance domain; exclusion required failure of one or more substantive eligibility conditions, such as governance focus, extractable governance/assessment evidence, organisation-level transferability, public-sector relevance/transferability, construct fit, source adequacy, or currency of the normative source.

Selection outcome	Total	Interpretation	Status
Full texts assessed	130	Academic and grey-literature full texts considered at eligibility stage.	Final
Excluded at full-text eligibility	39	Sources not meeting the final eligibility criteria.	Final
Proceeding to quality appraisal	91	Final appraisal pool: 71 academic-rubric sources and 20 grey/postgraduate sources.	Final

Note: Johnson (2012), a doctoral dissertation, is classified as grey/postgraduate evidence for quality appraisal. The final quality-appraisal pool therefore comprises 71 academic-rubric sources and 20 grey/postgraduate sources.

Evidence stream	Study / Source	Final exclusion criterion	Final exclusion reason
Academic	Anindra, F., Abbas, B. S., Trisetyarso, A., Suparta, W., Kang, C.-H., & Warnars, H. L. H. S. (2018). Improving the quality of enterprise IT goals using COBIT 5 prioritization approach. https://doi.org/10.1109/COIACT.2018.8350814	Extractable governance/assessment evidence	Fails Q2 extractable governance/assessment evidence under the final eligibility criteria.
Academic	Bayona, & Ayala. (2017). IT governance: Progress and challenges on public administration.	Extractable governance/assessment evidence	Fails Q2 extractable governance/assessment evidence under the final eligibility criteria.
Academic	Bowen, P. L. (2011). A framework for information systems governance.	Organisation-level / public-sector transferability	Fails Q3 organisation-level transferability, Q4 public-sector relevance/transferability under the final eligibility criteria.
Academic	Bowen, P. L., Cheung, M. Y. D., & Rohde, F. H. (2007). Enhancing IT governance practices: A model and empirical evidence.	Organisation-level / public-sector transferability	Fails Q3 organisation-level transferability, Q4 public-sector relevance/transferability under the final eligibility criteria.
Academic	Brown, A. E., & Magill, S. L. (2007). Alignment of the IT governance framework with organisational objectives.	Organisation-level / public-sector transferability	Fails Q3 organisation-level transferability, Q4 public-sector relevance/transferability under the final eligibility criteria.
Academic	Calder, A. (2014). IT governance: An international guide to data security and ISO/IEC 38500.	Governance focus / evidence / transferability	Fails Q1 governance focus, Q2 extractable governance/assessment evidence, Q3 organisation-level transferability under the final eligibility criteria.
Academic	Canedo et al. (2018). Best practices kits for the ICT governance process within the Secretariat of State-Owned Companies of Brazil.	Extractable governance/assessment evidence	Fails Q2 extractable governance/assessment evidence under the final eligibility criteria.
Academic	De Haes, S., Van Grembergen, W., & Debrecey, R. (2010). COBIT 5 and enterprise governance of information technology.	Governance/assessment evidence / public-sector transferability	Fails Q2 extractable governance/assessment evidence, Q4 public-sector relevance/transferability under the final eligibility criteria.
Academic	Gonçalves et al. (2019). The governance of information technology and communication in public health organizations.	Extractable governance/assessment evidence	Fails Q2 extractable governance/assessment evidence under the final eligibility criteria.
Academic	Ridley, G., Young, J. F., & Carroll, P. (2004). COBIT and its utilization: A framework from the literature. In Proceedings of the 37th Annual Hawaii International Conference on System Sciences (pp. 1–8). IEEE Computer Society. https://doi.org/10.1109/HICSS.2004.1265566	Governance/assessment evidence / public-sector transferability	Fails Q2 extractable governance/assessment evidence, Q4 public-sector relevance/transferability under the final eligibility criteria.
Academic	Jackson, R. A. (2019). Auditing the smart city.	Insufficient verifiable source evidence	The available full text could not be verified as the intended source; substantive governance-assessment evidence could therefore not be established reliably under the final eligibility criteria.
Academic	Johl et al. (2014). IT governance in the context of HE governance in South Africa.	Extractable governance/assessment evidence	Fails Q2 extractable governance/assessment evidence under the final eligibility criteria.
Academic	Juiz, C., & de Pous, V. A. (2013). Cloud computing: IT governance, legal, and public policy aspects. https://doi.org/10.4018/978-1-4666-8358-7_ch042	Governance focus / organisation-level transferability	Fails Q1 governance focus, Q3 organisation-level transferability under the final eligibility criteria.
Academic	Ko, D., & Fink, D. (2011). Information technology governance: A review of the literature.	Governance/assessment evidence / public-sector transferability	Fails Q2 extractable governance/assessment evidence, Q4 public-sector relevance/transferability under the final eligibility criteria.
Academic	Lee-Geiller. (2023). Developing digital governance: South Korea as a global digital government leader.	Insufficient substantive evidence	Insufficient substantive original governance-assessment evidence/source type for the review; extractable compliance-measurement evidence is not demonstrated.
Academic	López-Poveda, A., Rusu, L., & Johannesson, P. (2011). A maturity model for analyzing strategic IT management from a service perspective.	Construct mismatch	Adjacent construct: the source primarily assesses maturity/capability/implementation rather than demonstrable ICT-governance compliance.
Academic	Manuela, W. S., & Tiglaio, N. M. C. (2006). E-government applications in the Philippines.	Governance focus / organisation-level transferability	Fails Q1 governance focus, Q3 organisation-level transferability under the final eligibility criteria.
Academic	Mtsweni, J., & Van Belle, J. P. (2016). Information technology governance in South African government institutions.	Extractable governance/assessment evidence	Fails Q2 extractable governance/assessment evidence under the final eligibility criteria.

Evidence stream	Study / Source	Final exclusion criterion	Final exclusion reason
Academic	Nfuka, E. N. (2012). Critical success factors influencing IT governance implementation in the public sector.	Overlapping/precursor evidence	Overlapping/precursor evidence with no sufficiently distinct additional contribution beyond retained evidence.
Academic	Nfuka, E. N., & Rusu, L. (2015). IT governance capability assessment in public sector organisations.	Construct mismatch	Adjacent construct: the source primarily assesses maturity/capability/implementation rather than demonstrable ICT-governance compliance.
Academic	Omari, L. A., & Kishore, R. (2016). Assessment of IT governance implementation in public organisations using COBIT.	Construct mismatch	Adjacent construct: the source primarily assesses maturity/capability/implementation rather than demonstrable ICT-governance compliance.
Academic	Parra, I., Arroyo, G., & Garcia, A. (2014). Experiences and practices in the implementation of IT governance in Mexican electric utility.	Governance/assessment evidence / public-sector transferability	Fails Q2 extractable governance/assessment evidence, Q4 public-sector relevance/transferability under the final eligibility criteria.
Academic	Pereira, R., & Mira da Silva, M. (2010). A maturity model for information technology governance.	Construct mismatch	Adjacent construct: the source primarily assesses maturity/capability/implementation rather than demonstrable ICT-governance compliance.
Academic	Pereira, R., & Mira da Silva, M. (2012). Designing an IT governance framework based on COBIT.	Governance/assessment evidence / public-sector transferability	Fails Q2 extractable governance/assessment evidence, Q4 public-sector relevance/transferability under the final eligibility criteria.
Academic	Prasetyawan, N., & Nugroho, S. M. S. (2019). Maturity level analysis of governance and integration IT of Simkeuda in Pamekasan Regency using COBIT 4.1. https://doi.org/10.1109/ISITIA.2019.8937230	Construct mismatch	Adjacent construct: the source primarily assesses maturity/capability/implementation rather than demonstrable ICT-governance compliance.
Academic	Priyanti, V. E., & Durachman, Y. (2021). IT governance evaluation at the Regional Office of the Directorate General of Taxes of South Jakarta I using the COBIT 5 framework. https://doi.org/10.1109/CITSM52892.2021.9588945	Construct mismatch	Adjacent construct: the source primarily assesses maturity/capability/implementation rather than demonstrable ICT-governance compliance.
Academic	Rebollo. (2013). Overview of key information security governance frameworks.	Governance focus / organisation-level transferability	Fails Q1 governance focus, Q3 organisation-level transferability under the final eligibility criteria.
Academic	Silva et al. (2018). PeticGov: An auditing and direction framework for federal public organizations.	Governance/assessment evidence / public-sector transferability	Fails Q2 extractable governance/assessment evidence, Q4 public-sector relevance/transferability under the final eligibility criteria.
Academic	Simonsson, M., Johnson, P., & Ekstedt, M. (2011). The IT organisation modelling and assessment framework.	Organisation-level / public-sector transferability	Fails Q3 organisation-level transferability, Q4 public-sector relevance/transferability under the final eligibility criteria.
Academic	Van Der Walt, & Von Solms. (2017). Political corporate governance of ICT: Essential for national service delivery and security.	Extractable governance/assessment evidence	Fails Q2 extractable governance/assessment evidence under the final eligibility criteria.
Academic	Van Grembergen, W., De Haes, S., & Guldentops, E. (2004). Structures, processes and relational mechanisms for IT governance.	Governance/assessment evidence / public-sector transferability	Fails Q2 extractable governance/assessment evidence, Q4 public-sector relevance/transferability under the final eligibility criteria.
Academic	Van Grembergen, W. (2008). Strategies for information technology governance.	Governance/assessment evidence / public-sector transferability	Fails Q2 extractable governance/assessment evidence, Q4 public-sector relevance/transferability under the final eligibility criteria.
Academic	Van Grembergen, W., & De Haes, S. (2013). A research journey into enterprise governance of IT.	Governance/assessment evidence / public-sector transferability	Fails Q2 extractable governance/assessment evidence, Q4 public-sector relevance/transferability under the final eligibility criteria.
Academic	Velasco, M., Arroyo-Figueroa, G., & Parra, I. (2008). Directions and applications of IT governance in CFE.	Governance/assessment evidence / public-sector transferability	Fails Q2 extractable governance/assessment evidence, Q4 public-sector relevance/transferability under the final eligibility criteria.
Academic	Weill, P., & Ross, J. W. (2008). Enterprise governance of information technology.	Organisation-level / public-sector transferability	Fails Q3 organisation-level transferability, Q4 public-sector relevance/transferability under the final eligibility criteria.
Grey literature	ISACA. (2013). COBIT 5: A business framework for the governance and management of enterprise IT.	Superseded/duplicate source	Superseded or duplicate normative framework/standard version; the current version is retained.
Grey literature	ISO. (2008). ISO/IEC 38500:2008—Corporate governance of information technology.	Superseded/duplicate source	Superseded or duplicate normative framework/standard version; the current version is retained.
Grey literature	ISO. (2013). ISO/IEC 38500: Corporate governance of information technology.	Superseded/duplicate source	Superseded or duplicate normative framework/standard version; the current version is retained.
Grey literature	IT Governance Institute. (2009). COBIT 4.1.	Superseded/duplicate source	Superseded or duplicate normative framework/standard version; the current version is retained.

Supplementary Table S3A. Final study-selection and quality-appraisal flow

Stage	Total	Evidence-stream detail	Final outcome
Full texts assessed	130	107 academic-search records; 23 grey-literature records	Eligibility assessment
Excluded at full-text eligibility	39	35 academic-search records; 4 grey-literature records	Excluded
Quality appraised	91	71 academic-rubric; 20 grey/postgraduate (19 from the grey-literature search stream + Johnson, 2012, reclassified from the academic-search stream)	Quality appraisal
Excluded after quality appraisal	19	19 academic-rubric; 0 grey/postgraduate	Excluded
Included in final synthesis	72	52 academic; 20 grey/postgraduate	Retained

Colour key: pale blue = records in the original appraisal file; pale green = additional records incorporated during revision. All records form one final appraisal set and were analysed using the same protocol.

Note. The evidence-stream classification changes between the eligibility and quality-appraisal stages for one source. Johnson (2012), identified through the academic-search stream, is a doctoral dissertation and was therefore reclassified as grey/postgraduate evidence for source-appropriate quality appraisal. Consequently, the 107 academic-search full texts comprise 35 full-text exclusions, 71 sources appraised using the academic rubric, and Johnson (2012), which was appraised using the grey/postgraduate rubric. The 23 grey-literature full texts comprise four full-text exclusions and 19 sources proceeding to appraisal. Thus, the final appraisal pool of 91 consists of 71 academic-rubric sources and 20 grey/postgraduate sources (19 originating from the grey-literature search plus Johnson, 2012). The case-level independent reassessments and final reconciliation of the 21 disputed R1/R7 records are reported in Supplementary Tables S3B–S3D.

Eligibility re-audit of formerly disputed R1/R7 full-text exclusions. The following tables preserve the independent reviewer reassessments under the clarified four-part eligibility rule. Supplementary Table S3D then reconciles those independent decisions with the final eligibility and downstream quality-appraisal outcomes used in the review.

Supplementary Table S3B. Reviewer 1 eligibility re-audit under the clarified four-part transferability rule

S3 record	Source	Original code	Q1 Governance focus	Q2 Extractable evidence	Q3 Organisation-level transferability	Q4 Public-sector relevance / transferability	Final re-audit decision	Primary re-audit reason / contribution
1	Al-Ghazi et al. (2020)	R1	Yes	Yes	Yes	Direct	INCLUDE → quality appraisal	Five Saudi public-sector organisations were studied; the findings identify IT-governance mechanisms, strategic alignment, management characteristics and project-planning factors. The earlier exclusion merely because strategic alignment was a single domain is no longer defensible.
2	Ali, Green & Robb (2011)	R1	Yes	Strong	Yes	Transferable	INCLUDE → quality appraisal	This is especially important. It develops an empirically tested four-factor, 16-item IT-investment-governance measure covering decision making, value monitoring, implementation evaluation and project management. The validation sample is not public-sector specific, so it should be used as transferable measurement evidence rather than South African contextual evidence.
7	Brown & Magill (2007), alignment of IT governance with organisational objectives	R1	No	Yes	No	Yes	EXCLUDE	Confirmed exclusion under the clarified rule: Q1=No and Q3=No. The record does not provide sufficient organisation-level ICT-governance compliance evidence transferable to the review construct.
27	Munyoka & Maharaj (2017)	R1	Policy rather than organisational ICT governance	Limited	No/weak	Direct regional public-policy relevance	EXCLUDE	The study concerns harmonisation of national ICT policies and regulatory frameworks across SADC. Although relevant to the broader policy environment, its unit of analysis is regional/national policy harmonisation rather than organisation-level ICT-governance assessment. Revised reason should therefore be insufficient organisation-level governance-measurement transferability, not "narrow domain."
30	Ningsih et al. (2013)	R1	Yes	Strong	Yes	Direct	INCLUDE → quality appraisal	It designs an IT-investment-management framework for a government institution using ITIM and COBIT 5, including maturity assessment, goals, metrics, KPIs, monitoring and evaluation, with triangulation/validation. This is directly relevant measurement evidence.
8	Bujung et al. (2024)	R7	Yes	Yes	Yes	Direct	INCLUDE → quality appraisal	The paper is explicitly about IT governance and management in local-government Trade Offices, aligns COBIT 2019 with SPBE policy and develops governance recommendations. The smart-market application does not invalidate the transferable governance content.
9	Calder (2014), data security and ISO/IEC 38500	R7	No	Yes	No	Yes	EXCLUDE	Confirmed exclusion under the clarified rule: Q1=No and Q3=No. The source does not provide sufficient organisation-level ICT-governance compliance evidence for inclusion.
11	Da Veiga & Eloff (2017)	R7	No	Yes	No	Yes	EXCLUDE	Confirmed exclusion in Reviewer 1's independent re-audit: Q1=No and Q3=No. The source was judged insufficiently transferable to organisation-level ICT-governance compliance at this stage.
12	de Gier (2018)	R7	Yes	Yes	Yes	Direct	INCLUDE → quality appraisal	This is a municipal IT-governance case study. It provides organisation-level evidence on business-IT alignment, cooperation, decision-making authority, digital services and governance maturity. The fact that digital information management is the application context is not a valid reason for exclusion.
15	Heredia & Merchán (2020)	R7	Yes	Strong	Yes	Transferable	INCLUDE → quality appraisal	The study harmonises ISO/IEC 27014 and ISO/IEC 38500 and derives governance principles, objectives and indicators, including responsibility, performance, strategy, risk, compliance and human behaviour. This is exactly the type of domain-specific governance evidence the clarified rule permits.
17	Irzavika & Mahda (2023)	R7	Yes	Yes	Yes	Direct	INCLUDE → quality appraisal	COBIT 2019 is explicitly used to assess government SPBE audit tools; the study addresses monitoring, evaluation, maturity, risk and regulatory compliance across central/local government agencies. This goes beyond technical tool performance.
18	Jackson (2019)	R7	No	Yes	No	Yes	EXCLUDE	Confirmed exclusion under the clarified rule. The intended full text/source identity could not be verified sufficiently to establish reliable organisation-level governance-assessment evidence.
20	Johnson (2012)	R7	Yes	Yes	Yes	Direct	INCLUDE → quality	The dissertation examines IT-governance practices,

S3 record	Source	Original code	Q1 Governance focus	Q2 Extractable evidence	Q3 Organisation-level transferability	Q4 Public-sector relevance / transferability	Final re-audit decision	Primary re-audit reason / contribution
							appraisal, but reclassify as grey/postgraduate evidence	policy/planning and risk assessment in the US federal government and develops policy/assessment implications for critical infrastructure. Security is the domain, but governance and organisational policy are substantive.
21	Juiz & de Pous (2013), cloud computing, IT governance, law and public policy	R7	No	Yes	No	Yes	EXCLUDE	Confirmed Exclude (Q1=No, Q3=No): Focuses on legal cloud procurement contracts and technical SLA parameters without org-level ICT governance constructs.
23	Lee-Geiller (2023)	R7	Partial	No	Limited	Public-policy context	EXCLUDE	The supplied item is a book review, not the underlying Chung book or an original empirical/review study. It summarises and critiques another author's work. Revised reason: ineligible source type / insufficient substantive original governance-assessment evidence, not "digital-government sub-domain."
25	Manuela & Tiglao (2006), e-government applications in the Philippines	R7	No	Yes	No	Yes	EXCLUDE	Confirmed Exclude (Q1=No, Q3=No): lacks org-level governance compliance indicators.
31	Nugraha & Syaldah (2022)	R7	Yes	Strong	Yes	Direct	INCLUDE → quality appraisal	XYZ Polytechnic is a state institution under an Indonesian ministry. The study designs a COBIT 2019 governance system, assesses current capability, conducts gap analysis and produces recommendations across people, processes and technology. "Smart campus" is the setting, not merely a technical application.
33	Ott et al. (2011)	R7	Yes	Yes	Yes, with bounded extraction	Direct government application	INCLUDE → quality appraisal	Although SOA is the domain, the paper operationalises governance through structures, processes, policies, metrics, decision rights, accountability and compliance, and tests the framework in a public-sector organisation. Extract only the transferable governance mechanisms, not SOA-specific technical elements.
39	Rebollo (2013), information-security governance frameworks	R7	No	Yes	No	Yes	EXCLUDE	Confirmed exclusion under the clarified rule: Q1=No and Q3=No. The source was judged insufficiently transferable to organisation-level ICT-governance compliance.
40	Reis et al. (2020)	R7	Yes	Yes	Yes	Direct	INCLUDE → quality appraisal	The paper explicitly develops a roadmap for applying COBIT 5 governance requirements to city-government initiatives and frames governance as evaluating, directing and monitoring ICT to achieve city objectives. Smart city is an application context, not grounds for automatic exclusion.
48	Wang, Sun & Yan (2012)	R7	Yes	Yes	Yes	Direct	INCLUDE → quality appraisal	The study operationalises e-government governance capability and empirically tests its relationship with implementation effectiveness using Chinese public-sector officials. It is useful particularly for distinguishing governance capability/effectiveness from compliance and for extracting organisation-level governance mechanisms. The source is a scholarly book chapter within the supplied Springer proceedings volume.

Supplementary Table S3C. Reviewer 2 eligibility re-audit under the clarified four-part transferability rule

S3 record	Source	Original code	Q1 Governance focus	Q2 Extractable evidence	Q3 Organisation-level transferability	Q4 Public-sector relevance / transferability	Final re-audit decision	Primary re-audit reason / contribution
1	Al-Ghazi et al. (2020)	R1	Yes	Yes	Yes	Yes	INCLUDE	Overtuned (formerly R1): Domain-specific study on strategic alignment governance providing extractable alignment structures and decision-rights indicators transferable to org-level compliance.
2	Ali, Green, & Robb (2011)	R1	Yes	Yes	Yes	Yes	INCLUDE	Overtuned (formerly R1): Focuses on IT investment governance; contains extractable mechanisms, oversight controls, and decision-rights structures transferable to public sector compliance.
7	Brown & Magill (2007)	R1	No	Yes	No	Yes	EXCLUDE	Confirmed exclusion in Reviewer 2's independent re-audit: Q1=No and Q3=No. The record was judged not to provide sufficient organisation-level ICT-governance compliance evidence.

S3 record	Source	Original code	Q1 Governance focus	Q2 Extractable evidence	Q3 Organisation-level transferability	Q4 Public-sector relevance / transferability	Final re-audit decision	Primary re-audit reason / contribution
27	Munyoka & Maharaj (2017)	R1	Yes	Yes	Yes	Yes	INCLUDE	Overtuned (formerly R1): Regional SADC ICT governance and e-government policy harmonization study; offers transferable policy governance compliance dimensions.
30	Ningsih et al. (2013)	R1	Yes	Yes	Yes	Yes	INCLUDE	Overtuned (formerly R1): IT investment governance framework in public sector context; provides extractable capital allocation and governance control indicators.
8	Bujung et al. (2024)	R7	No	No	No	Yes	EXCLUDE	Confirmed Exclude (Q1=No, Q3=No): Focuses on operational/market digitalization of smart-city apps rather than ICT governance structures or compliance.
9	Calder (2014)	R7	No	Yes	No	Yes	EXCLUDE	Confirmed exclusion in Reviewer 2's independent re-audit: Q1=No and Q3=No. The source was judged insufficiently transferable to organisation-level ICT-governance compliance.
11	Da Veiga & Eloff (2017)	R7	Yes	Yes	Yes	Yes	INCLUDE	Overtuned (formerly R7): Information security governance framework offering clear governance structures, policy compliance indicators, and assessment logic.
12	de Gier (2018)	R7	No	Yes	No	Yes	EXCLUDE	Confirmed Exclude (Q1=No, Q3=No): Operational municipal record/information management practices; lacks org-level ICT governance compliance construct.
15	Heredia & Merchán (2020)	R7	Yes	Yes	Yes	Yes	INCLUDE	Overtuned (formerly R7): Information security governance standards integration in public higher education; provides extractable governance alignment metrics.
17	Irzavika & Mahda (2023)	R7	No	Yes	No	Yes	EXCLUDE	Confirmed Exclude (Q1=No, Q3=No): Single application audit (educational portal); operational system assessment rather than org-level ICT governance.
18	Jackson (2019)	R7	No	Yes	No	Yes	EXCLUDE	Confirmed exclusion in Reviewer 2's independent re-audit: Q1=No and Q3=No. The source was judged not to establish sufficient organisation-level ICT-governance compliance evidence.
20	Johnson (2012)	R7	No	Yes	No	Yes	EXCLUDE	Confirmed Exclude (Q1=No, Q3=No): Operational cybersecurity technical controls for critical infrastructure; lacks broader ICT governance structures.
21	Juiz & de Pous (2013)	R7	No	Yes	No	Yes	EXCLUDE	Confirmed Exclude (Q1=No, Q3=No): Focuses on legal cloud procurement contracts and technical SLA parameters without org-level ICT governance constructs.
23	Lee-Geiller (2023)	R7	Yes	No	Yes	Yes	EXCLUDE	Confirmed Exclude (Q2=No): Public administration commentary on political e-government leadership; lacks extractable ICT governance compliance controls.
25	Manuela & Tiglao (2006)	R7	No	Yes	No	Yes	EXCLUDE	Confirmed Exclude (Q1=No, Q3=No): Operational evaluation of software application rollout in public agencies; lacks org-level governance construct.
31	Nugraha & Syaldah (2022)	R7	No	Yes	No	Yes	EXCLUDE	Confirmed Exclude (Q1=No, Q3=No): Localized technical network design/audit for a single campus; operational IT system focus.
33	Ott et al. (2011)	R7	No	Yes	No	No	EXCLUDE	Confirmed Exclude (Q1=No, Q3=No): Technical service-oriented architecture (SOA) software governance; non-transferable application-level focus.
39	Rebollo (2013)	R7	No	Yes	No	Yes	EXCLUDE	Confirmed exclusion in Reviewer 2's independent re-audit: Q1=No and Q3=No. The source was judged insufficiently transferable to organisation-level ICT-governance compliance.
40	Reis et al. (2020)	R7	Yes	No	No	Yes	EXCLUDE	Confirmed Exclude (Q2=No, Q3=No): Smart-city infrastructure requirements mapping; lacks extractable org-level ICT governance compliance indicators.
48	Wang, Sun, & Yan (2012)	R7	Yes	Yes	Yes	Yes	INCLUDE	Overtuned (formerly R7): Structural e-government governance mechanisms and adoption compliance controls; provides extractable governance indicators.

Note. Supplementary Tables S3B and S3C preserve the independent pre-consensus reassessments. Reviewer 1 classified 12 of the 21 disputed records as INCLUDE and 9 as EXCLUDE; Reviewer 2 classified 7 as INCLUDE and 14 as EXCLUDE. The reviewers agreed on 12 records and disagreed on 9. The discordant cases were subsequently reconciled against the clarified eligibility criteria and, where eligible, subjected to the same source-appropriate quality-appraisal procedure reported in Tables S5–S6C.

Supplementary Table S3D. Final reconciliation register and downstream outcomes for the 21 disputed R1/R7 records

S3 record	Source	Reviewer 1	Reviewer 2	Final reconciled eligibility	Quality-appraisal outcome	Final synthesis status	Reconciliation/audit note
1	Al-Ghazi et al. (2020)	INCLUDE	INCLUDE	Eligible → quality appraisal	26/30 (High)	Retained	Agreement; retained after appraisal.
2	Ali, Green, & Robb (2011)	INCLUDE	INCLUDE	Eligible → quality appraisal	29/30 (High)	Retained	Agreement; retained after appraisal.
7	Brown & Magill (2007)	EXCLUDE	EXCLUDE	Excluded at full-text eligibility	Not appraised	Excluded	Agreement on failure of governance focus/organisation-level transferability.
27	Munyoka & Maharaj (2017)	EXCLUDE	INCLUDE	Eligible → quality appraisal	22/30 (Moderate)	Retained	Discordant independent decisions reconciled to eligibility; regional policy-governance evidence was retained as transferable.
30	Ningsih et al. (2013)	INCLUDE	INCLUDE	Eligible → quality appraisal	27/30 (High)	Retained	Agreement; retained after appraisal.
8	Bujung et al. (2024)	INCLUDE	EXCLUDE	Eligible → quality appraisal	24/30 (Moderate)	Retained	Discordant independent decisions reconciled to eligibility; extractable governance content was separated from the application context.
9	Calder (2014)	EXCLUDE	EXCLUDE	Excluded at full-text eligibility	Not appraised	Excluded	Agreement on insufficient organisation-level transferable governance evidence.
11	Da Veiga & Eloff (2017)	EXCLUDE	INCLUDE	Eligible → quality appraisal	16/30 (Low)	Excluded after appraisal	Discordant independent decisions reconciled to eligibility for appraisal; the source subsequently failed the 18/30 retention threshold.
12	de Gier (2018)	INCLUDE	EXCLUDE	Eligible → quality appraisal	25/30 (High)	Retained	Discordant independent decisions reconciled to eligibility; organisation-level municipal governance evidence was retained.
15	Heredia & Merchán (2020)	INCLUDE	INCLUDE	Eligible → quality appraisal	26/30 (High)	Retained	Agreement; retained after appraisal.
17	Irzavika & Mahda (2023)	INCLUDE	EXCLUDE	Eligible → quality appraisal	25/30 (High)	Retained	Discordant independent decisions reconciled to eligibility; governance/audit evidence was extractable beyond the application context.
18	Jackson (2019)	EXCLUDE	EXCLUDE	Excluded at full-text eligibility	Not appraised	Excluded	Agreement; intended full text/source identity could not be verified sufficiently for reliable inclusion.
20	Johnson (2012)	INCLUDE	EXCLUDE	Eligible → grey/postgraduate appraisal	27/30 (High)	Retained	Discordant independent decisions reconciled to eligibility; the dissertation was reclassified as grey/postgraduate evidence for appraisal.
21	Juiz & de Pous (2013)	EXCLUDE	EXCLUDE	Excluded at full-text eligibility	Not appraised	Excluded	Reviewer 2 exclusion and final eligibility review did not support inclusion.
23	Lee-Geiller (2023)	EXCLUDE	EXCLUDE	Excluded at full-text eligibility	Not appraised	Excluded	Insufficient substantive original governance-assessment evidence/source type.

25	Manuela & Tiglao (2006)	EXCLUDE	EXCLUDE	Excluded at full-text eligibility	Not appraised	Excluded	final review found insufficient organisation-level ICT-governance construct.
31	Nugraha & Syaidah (2022)	INCLUDE	EXCLUDE	Eligible → quality appraisal	26/30 (High)	Retained	Discordant independent decisions reconciled to eligibility; the state-polytechnic COBIT governance design provided organisation-level evidence.
33	Ott et al. (2011)	INCLUDE	EXCLUDE	Eligible → quality appraisal	27/30 (High)	Retained	Discordant independent decisions reconciled to eligibility with bounded extraction of transferable governance mechanisms.
39	Rebollo (2013)	EXCLUDE	EXCLUDE	Excluded at full-text eligibility	Not appraised	Excluded	Agreement on insufficient organisation-level transferable governance evidence.
40	Reis et al. (2020)	INCLUDE	EXCLUDE	Eligible → quality appraisal	26/30 (High)	Retained	Discordant independent decisions reconciled to eligibility; COBIT governance requirements were extractable at city-government level.
48	Wang, Sun, & Yan (2012)	INCLUDE	INCLUDE	Eligible → quality appraisal	17/30 (Low)	Excluded after appraisal	Agreement on eligibility; source did not meet the 18/30 retention threshold.

Final reconciliation summary. Of the 21 disputed records, 14 were finally judged eligible and proceeded to source-appropriate quality appraisal. Thirteen entered the academic appraisal stream and Johnson (2012), a doctoral dissertation, entered the grey/postgraduate appraisal stream. Twelve of the 14 met the $\geq 18/30$ retention threshold and were retained in the synthesis; two (Da Veiga & Eloff, 2017, 16/30; Wang, Sun, & Yan, 2012, 17/30) were excluded after quality appraisal. Seven records were excluded at full-text eligibility. These outcomes reconcile with Table S3 (39 full-text exclusions), Table S3A (91 appraised; 72 retained), Tables S5–S5C (71 academic-rubric appraisals) and Tables S6–S6D (20 grey/postgraduate appraisals).

Table S4. Characteristics and analytical contribution of the final 72-source synthesis set

ID	Source (working appraisal label)	Evidence stream	Context/focus	Final appraisal score /30	Primary contribution to synthesis	RQ/dimension mapping
A01	Ab Razak, R., & Zakaria, M. S. (2017). The information and communication technology governance maturity level for Malaysian public sector. In Proceedings of the Second International Conference on Internet of Things, Data and Cloud Computing (pp. 1–8). Association for Computing Machinery. https://doi.org/10.1145/3018896.3018967	Academic	Malaysia; public sector ICT governance maturity	27	Develops maturity-oriented ICT governance measurement and critical success factors; informs distinction between maturity and compliance.	RQ1/RQ3; Performance Monitoring & Continuous Improvement
A02	Al Hilali, R. A., & Vijaya, P. (2021). An exploratory study of the key enabling factors of IT projects governance (ITPG) implementation in the public sector in Oman. International Journal of Computing and Digital Systems, 10(1), 639–658. https://doi.org/10.12785/IJCDS/100162	Academic	Oman; public-sector IT project governance	29	Identifies enabling factors for project governance implementation, including policy, authority, auditing, risk and accountability.	RQ1/RQ3; Governance Structures; Risk; Investment/Procurement
A03	Al Qassimi, N., & Rusu, L. (2015). IT governance in a public organization in a developing country: A case study of a governmental organization. Procedia Computer Science, 64, 450–456.	Academic	Developing-country governmental organisation	23	Shows IT governance through structures, processes and relational mechanisms; supports decision rights, committees and accountability.	RQ1/RQ3; Governance Structures & Accountability
A04	Al-Taei, S. H. H., & Flayyih, H. H. (2023). Impact of the electronic internal auditing based on IT governance to reduce auditing risk. Corporate Governance and Organizational Behavior Review, 7(1), 94–100.	Academic	Iraq; public-sector electronic internal audit	25	Links COBIT-based electronic internal auditing with reduced audit risk; contributes assurance and control evidence.	RQ1/RQ3; Risk & Security; Regulatory & Policy Compliance
A05	Ali, S., & Green, P. (2006). Effective information technology governance mechanisms in public sectors: An Australian case. PACIS 2006 Proceedings, 99.	Academic	Australia; public sector	27	Empirically supports strategy committees, communication and performance measurement as governance mechanisms.	RQ1/RQ3; Strategic Alignment; Governance Structures; Performance Monitoring
A06	Amali, L. N., Katili, M. R., & Suhada, S. (2023). Core model of information technology governance system design in local government. TELKOMNIKA, 21(4), 750–761.	Academic	Indonesia; local government	28	Uses COBIT 2019 to design a local-government governance core model and capability priorities.	RQ1/RQ3; capability/measurement; cross-dimensional
A07	Arif, A., et al. (2020). IT governance audit and determination of work priorities using analytical hierarchy process: Case study the government of North Maluku, Indonesia. Journal of Physics: Conference Series, 1577, 012046.	Academic	Indonesia; North Maluku government	28	Combines governance audit with AHP prioritisation, informing evidence-based gap analysis and improvement prioritisation.	RQ1/RQ3; Performance Monitoring & Continuous Improvement

ID	Source (working appraisal label)	Evidence stream	Context/focus	Final appraisal score /30	Primary contribution to synthesis	RQ/dimension mapping
A08	Arpandi, D., Affandi, A., & Endroyono. (2024). Stakeholder perspective on the architecture of the electronic based government system (SPBE) in regional hospitals. In 5th Technology Innovation Management and Engineering Science International Conference (TIMES-ICON 2024). IEEE. https://doi.org/10.1109/TIMES-ICON61890.2024.10630726	Academic	Indonesia; regional public hospitals/SPBE	25	Captures stakeholder perspectives on government-system architecture, integration and governance design.	RQ1/RQ3; Strategic Alignment; Governance Structures
A09	Canedo, E. D., et al. (2022). ICT governance and management macroprocesses of a Brazilian federal government agency. Information, 13(5), 231.	Academic	Brazil; federal government agency	27	Models ICT governance and risk-management macroprocesses; contributes risk governance, process design and decision support.	RQ1/RQ3; Risk & Security; Governance Structures
A10	Canedo, E. D., et al. (2020). Information and communication technology (ICT) governance processes: A case study. Information, 11(10), 462.	Academic	Brazil; public-sector ICT governance processes	26	Demonstrates process diagnosis/conformity and improvement logic for ICT governance implementation.	RQ1/RQ3/RQ4; Investment/Procurement; Regulatory Compliance
A11	Clara, A. M. C., et al. (2018). A synthesis of common guidelines for regulatory compliance verification in the context of ICT governance audits. Information Polity, 23(2), 221–237.	Academic	Public-sector regulatory compliance	30	Provides compliance-verification elements, documentary evidence and remediation cycle central to the evidence-based compliance construct.	RQ1/RQ3/RQ4; Regulatory Compliance; Performance Monitoring
A12	Gerke, L., & Ridley, G. (2006). Towards an abbreviated COBIT framework for use in an Australian state public sector. ACIS 2006 Proceedings.	Academic	Australia; state public sector audit	27	Shows how COBIT controls can be prioritised into a public-sector assessment instrument; informs measurement design.	RQ1/RQ3/RQ4; measurement approaches
A13	Juiz, C., Guerrero, C., & Lera, I. (2014). Implementing good governance principles for the public sector in information technology governance frameworks. Open Journal of Accounting, 3(1), 9–27. https://doi.org/10.4236/ojaact.2014.31003	Academic	Public-sector/university good governance	26	Connects IT governance frameworks with transparency, accountability and good-governance principles.	RQ1/RQ3; Governance Structures; public-value validation
A14	Kalkhoran, S. D., Babalhavaej, F., Hariri, N., & Mozafari, A. (2025). Providing a governance model for information technology (COBIT) in the enterprise architecture of Iran Public Libraries Foundation. International Journal of Information Science and Management, 23(3), 1–21. https://doi.org/10.22034/ijism.2025.2048634.1672	Academic	Iran; public libraries	30	Integrates COBIT with enterprise architecture and governance dimensions; supports strategic alignment and tailored governance design.	RQ1/RQ3; Strategic Alignment; Governance Structures
A15	Katili, M. R., Amali, L. N., & Suhada, S. (2023). Design factors in evaluating and formulating IT governance systems. Jurnal RESTI, 7(5), 1182–1191.	Academic	Indonesia; public organisations	28	Applies COBIT 2019 design factors to formulate tailored governance systems.	RQ1/RQ3/RQ4; governance capability and design
A16	Luna-Reyes, L. F., et al. (2020). Exploring the relationships between dynamic capabilities and IT governance: Implications for local governments. Transforming Government: People, Process and Policy, 14(2), 149–169.	Academic	Local government	25	Links dynamic capabilities with IT governance, resource prioritisation, innovation and adaptation.	RQ1/RQ3/RQ4; capability; Strategic Alignment; continuous improvement
A17	Martin, N., & Gregor, S. (2006). ICT governance: Frameworks for managing Australian e-government. Journal of E-Government, 2(3), 19–49. https://doi.org/10.1300/J399v02n03_03	Academic	Australia; e-government agencies	29	Examines ICT governance frameworks, legislation, budgets and governance arrangements in public agencies.	RQ1/RQ2/RQ3; Strategic Alignment; Governance Structures
A18	Nfuka, E. N., & Rusu, L. (2013). Critical success framework for implementing effective IT governance in Tanzanian public sector organizations. Journal of Global Information Technology Management, 16(3), 53–77.	Academic	Tanzania; public sector	30	Develops a critical-success framework showing how resources, knowledge and culture condition implementation.	RQ1/RQ3/RQ4; organisational capability
A19	Nfuka, E. N., et al. (2010). IT governance maturity in the public sector organizations in a developing country: The case of Tanzania. AMCIS 2010 Proceedings.	Academic	Tanzania; public sector	27	Benchmarks COBIT maturity and shows lower maturity where governance mechanisms are less established.	RQ1/RQ3; maturity/capability measurement
A20	Pagayonan, S. M. S., & Wenceslao, F. V. (2026). AI-enabled continuous IT auditing using process mining and risk-based analytics: A framework for Philippine state universities and colleges. In 2026 7th International Conference on Mobile Computing and Sustainable Informatics (ICMCSI). IEEE. https://doi.org/10.1109/ICMCSI67283.2026.11412622	Academic	Philippines; state universities and colleges	27	Proposes AI-enabled continuous IT auditing with process mining and risk analytics; informs assurance and emerging-domain extension.	RQ3/RQ4; Performance Monitoring; Risk & Security
A21	Parfitt, M., & Tryfonas, T. (2009). Painless: A model for IT governance assessment in the UK public sector. EDPACS, 39(2–3), 1–25. https://doi.org/10.1080/07366980902907779	Academic	United Kingdom; Welsh public sector	25	Provides a practical public-sector IT governance assessment model and audit-oriented measurement approach.	RQ1/RQ3/RQ4; measurement architecture
A22	Phahlane. (2023). An institutional perspective of CGICTPF implementation in the public sector.	Academic	South Africa; national public-sector department	21	Uses institutional theory to explain CGICTPF adoption/implementation and the roles of management support and structure.	RQ1/RQ2/RQ4; Governance Structures; institutionalisation
A23	Plevnik, M. (2026). Communication and information systems user support as a governance mechanism in a high-security public organization. Systems, 14(3), 288. https://doi.org/10.3390/systems14030288	Academic	Slovenia; high-security public organisation	30	Reconceptualises user support, escalation, security and continuity as governance mechanisms supporting resilience.	RQ1/RQ3; Risk & Security; Governance Structures
A24	Rizal, R. A., Sarno, R., & Sungkono, K. R. (2020). COBIT 5 for analysing information technology governance maturity level on masterplan e-government. In 2020 International Seminar on Application for Technology of Information and Communication (iSemantic) (pp. 517–522). IEEE. https://doi.org/10.1109/iSemantic50169.2020.9234301	Academic	Indonesia; SPBE/e-government	24	Uses COBIT 5 to evaluate governance maturity and gaps in an SPBE masterplan context.	RQ1/RQ3; maturity measurement; Strategic Alignment
A25	Zdravkovic, J., Rychkova, I., & Speckert, T. (2014). Requirements for IT governance in organizations experiencing decentralization. In Information systems engineering in complex environments (Lecture Notes in Business Information Processing, Vol. 204, pp. 269–285). Springer. https://doi.org/10.1007/978-3-319-19270-3_17	Academic	Decentralised higher-education organisation	23	Derives IT governance requirements for decentralised structures, decision rights and lateral communication.	RQ1/RQ3; Governance Structures & Accountability
A26	Muniz dos Santos, V., Moura, L. F., & Zarelli, P. R. (2025). Diagnostic model for IT governance assessment in federal public universities. Revista de Administração Contemporânea, 29(3), e240318. https://doi.org/10.1590/1982-7849rac2025240318.en	Academic	Brazil; federal public universities	30	Develops a context-sensitive diagnostic IT governance assessment model and differentiates institutional governance profiles.	RQ1/RQ3/RQ4; measurement design; Performance Monitoring

ID	Source (working appraisal label)	Evidence stream	Context/focus	Final appraisal score /30	Primary contribution to synthesis	RQ/dimension mapping
A27	Sofyani, H., Riyadh, H. A., & Fahlevi, H. (2020). Improving service quality, accountability and transparency of local government: The intervening role of information technology governance. <i>Cogent Business & Management</i> , 7(1), 1735690. https://doi.org/10.1080/23311975.2020.1735690	Academic	Local government	29	Empirically separates compliance culture, IT governance effectiveness and service/accountability/transparency outcomes.	RQ1/RQ4; outcomes/public-value validation
A28	Solekhan, Affandi, A., & Endroyono. (2024). Assessment of IT governance in supporting XYZ University KPIs using COBIT 2019. In <i>2024 International Seminar on Intelligent Technology and Its Applications (ISITIA 2024)</i> (pp. 436–441). IEEE. https://doi.org/10.1109/ISITIA63062.2024.10668310	Academic	Indonesia; university	23	Assesses COBIT 2019 governance against university KPIs and maturity targets; informs capability and performance assessment.	RQ1/RQ3; maturity; Performance Monitoring
A29	Toaza, G., Montenegro, C., & Salazar, C. (2022). Designing an I&T governance system in the context of strategic public sector based on COBIT 2019 framework: Case study in a developing country. In <i>Proceedings of the 5th International Conference on Information Management and Management Science</i> (pp. 401–406). Association for Computing Machinery. https://doi.org/10.1145/3564858.3564920	Academic	Ecuador; strategic military public organisation	26	Applies COBIT 2019 design factors to tailor a public-sector I&T governance system.	RQ1/RQ3/RQ4; governance capability/design
A30	Utomo, D., Wijaya, M., Suzanna, Efendi, & Sagala, N. T. M. (2022). Leveraging COBIT 2019 to implement IT governance in SME context: A case study of higher education in Campus A. <i>CommIT (Communication and Information Technology) Journal</i> , 16(2), 129–141. https://doi.org/10.21512/commit.v16i2.8172	Academic	Higher education; tailored COBIT 2019	25	Demonstrates context-sensitive use of COBIT 2019 design factors and capability targets.	RQ1/RQ3/RQ4; governance capability/design
A31	Vogt, M., & Hales, K. (2010). Strategic alignment of ICT projects with community values in local government. In <i>Proceedings of the 43rd Hawaii International Conference on System Sciences (HICSS 2010)</i> (pp. 1–10). IEEE. https://doi.org/10.1109/HICSS.2010.350	Academic	Local government	25	Links ICT-project alignment to community/public values; supports strategic alignment and public-value framing.	RQ1/RQ3/RQ4; Strategic Alignment; public value
A32	Wiedenhöft, G. C., Luciano, E. M., & Pereira, G. V. (2020). Information technology governance institutionalization and the behavior of individuals in the context of public organizations. <i>Information Systems Frontiers</i> , 22(6), 1487–1504. https://doi.org/10.1007/s10796-019-09945-7	Academic	Brazil; state public organisations	29	Shows that IT governance institutionalisation influences civil-servant behaviour and organisational citizenship.	RQ1/RQ3/RQ4; capability/institutionalisation; relational mechanisms
A33	Wiedenhöft, G. C., & Luciano, E. M. (2021). Going the extra mile: Impact of individuals' behavior on information technology governance. <i>Revista de Administração Contemporânea</i> , 25(5), e190237. https://doi.org/10.1590/1982-7849rac2021190237.en	Academic	Brazil; public-sector IT personnel	30	Shows individual initiative/behaviour contributes to perceived maturity of governance mechanisms.	RQ1/RQ3; governance capability; relational mechanisms
A34	Zainuddin, Z., Winarno, E., Ningsi, N., Pasrun, Y. P., & Muliyadi, M. (2020). IT governance evaluation at the Population and Civil Registry Office in Kolaka District using COBIT 5 framework. <i>Register: Jurnal Ilmiah Teknologi Sistem Informasi</i> , 6(2), 86–95. https://doi.org/10.26594/register.v6i2.1728	Academic	Indonesia; population/civil registry office	25	Uses COBIT 5 capability assessment and current-target gaps, including weaker security/control processes.	RQ1/RQ3/RQ4; Risk & Security; maturity measurement
A35	Al-Shamayleh, G. M. Y. A., Alwhshat, Z., Al-Shabatat, M. A., & Al-Sarayrah, A. A. K. M. (2026). IT governance perspective on the nature of public office in the Jordanian Constitution: A comparative study. <i>EDPACS</i> , advance online publication. https://doi.org/10.1080/07366981.2026.2677204	Academic	Jordan; constitutional/public administration	26	Examines IT-governance implications for public office, administrative modernisation and formal public accountability.	RQ1/RQ2; institutional/legal governance context
A36	Borja, S., Kim, K., Yoon, H., & Hwang, J. (2022). Mechanisms that influence IT governance effectiveness: Empirical analysis in private and public sector in Colombia. In <i>2022 Portland International Conference on Management of Engineering and Technology (PICMET)</i> (pp. 1–9). IEEE. https://doi.org/10.23919/PICMET53225.2022.9882706	Academic	Colombia; public/private organisations	28	Tests governance mechanisms associated with IT governance effectiveness; informs structural/process/relational mechanisms and outcome separation.	RQ1/RQ4; Governance Structures; effectiveness outcomes
A37	Ngqondi, T., & Mauwa, H. (2020). Information technology governance model for a low resource institution with fragmented IT portfolio. <i>South African Journal of Higher Education</i> , 34(3), 246–262. https://doi.org/10.20853/34-3-3326	Academic	South Africa; low-resource university	28	Documents gaps between governance artefacts and operational structures, role clarity, skills, communication and alignment.	RQ1/RQ3; Strategic Alignment; Governance Structures; capability
A38	Olaitan, O., Herselman, M., & Wayi, N. (2019). A data governance maturity evaluation model for government departments of the Eastern Cape province, South Africa. <i>South African Journal of Information Management</i> , 21(1), a996. https://doi.org/10.4102/sajim.v21i1.996	Academic	South Africa; Eastern Cape government departments	30	Develops a data-governance maturity evaluation model and demonstrates context-sensitive assessment.	RQ1/RQ3/RQ4; maturity/capability measurement
A39	Simonsson, M., et al. (2010). The effect of IT governance maturity on IT governance performance. <i>Information Systems Management</i> , 27(1), 10–24.	Academic	IT governance measurement	29	Separates maturity from governance performance and advocates activity-, metric-, documentation- and role-based assessment.	RQ1/RQ3/RQ4; measurement logic; Performance Monitoring
A40	Vaya-Arboledas, A., Ferrer-Oliva, M., & Medina-Merodio, J. A. (2025). Evolution and perspectives in IT governance: A systematic literature review. <i>Computers</i> , 14(12), 520. https://doi.org/10.3390/computers14120520	Academic	Systematic review of IT governance	30	Provides contemporary conceptual coverage of IT-governance themes, including alignment, resource allocation and emerging regulatory/security issues.	RQ1/RQ3; conceptual triangulation

ID	Source (working appraisal label)	Evidence stream	Context/focus	Final appraisal score /30	Primary contribution to synthesis	RQ/dimension mapping
A41	Steuperaert, D., Poels, G., & Devos, J. (2025). A reference model for information quality in an IT governance context. <i>Information Systems Management</i> , 42(3), 346–364. https://doi.org/10.1080/10580530.2025.2477455	Academic	IT governance information quality	30	Develops an information-quality reference model as a measurable governance-system component.	RQ3/RQ4; evidence quality; Performance Monitoring
A42	Al-Ghazi et al. (2020). A qualitative study of the strategic alignment perspective of public-sector organisations in Saudi Arabia in the digital age.	Academic	Saudi Arabia; five public-sector organisations; strategic alignment and IT-governance mechanisms	26	Provides qualitative evidence on formal governance mechanisms, decision structures, top-management participation and business-IT strategic alignment in public-sector digital transformation.	RQ1/RQ3; Strategic Alignment; Governance Structures & Accountability
A43	Ali, S., Green, P., & Robb, A. (2011). Information technology investment governance in public organisations.	Academic	Organisational IT-investment governance; measurement-instrument development	29	Develops and validates a four-factor, 16-item IT-investment-governance measure covering decision making, value monitoring, implementation evaluation and project management.	RQ1/RQ3/RQ4; ICT Investment & Procurement Governance; Performance Monitoring
A44	Bujung et al. (2024). IT governance and management for smart city: Aligning COBIT 2019 with SPBE policies for traditional market digitalization initiatives.	Academic	Indonesia; local-government Trade Offices; COBIT 2019 and SPBE policy alignment	24	Links COBIT 2019 governance design with SPBE policy, stakeholder engagement, resource constraints and implementation conditions in a local-government digitalisation context.	RQ2/RQ3; Strategic Alignment; Governance Structures; Regulatory & Policy Compliance
A45	Munyoka, & Maharaj. (2017). Towards the harmonisation of information and communication technology policy frameworks in the Southern African Development Community.	Academic	Southern African Development Community; ICT-policy harmonisation	22	Provides regional public-policy evidence on alignment of national ICT policies with regional regulatory frameworks and the governance implications of policy fragmentation.	RQ2/RQ3; Regulatory & Policy Compliance; Strategic Alignment
A46	Ningsih, K. R., Sembiring, J., Arman, A. A., & Wuryandari, A. I. (2013). Developing IT investment management framework of government institution. https://doi.org/10.1109/ICACISIS.2013.6761582	Academic	Indonesia; government institution; IT-investment management	27	Integrates ITIM and COBIT 5 with maturity assessment, strategic objectives, metrics and KPIs to support measurable IT-investment governance and benefits realisation.	RQ3/RQ4; ICT Investment & Procurement Governance; Performance Monitoring & Continuous Improvement
A47	Nugraha, R. A., & Syaidah, R. (2022). Smart campus governance design for XYZ Polytechnic based on COBIT 2019. https://doi.org/10.30630/oiiv.6.3.1257	Academic	Indonesia; state polytechnic; COBIT 2019 governance design	26	Uses COBIT 2019 capability assessment and gap analysis to design governance processes and improvement recommendations across people, process and technology.	RQ3/RQ4; Strategic Alignment; Governance Structures; Performance Monitoring
A48	Ott, C., Korthaus, A., Böhmman, T., Rosemann, M., & Krmar, H. (2011). Foundations of a reference model for SOA governance. https://doi.org/10.1007/978-3-642-17722-4_4	Academic	Government organisation; SOA-governance reference model	27	Operationalises governance through structures, processes, policies, metrics, decision rights and accountability, refined through expert input and government application.	RQ1/RQ3/RQ4; Governance Structures & Accountability; Strategic Alignment
A49	Reis, L. C. D., Ferreira, S. B. L., Bernardini, F. C., & Cappelli, C. (2020). Towards a COBIT 5 approach to ICT governance requirements in smart cities. https://doi.org/10.1145/3428502.3428598	Academic	City government; smart-city ICT governance; COBIT 5	26	Develops a roadmap for applying COBIT 5 governance requirements to evaluate, direct and monitor government smart-city initiatives.	RQ2/RQ3/RQ4; Strategic Alignment; Regulatory & Policy Compliance; Performance Monitoring
A50	de Gier. (2018). IT governance of Dutch municipalities and digital information management.	Academic	Netherlands; municipal IT governance and digital information management	25	Provides organisation-level evidence on governance structures, decision authority, business-IT alignment, cooperation and governance maturity in municipal settings.	RQ1/RQ3; Strategic Alignment; Governance Structures & Accountability
A51	Heredia, H., & Merchán, V. (2020). Towards information security governance for institutions of higher education: Harmonization of standards. https://doi.org/10.1007/978-3-030-42531-9_37	Academic	Higher education; information-security governance; standards harmonisation	26	Derives governance principles, objectives and indicators spanning responsibility, strategy, risk, compliance and human behaviour; strengthens domain-specific compliance measurement.	RQ2/RQ3/RQ4; Risk & Security Governance; Regulatory & Policy Compliance
A52	Irzavika, N., & Mahda, F. R. (2023). The effectiveness of SPBE application and infrastructure audit tools in enhancing information technology governance using COBIT 2019. https://doi.org/10.1109/ICIMCIS60089.2023.10348973	Academic	Indonesia; government SPBE audit tools; COBIT 2019	25	Contributes evidence on government ICT audit, monitoring, capability assessment, regulatory alignment and continuous governance improvement.	RQ2/RQ3/RQ4; Regulatory & Policy Compliance; Performance Monitoring & Continuous Improvement
G01	Terblanche, J. (2011). An information technology governance framework for the public sector [Master's thesis, Stellenbosch University]. Stellenbosch University.	Grey	South Africa; public-sector thesis	23	Develops a public-sector-specific IT governance framework; supports contextual tailoring and governance architecture.	RQ1/RQ2/RQ3
G02	Al Omari, L. (2016). IT governance evaluation: Adapting and adopting the COBIT framework for public sector organisations [Doctoral dissertation, Queensland University of Technology]. QUT ePrints.	Grey	Public-sector doctoral research	26	Adapts COBIT for public-sector governance evaluation; informs assessment architecture and usability.	RQ1/RQ3/RQ4
G03	AGSA – The Citizen's Report: PFMA 2020–21	Grey	South Africa; AGSA citizen report	23	Provides contextual audit evidence on accountability and recurring control weaknesses; used as supplementary context only.	RQ2/RQ3; assurance context
G04	AGSA – PFMA 2020–21 Consolidated General Report	Grey	South Africa; AGSA PFMA 2020–21	26	Provides independent audit evidence on controls, procurement, performance information, accountability and remediation.	RQ2/RQ3/RQ4; Regulatory Compliance; Performance Monitoring
G05	AGSA – PFMA 2021–22 Consolidated General Report	Grey	South Africa; AGSA PFMA 2021–22	25	Provides independent audit evidence on recurring findings, leadership action and corrective controls.	RQ2/RQ3/RQ4; Regulatory Compliance; Performance Monitoring
G06	DPSA – CGICTPF Implementation Guideline (2013)	Grey	South Africa; DPSA 2013	25	Defines CGICTPF implementation expectations for governance charters, accountability, alignment, conformance, reporting and improvement.	RQ2/RQ3/RQ4; primary normative layer
G07	DPSA – Determination and Directive on implementation of CGICTPF (2022)	Grey	South Africa; DPSA 2022 directive	26	Formalises implementation, assessment and reporting requirements for public-service CGICT governance.	RQ2/RQ3/RQ4; compliance/assessment layer
G08	DPSA – Public Service CGICT Policy Framework Version 2 (2022)	Grey	South Africa; CGICTPF Version 2	29	Defines executive responsibility, structures, strategic alignment, risk, value, performance and reporting expectations.	RQ2/RQ3/RQ4; primary normative layer
G09	IoDSA – King IV Report on Corporate Governance for South Africa (2016)	Grey	South Africa; King IV	29	Provides governing-body principles for technology and information oversight, accountability and strategic support.	RQ2/RQ3; corporate-governance layer
G10	ISO/IEC 38506:2020 – Governance of IT-enabled investments	Grey	International standard	27	Provides governance principles for IT-enabled investment, acquisition, value, risk and conformance.	RQ2/RQ3/RQ4; Investment & Procurement
G11	ISO/IEC 38503:2022 – Assessment of the governance of IT	Grey	International standard	28	Provides governance assessment approaches, criteria and evidence requirements.	RQ2/RQ3/RQ4; assessment-method layer
G12	ISACA – COBIT 2019 Design Guide	Grey	Professional framework	27	Provides contextual design factors for tailoring an information and technology governance system.	RQ2/RQ3/RQ4; design layer
G13	ISACA – COBIT 2019 Governance and Management Objectives	Grey	Professional framework	26	Provides governance/management objectives, practices and example metrics supporting candidate indicators.	RQ2/RQ3/RQ4; operationalisation layer
G14	ISACA – COBIT 2019 Introduction and Methodology	Grey	Professional framework	27	Defines governance-system components and methodological foundations for COBIT 2019.	RQ2/RQ3/RQ4; operationalisation layer
G15	NIST – Cybersecurity Framework 2.0 (2024)	Grey	International cybersecurity framework	27	Provides governance outcomes for risk strategy, roles, policy, oversight and supply-chain risk.	RQ2/RQ3; Risk & Security
G16	OECD – Digital Government Policy Framework (2020)	Grey	International public-sector framework	27	Provides six digital-government dimensions and indicator architecture for benchmarking.	RQ2/RQ3/RQ4; measurement design
G17	OECD – E-Leaders Handbook on the Governance of Digital Government (2021)	Grey	International public-sector guidance	28	Provides institutional governance, leadership and coordination architecture for digital government.	RQ2/RQ3/RQ4; governance/benchmark layer
G18	UN DESA – E-Government Survey 2024	Grey	International benchmark	28	Provides comparative digital-government indicators and benchmarking architecture.	RQ2/RQ3/RQ4; measurement/benchmark layer

ID	Source (working appraisal label)	Evidence stream	Context/focus	Final appraisal score /30	Primary contribution to synthesis	RQ/dimension mapping
G19	World Bank – GovTech Maturity Index 2025	Grey	International benchmark	26	Provides GovTech maturity/index architecture and comparative public-sector measurement design.	RQ2/RQ3/RQ4; measurement/benchmark layer
G20	Johnson, R. L. (2012). An analysis of IT governance practices in the federal government: Protecting U.S. critical infrastructure from cyber terrorist attacks. [Doctoral dissertation].	Grey/Postgraduate	United States; federal-government IT governance, cybersecurity and critical-infrastructure risk	27	Provides policy- and practice-oriented evidence on federal IT-governance practices, risk assessment, policy/planning and cybersecurity governance for critical infrastructure.	RQ2/RQ3; Risk & Security Governance; Regulatory & Policy Compliance

Table S5. Final combined academic-source quality appraisal (n = 71)

No.	Study	Reviewer 1 total	Reviewer 2 total	Final hybrid score	Hybrid discussion required	Final decision
1	Ab Razak, R., & Zakaria, M. S. (2017). The information and communication technology governance maturity level for Malaysian public sector. In <i>Proceedings of the Second International Conference on Internet of Things, Data and Cloud Computing</i> (pp. 1–8). Association for Computing Machinery. https://doi.org/10.1145/3018896.3018967	29	25	27	YES	Include
2	Al Hilali, R. A., & Vijaya, P. (2021). An exploratory study of the key enabling factors of IT projects governance (ITPG) implementation in the public sector in Oman. <i>International Journal of Computing and Digital Systems</i> , 10(1), 639–658. https://doi.org/10.12785/IJCDS/100162	29	28	29	NO	Include
3	Al Qassimi, N., & Rusu, L. (2015). IT governance in a public organization in a developing country: A case study of a governmental organization. <i>Procedia Computer Science</i> , 64, 450–456.	25	22	23	YES	Include
4	Al-Taei, S. H. H., & Flayyih, H. H. (2023). Impact of the electronic internal auditing based on IT governance to reduce auditing risk. <i>Corporate Governance and Organizational Behavior Review</i> , 7(1), 94–100.	26	24	25	YES	Include
5	Ali, S., & Green, P. (2006). Effective information technology governance mechanisms in public sectors: An Australian case. <i>PACIS 2006 Proceedings</i> , 99.	27	26	27	NO	Include
6	Amali, L. N., Katili, M. R., & Suhada, S. (2023). Core model of information technology governance system design in local government. <i>TELKOMNIKA</i> , 21(4), 750–761.	27	28	28	NO	Include
7	Arief, A., et al. (2020). IT governance audit and determination of work priorities using analytical hierarchy process: Case study the government of North Maluku, Indonesia. <i>Journal of Physics: Conference Series</i> , 1577, 012046.	26	30	28	YES	Include
8	Arpandi, D., Affandi, A., & Endroyono. (2024). Stakeholder perspective on the architecture of the electronic based government system (SPBE) in regional hospitals. In <i>5th Technology Innovation Management and Engineering Science International Conference (TIMES-ICON 2024)</i> . IEEE. https://doi.org/10.1109/TIMES-ICON61890.2024.10630726	26	24	25	YES	Include
9	Canedo, E. D., et al. (2022). ICT governance and management macroprocesses of a Brazilian federal government agency. <i>Information</i> , 13(5), 231.	28	25	27	NO	Include
10	Canedo, E. D., et al. (2020). Information and communication technology (ICT) governance processes: A case study. <i>Information</i> , 11(10), 462.	30	25	26	YES	Include
11	Clara, A. M. C., et al. (2018). A synthesis of common guidelines for regulatory compliance verification in the context of ICT governance audits. <i>Information Polity</i> , 23(2), 221–237.	30	30	30	NO	Include
12	Gerke, L., & Ridley, G. (2006). Towards an abbreviated COBIT framework for use in an Australian state public sector. <i>ACIS 2006 Proceedings</i> .	29	25	27	YES	Include
13	Juiz, C., Guerrero, C., & Lera, I. (2014). Implementing good governance principles for the public sector in information technology governance frameworks. <i>Open Journal of Accounting</i> , 3(1), 9–27. https://doi.org/10.4236/ojaacct.2014.31003	25	26	26	NO	Include
14	Kalkhoran, S. D., Babalhavaejl, F., Hariri, N., & Mozafari, A. (2025). Providing a governance model for information technology (COBIT) in the enterprise architecture of Iran Public Libraries Foundation. <i>International Journal of Information Science and Management</i> , 23(3), 1–21. https://doi.org/10.22034/ijism.2025.2048634.1672	29	30	30	NO	Include
15	Katili, M. R., Amali, L. N., & Suhada, S. (2023). Design factors in evaluating and formulating IT governance systems. <i>Jurnal RESTI</i> , 7(5), 1182–1191.	28	28	28	NO	Include
16	Luna-Reyes, L. F., et al. (2020). Exploring the relationships between dynamic capabilities and IT governance: Implications for local governments. <i>Transforming Government: People, Process and Policy</i> , 14(2), 149–169.	29	21	25	YES	Include
17	Martin, N., & Gregor, S. (2006). ICT governance: Frameworks for managing Australian e-government. <i>Journal of E-Government</i> , 2(3), 19–49. https://doi.org/10.1300/J399v02n03_03	30	27	29	NO	Include
18	Nfuka, E. N., & Rusu, L. (2013). Critical success framework for implementing effective IT governance in Tanzanian public sector organizations. <i>Journal of Global Information Technology Management</i> , 16(3), 53–77.	30	30	30	NO	Include
19	Nfuka, E. N., et al. (2010). IT governance maturity in the public sector organizations in a developing country: The case of Tanzania. <i>AMCIS 2010 Proceedings</i> .	28	26	27	NO	Include
20	Pagayonan, S. M. S., & Wenceslao, F. V. (2026). AI-enabled continuous IT auditing using process mining and risk-based analytics: A framework for Philippine state universities and colleges. In <i>2026 7th International Conference on Mobile Computing and Sustainable Informatics (ICMSI)</i> . IEEE. https://doi.org/10.1109/ICMSI67283.2026.11412622	25	30	27	YES	Include
21	Parfitt, M., & Tryfonas, T. (2009). Painless: A model for IT governance assessment in the UK public sector. <i>EDPACS</i> , 39(2–3), 1–25. https://doi.org/10.1080/07366980902907779	27	24	25	YES	Include
22	Phahlane. (2023). An institutional perspective of CGICTPF implementation in the public sector.	22	20	21	NO	Include
23	Plevnik, M. (2026). Communication and information systems user support as a governance mechanism in a high-security public organization. <i>Systems</i> , 14(3), 288. https://doi.org/10.3390/systems14030288	29	30	30	NO	Include
24	Rizal, R. A., Sarno, R., & Sungkono, K. R. (2020). COBIT 5 for analysing information technology governance maturity level on masterplan e-government. In <i>2020 International Seminar on Application for Technology of Information and Communication (I-Semantic)</i> (pp. 517–522). IEEE. https://doi.org/10.1109/I-Semantic50169.2020.9234301	27	20	24	YES	Include
25	Zdravkovic, J., Rychkova, I., & Speckert, T. (2014). Requirements for IT governance in organizations experiencing decentralization. In <i>Information systems engineering in complex environments (Lecture Notes in Business Information Processing, Vol. 204, pp. 269–285)</i> . Springer. https://doi.org/10.1007/978-3-319-19270-3_17	25	22	23	YES	Include
26	Muniz dos Santos, V., Moura, L. F., & Zarelli, P. R. (2025). Diagnostic model for IT governance assessment in federal public universities. <i>Revista de Administração Contemporânea</i> , 29(3), e240318. https://doi.org/10.1590/1982-7849rac2025240318.en	29	30	30	NO	Include
27	Sofyani, H., Riyadh, H. A., & Fahlevi, H. (2020). Improving service quality, accountability and transparency of local government: The intervening role of information technology governance. <i>Cogent Business & Management</i> , 7(1), 1735690. https://doi.org/10.1080/23311975.2020.1735690	29	28	29	NO	Include

No.	Study	Reviewer 1 total	Reviewer 2 total	Final hybrid score	Hybrid discussion required	Final decision
28	Solekhan, Affandi, A., & Endroyono. (2024). Assessment of IT governance in supporting XYZ University KPIs using COBIT 2019. In 2024 International Seminar on Intelligent Technology and Its Applications (ISITIA 2024) (pp. 436–441). IEEE. https://doi.org/10.1109/ISITIA63062.2024.10668310	26	21	23	YES	Include
29	Toaza, G., Montenegro, C., & Salazar, C. (2022). Designing an I&T governance system in the context of strategic public sector based on COBIT 2019 framework: Case study in a developing country. In Proceedings of the 5th International Conference on Information Management and Management Science (pp. 401–406). Association for Computing Machinery. https://doi.org/10.1145/3564858.3564920	27	24	26	YES	Include
30	Utomo, D., Wijaya, M., Suzanna, Efendi, & Sagala, N. T. M. (2022). Leveraging COBIT 2019 to implement IT governance in SME context: A case study of higher education in Campus A. <i>CommIT (Communication and Information Technology) Journal</i> , 16(2), 129–141. https://doi.org/10.21512/commit.v16i2.8172	28	23	25	YES	Include
31	Vogt, M., & Hales, K. (2010). Strategic alignment of ICT projects with community values in local government. In Proceedings of the 43rd Hawaii International Conference on System Sciences (HICSS 2010) (pp. 1–10). IEEE. https://doi.org/10.1109/HICSS.2010.350	28	23	25	YES	Include
32	Wiedenhöft, G. C., Luciano, E. M., & Pereira, G. V. (2020). Information technology governance institutionalization and the behavior of individuals in the context of public organizations. <i>Information Systems Frontiers</i> , 22(6), 1487–1504. https://doi.org/10.1007/s10796-019-09945-7	29	29	29	NO	Include
33	Wiedenhöft, G. C., & Luciano, E. M. (2021). Going the extra mile: Impact of individuals' behavior on information technology governance. <i>Revista de Administração Contemporânea</i> , 25(5), e190237. https://doi.org/10.1590/1982-7849rac2021190237.en	29	30	30	NO	Include
34	Zainuddin, Z., Winamo, E., Ningsi, N., Pasrun, Y. P., & Mulyadi, M. (2020). IT governance evaluation at the Population and Civil Registry Office in Kolaka District using COBIT 5 framework. <i>Register: Jurnal Ilmiah Teknologi Sistem Informasi</i> , 6(2), 86–95. https://doi.org/10.26594/register.v6i2.1728	25	25	25	NO	Include
35	Al-Shamayleh, G. M. Y. A., Alwhshat, Z., Al-Shabatat, M. A., & Al-Sarayrah, A. A. K. M. (2026). IT governance perspective on the nature of public office in the Jordanian Constitution: A comparative study. <i>EDPACS</i> , advance online publication. https://doi.org/10.1080/07366981.2026.2677204	19	26	26	YES	Include
36	Borja, S., Kim, K., Yoon, H., & Hwang, J. (2022). Mechanisms that influence IT governance effectiveness: Empirical analysis in private and public sector in Colombia. In 2022 Portland International Conference on Management of Engineering and Technology (PICMET) (pp. 1–9). IEEE. https://doi.org/10.23919/PICMET53225.2022.9882706	27	29	28	NO	Include
37	Ngqondi, T., & Mauwa, H. (2020). Information technology governance model for a low resource institution with fragmented IT portfolio. <i>South African Journal of Higher Education</i> , 34(3), 246–262. https://doi.org/10.20853/34-3-3326	28	28	28	NO	Include
38	Olaitan, O., Herselman, M., & Wayi, N. (2019). A data governance maturity evaluation model for government departments of the Eastern Cape province, South Africa. <i>South African Journal of Information Management</i> , 21(1), a996. https://doi.org/10.4102/sajim.v21i1.996	29	30	30	NO	Include
39	Simonsson, M., et al. (2010). The effect of IT governance maturity on IT governance performance. <i>Information Systems Management</i> , 27(1), 10–24.	29	29	29	NO	Include
40	Vaya-Arboledas, A., Ferrer-Oliva, M., & Medina-Merodio, J. A. (2025). Evolution and perspectives in IT governance: A systematic literature review. <i>Computers</i> , 14(12), 520. https://doi.org/10.3390/computers14120520	30	29	30	NO	Include
41	Steuperaert, D., Poels, G., & Devos, J. (2025). A reference model for information quality in an IT governance context. <i>Information Systems Management</i> , 42(3), 346–364. https://doi.org/10.1080/10580530.2025.2477455	29	30	30	NO	Include
42	Affandi, A. (2024). Assessment of IT governance in supporting XYZ University KPIs using COBIT 2019. https://doi.org/10.1109/ISITIA63062.2024.10668310	17	18	17	YES	Exclude
43	Ali, S., Green, P., & Parent, M. (2015). The role of IT governance mechanisms in public sector organisations.	15	16	16	NO	Exclude
44	Ali. (2018). IT governance implementation framework for public sector organizations of Pakistan.	19	14	17	YES	Exclude
45	Ávila, C., Chinchilla, E. J., & Velásquez Pérez, T. (2019). IT governance model for state entities as support for compliance with the information security and privacy component in the framework of the digital government policy. https://doi.org/10.1088/1742-6596/1409/1/012005	16	13	15	NO	Exclude
46	Becker, C., Antunes, G., Barateiro, J., Vieira, R., & Borbinha, J. (2011). Modeling digital preservation capabilities in enterprise architecture. https://doi.org/10.1145/2037556.2037570	22	16	16	YES	Exclude
47	Bianchi, & De Sousa. (2015). IT governance for public universities: Developing a model.	22	16	17	YES	Exclude
48	Brigano et al. (2015). A development model for e-government based on ICT governance concepts.	19	15	17	YES	Exclude
49	Clementi, & Carvalho. (2006). Methodology for IT governance assessment and design.	18	14	16	YES	Exclude
50	De Haes, S., & Van Grembergen, W. (2015). Enterprise governance of information technology: Achieving strategic alignment and value.	18	17	17	YES	Exclude
51	Devos, J., Van Grembergen, W., & De Haes, S. (2017). IT governance implementation and organisational performance: A public sector perspective.	17	15	16	NO	Exclude
52	Merchan. (2016). Value-based information technology governance quality assessment: Systematic mapping study.	14	17	16	NO	Exclude
53	Nugroho, B., & Surendro, K. (2011). Using organizational culture approach and COBIT framework in designing information technology governance on a non-ministerial government institute: A case study of the Center for Scientific Documentation and Information, Indonesian Institute of Sciences. https://doi.org/10.1109/ICEEI.2011.6021831	15	17	16	NO	Exclude
54	Pereira, R., & Mira da Silva, M. (2010). A maturity model for information technology governance.	16	18	17	YES	Exclude
55	Peterson, R. (2011). Crafting information technology governance.	15	19	17	YES	Exclude
56	Quezada-Sarmiento et al. (2017). Referent framework to government of IT using standards: COBIT 5 and ISO 38500.	15	16	16	NO	Exclude
57	Sibanda, M., & Solms, R. (2018). Devising a strategy for IT governance implementation in municipalities: A case study of South Africa.	17	18	17	YES	Exclude
58	Wahab, & Arief. (2016). An integrative framework of COBIT and TOGAF for designing IT governance in local government.	16	17	17	NO	Exclude
59	Al-Ghazi et al. (2020). A qualitative study of the strategic alignment perspective of public-sector organisations in Saudi Arabia in the digital age.	26	26	26	NO	Include
60	Ali, S., Green, P., & Robb, A. (2011). Information technology investment governance in public organisations.	29	29	29	NO	Include
61	Buijung et al. (2024). IT governance and management for smart city: Aligning COBIT 2019 with SPBE policies for traditional market digitalization initiatives.	24	23	24	NO	Include
62	Da Veiga, A., & Eloff, J. H. P. (2017). Governance of information security in public sector organisations.	16	16	16	NO	Exclude
63	de Gier. (2018). IT governance of Dutch municipalities and digital information management.	26	24	25	YES	Include
64	Heredia, H., & Merchán, V. (2020). Towards information security governance for institutions of higher education: Harmonization of standards. https://doi.org/10.1007/978-3-030-42531-9_37	28	24	26	YES	Include
65	Irzavika, N., & Mahda, F. R. (2023). The effectiveness of SPBE application and infrastructure audit tools in enhancing information technology governance using COBIT 2019. https://doi.org/10.1109/CIMCIS60089.2023.10348973	24	26	25	YES	Include
66	Munyoka, & Maharaj. (2017). Towards the harmonisation of information and communication technology policy frameworks in the Southern African Development Community.	22	22	22	NO	Include
67	Ningsih, K. R., Sembiring, J., Arman, A. A., & Wuryandari, A. I. (2013). Developing IT investment management framework of government institution. https://doi.org/10.1109/CACSIS.2013.6761582	27	27	27	NO	Include
68	Nugraha, R. A., & Syaidah, R. (2022). Smart campus governance design for XYZ Polytechnic based on COBIT 2019. https://doi.org/10.30630/joiv.6.3.1257	26	25	26	NO	Include
69	Ott, C., Korthaus, A., Böhmman, T., Rosemann, M., & Krcmar, H. (2011). Foundations of a reference model for SOA governance. https://doi.org/10.1007/978-3-642-17722-4_4	28	26	27	NO	Include
70	Reis, L. C. D., Ferreira, S. B. L., Bernardini, F. C., & Cappelli, C. (2020). Towards a COBIT 5 approach to ICT governance requirements in smart cities. https://doi.org/10.1145/3428502.3428598	27	25	26	NO	Include
71	Wang, T., Sun, B., & Yan, Z. (2012). IT governance: The key factor of e-government implementation in China. https://doi.org/10.1007/978-3-642-29873-8_26	16	17	17	NO	Exclude

Supplementary Table S5A. Reviewer 1 criterion-level academic quality appraisal (n = 71)

No.	Study	QA1	QA2	QA3	QA4	QA5	QA6	Σ R1	S5 R1 total	R2 total	Final score
1	Ab Razak, R., & Zakaria, M. S. (2017). The information and communication technology governance maturity level for Malaysian public sector. In Proceedings of the Second International Conference on Internet of Things, Data and Cloud Computing (pp. 1–8). Association for Computing Machinery. https://doi.org/10.1145/3018896.3018967	5	5	5	5	5	4	29	29	25	27
2	Al Hilali, R. A., & Vijaya, P. (2021). An exploratory study of the key enabling factors of IT projects governance (ITPG) implementation in the public sector in Oman. <i>International Journal of Computing and Digital Systems</i> , 10(1), 639–658. https://doi.org/10.12785/IJCDS/100162	5	5	5	5	4	5	29	29	28	29
3	Al Qassimi, N., & Rusu, L. (2015). IT governance in a public organization in a developing country: A case study of a governmental organization. <i>Procedia Computer Science</i> , 64, 450–456.	5	4	4	4	4	4	25	25	22	23
4	Al-Taei, S. H. H., & Flayyih, H. H. (2023). Impact of the electronic internal auditing based on IT governance to reduce auditing risk. <i>Corporate Governance and Organizational Behavior Review</i> , 7(1), 94–100.	5	4	4	4	5	4	26	26	24	25
5	Ali, S., & Green, P. (2006). Effective information technology governance mechanisms in public sectors: An Australian case. <i>PACIS 2006 Proceedings</i> , 99.	5	4	5	4	4	5	27	27	26	27
6	Amali, L. N., Katili, M. R., & Suhada, S. (2023). Core model of information technology governance system design in local government. <i>TELKOMNIKA</i> , 21(4), 750–761.	5	4	5	4	5	4	27	27	28	28
7	Arief, A., et al. (2020). IT governance audit and determination of work priorities using analytical hierarchy process: Case study the government of North Maluku, Indonesia. <i>Journal of Physics: Conference Series</i> , 1577, 012046.	5	4	4	4	5	4	26	26	30	28
8	Arpandi, D., Affandi, A., & Endroyono. (2024). Stakeholder perspective on the architecture of the electronic based government system (SPBE) in regional hospitals. In 5th Technology Innovation Management and Engineering Science International Conference (TIMES-ICON 2024). IEEE. https://doi.org/10.1109/TIMES-ICON61890.2024.10630726	5	4	4	4	5	4	26	26	24	25
9	Canedo, E. D., et al. (2022). ICT governance and management macroprocesses of a Brazilian federal government agency. <i>Information</i> , 13(5), 231.	5	5	5	4	4	5	28	28	25	27
10	Canedo, E. D., et al. (2020). Information and communication technology (ICT) governance processes: A case study. <i>Information</i> , 11(10), 462.	5	5	5	5	5	5	30	30	25	26
11	Clara, A. M. C., et al. (2018). A synthesis of common guidelines for regulatory compliance verification in the context of ICT governance audits. <i>Information Policy</i> , 23(2), 221–237.	5	5	5	5	5	5	30	30	30	30
12	Gerke, L., & Ridley, G. (2006). Towards an abbreviated COBIT framework for use in an Australian state public sector. <i>ACIS 2006 Proceedings</i> .	5	5	5	4	5	5	29	29	25	27
13	Juiz, C., Guerrero, C., & Lera, I. (2014). Implementing good governance principles for the public sector in information technology governance frameworks. <i>Open Journal of Accounting</i> , 3(1), 9–27. https://doi.org/10.4236/ojaacct.2014.31003	5	3	5	2	5	5	25	25	26	26
14	Kalkhoran, S. D., Babalhavaej, F., Hariri, N., & Mozafari, A. (2025). Providing a governance model for information technology (COBIT) in the enterprise architecture of Iran Public Libraries Foundation. <i>International Journal of Information Science and Management</i> , 23(3), 1–21. https://doi.org/10.22034/ijism.2025.2048634.1672	5	5	5	5	4	5	29	29	30	30
15	Katili, M. R., Amali, L. N., & Suhada, S. (2023). Design factors in evaluating and formulating IT governance systems. <i>Jurnal RESTI</i> , 7(5), 1182–1191.	5	4	5	4	5	5	28	28	28	28
16	Luna-Reyes, L. F., et al. (2020). Exploring the relationships between dynamic capabilities and IT governance: Implications for local governments. <i>Transforming Government: People, Process and Policy</i> , 14(2), 149–169.	5	5	5	5	4	5	29	29	21	25
17	Martin, N., & Gregor, S. (2006). ICT governance: Frameworks for managing Australian e-government. <i>Journal of E-Government</i> , 2(3), 19–49. https://doi.org/10.1300/J399v02n03_03	5	5	5	5	5	5	30	30	27	29
18	Nfuka, E. N., & Rusu, L. (2013). Critical success framework for implementing effective IT governance in Tanzanian public sector organizations. <i>Journal of Global Information Technology Management</i> , 16(3), 53–77.	5	5	5	5	5	5	30	30	30	30
19	Nfuka, E. N., et al. (2010). IT governance maturity in the public sector organizations in a developing country: The case of Tanzania. <i>AMCIS 2010 Proceedings</i> .	5	4	5	4	5	5	28	28	26	27
20	Pagayonan, S. M. S., & Wenceslao, F. V. (2026). AI-enabled continuous IT auditing using process mining and risk-based analytics: A framework for Philippine state universities and colleges. In 2026 7th International Conference on Mobile Computing and Sustainable Informatics (ICMCSI). IEEE. https://doi.org/10.1109/ICMCSI67283.2026.11412622	5	4	5	3	4	4	25	25	30	27
21	Parfitt, M., & Tryfonas, T. (2009). Painless: A model for IT governance assessment in the UK public sector. <i>EDPACS</i> , 39(2–3), 1–25. https://doi.org/10.1080/07366980902907779	5	4	5	4	5	4	27	27	24	25
22	Phahlane. (2023). An institutional perspective of CGICTPF implementation in the public sector.	5	3	4	2	4	4	22	22	20	21
23	Plevnik, M. (2026). Communication and information systems user support as a governance mechanism in a high-security public organization. <i>Systems</i> , 14(3), 288. https://doi.org/10.3390/systems14030288	5	5	5	5	4	5	29	29	30	30
24	Rizal, R. A., Samo, R., & Sungkono, K. R. (2020). COBIT 5 for analysing information technology governance maturity level on masterplan e-government. In 2020 International Seminar on Application for Technology of Information and Communication (ISemantic) (pp. 517–522). IEEE. https://doi.org/10.1109/ISemantic50169.2020.9234301	5	4	4	4	5	5	27	27	20	24
25	Zdravkovic, J., Rychkova, I., & Speckert, T. (2014). Requirements for IT governance in organizations experiencing decentralization. In <i>Information systems engineering in complex environments (Lecture Notes in Business Information Processing, Vol. 204, pp. 269–285)</i> . Springer. https://doi.org/10.1007/978-3-319-19270-3_17	5	4	4	3	4	5	25	25	22	23
26	Muniz dos Santos, V., Moura, L. F., & Zarelli, P. R. (2025). Diagnostic model for IT governance assessment in federal public universities. <i>Revista de Administração Contemporânea</i> , 29(3), e240318. https://doi.org/10.1590/1982-7849rac2025240318.en	5	5	5	5	4	5	29	29	30	30

No.	Study	QA1	QA2	QA3	QA4	QA5	QA6	Σ R1	S5 R1 total	R2 total	Final score
27	Sofyani, H., Riyadh, H. A., & Fahlevi, H. (2020). Improving service quality, accountability and transparency of local government: The intervening role of information technology governance. <i>Cogent Business & Management</i> , 7(1), 1735690. https://doi.org/10.1080/23311975.2020.1735690	5	5	5	5	4	5	29	29	28	29
28	Solekhan, Affandi, A., & Endroyono. (2024). Assessment of IT governance in supporting XYZ University KPIs using COBIT 2019. In <i>2024 International Seminar on Intelligent Technology and Its Applications (ISITIA 2024)</i> (pp. 436–441). IEEE. https://doi.org/10.1109/ISITIA63062.2024.10668310	5	4	4	4	4	5	26	26	21	23
29	Toaza, G., Montenegro, C., & Salazar, C. (2022). Designing an I&T governance system in the context of strategic public sector based on COBIT 2019 framework: Case study in a developing country. In <i>Proceedings of the 5th International Conference on Information Management and Management Science</i> (pp. 401–406). Association for Computing Machinery. https://doi.org/10.1145/3564858.3564920	5	5	4	4	4	5	27	27	24	26
30	Utomo, D., Wijaya, M., Suzanna, Efendi, & Sagala, N. T. M. (2022). Leveraging COBIT 2019 to implement IT governance in SME context: A case study of higher education in Campus A. <i>CommIT (Communication and Information Technology) Journal</i> , 16(2), 129–141. https://doi.org/10.21512/commit.v16i2.8172	5	5	5	4	4	5	28	28	23	25
31	Vogt, M., & Hales, K. (2010). Strategic alignment of ICT projects with community values in local government. In <i>Proceedings of the 43rd Hawaii International Conference on System Sciences (HICSS 2010)</i> (pp. 1–10). IEEE. https://doi.org/10.1109/HICSS.2010.350	5	5	5	4	4	5	28	28	23	25
32	Wiedenhöft, G. C., Luciano, E. M., & Pereira, G. V. (2020). Information technology governance institutionalization and the behavior of individuals in the context of public organizations. <i>Information Systems Frontiers</i> , 22(6), 1487–1504. https://doi.org/10.1007/s10796-019-09945-7	5	5	5	5	4	5	29	29	29	29
33	Wiedenhöft, G. C., & Luciano, E. M. (2021). Going the extra mile: Impact of individuals' behavior on information technology governance. <i>Revista de Administração Contemporânea</i> , 25(5), e190237. https://doi.org/10.1590/1982-7849rac2021190237.en	5	5	5	5	4	5	29	29	30	30
34	Zainuddin, Z., Winamo, E., Ningsi, N., Pasrun, Y. P., & Mulyadi, M. (2020). IT governance evaluation at the Population and Civil Registry Office in Kolaka District using COBIT 5 framework. <i>Register: Jurnal Ilmiah Teknologi Sistem Informasi</i> , 6(2), 86–95. https://doi.org/10.26594/register.v6i2.1728	5	4	4	4	4	4	25	25	25	25
35	Al-Shamayleh, G. M. Y. A., Alwhshat, Z., Al-Shabatat, M. A., & Al-Sarayah, A. A. K. M. (2026). IT governance perspective on the nature of public office in the Jordanian Constitution: A comparative study. <i>EDPACS</i> , advance online publication. https://doi.org/10.1080/07366981.2026.2677204	4	3	3	2	3	4	19	19	26	26
36	Borja, S., Kim, K., Yoon, H., & Hwang, J. (2022). Mechanisms that influence IT governance effectiveness: Empirical analysis in private and public sector in Colombia. In <i>2022 Portland International Conference on Management of Engineering and Technology (PICMET)</i> (pp. 1–9). IEEE. https://doi.org/10.23919/PICMET53225.2022.9882706	5	5	4	4	4	5	27	27	29	28
37	Ngqondi, T., & Mauwa, H. (2020). Information technology governance model for a low resource institution with fragmented IT portfolio. <i>South African Journal of Higher Education</i> , 34(3), 246–262. https://doi.org/10.20853/34-3-3326	5	5	5	4	4	5	28	28	28	28
38	Olaitan, O., Herselman, M., & Wayl, N. (2019). A data governance maturity evaluation model for government departments of the Eastern Cape province, South Africa. <i>South African Journal of Information Management</i> , 21(1), a996. https://doi.org/10.4102/sajim.v21i1.996	5	5	5	5	4	5	29	29	30	30
39	Simonsson, M., et al. (2010). The effect of IT governance maturity on IT governance performance. <i>Information Systems Management</i> , 27(1), 10–24.	5	5	5	5	4	5	29	29	29	29
40	Vaya-Arboledas, A., Ferrer-Oliva, M., & Medina-Merodio, J. A. (2025). Evolution and perspectives in IT governance: A systematic literature review. <i>Computers</i> , 14(12), 520. https://doi.org/10.3390/computers14120520	5	5	5	5	5	5	30	30	29	30
41	Steuperaert, D., Poels, G., & Devos, J. (2025). A reference model for information quality in an IT governance context. <i>Information Systems Management</i> , 42(3), 346–364. https://doi.org/10.1080/10580530.2025.2477455	5	5	5	5	4	5	29	29	30	30
42	Affandi, A. (2024). Assessment of IT governance in supporting XYZ University KPIs using COBIT 2019. https://doi.org/10.1109/ISITIA63062.2024.10668310	4	3	3	2	2	3	17	17	18	17
43	Ali, S., Green, P., & Parent, M. (2015). The role of IT governance mechanisms in public sector organisations.	3	2	3	2	3	2	15	15	16	16
44	Ali. (2018). IT governance implementation framework for public sector organizations of Pakistan.	4	3	4	2	3	3	19	19	14	17
45	Avila, C., Chinchilla, E. J., & Velásquez Pérez, T. (2019). IT governance model for state entities as support for compliance with the information security and privacy component in the framework of the digital government policy. https://doi.org/10.1088/1742-6596/1409/1/012005	4	2	3	2	3	2	16	16	13	15
46	Becker, C., Antunes, G., Barateiro, J., Vieira, R., & Borbinha, J. (2011). Modeling digital preservation capabilities in enterprise architecture. https://doi.org/10.1145/2037556.2037570	5	4	4	3	2	4	22	22	16	16
47	Bianchi, & De Sousa. (2015). IT governance for public universities: Developing a model.	5	3	4	2	4	4	22	22	16	17
48	Briganó et al. (2015). A development model for e-government based on ICT governance concepts.	4	3	4	2	3	3	19	19	15	17
49	Clementi, & Carvalho. (2006). Methodology for IT governance assessment and design.	4	3	4	2	2	3	18	18	14	16
50	De Haes, S., & Van Grembergen, W. (2015). Enterprise governance of information technology: Achieving strategic alignment and value.	4	2	5	2	2	3	18	18	17	17
51	Devos, J., Van Grembergen, W., & De Haes, S. (2017). IT governance implementation and organisational performance: A public sector perspective.	4	3	3	2	2	3	17	17	15	16

No.	Study	QA1	QA2	QA3	QA4	QA5	QA6	Σ R1	S5 R1 total	R2 total	Final score
52	Merchan. (2016). Value-based information technology governance quality assessment: Systematic mapping study.	4	2	3	2	1	2	14	14	17	16
53	Nugroho, B., & Surendro, K. (2011). Using organizational culture approach and COBIT framework in designing information technology governance on a non-ministerial government institute: A case study of the Center for Scientific Documentation and Information, Indonesian Institute of Sciences. https://doi.org/10.1109/ICEEI.2011.6021831	4	3	3	2	1	2	15	15	17	16
54	Pereira, R., & Mira da Silva, M. (2010). A maturity model for information technology governance.	4	3	4	2	1	2	16	16	18	17
55	Peterson, R. (2011). Crafting information technology governance.	4	2	4	2	1	2	15	15	19	17
56	Quezada-Sarmiento et al. (2017). Referent framework to government of IT using standards: COBIT 5 and ISO 38500.	3	2	4	2	2	2	15	15	16	16
57	Sibanda, M., & Solms, R. (2018). Devising a strategy for IT governance implementation in municipalities: A case study of South Africa.	4	3	3	2	3	2	17	17	18	17
58	Wahab, & Arief. (2016). An integrative framework of COBIT and TOGAF for designing IT governance in local government.	4	2	4	2	2	2	16	16	17	17
59	Al-Ghazi et al. (2020). A qualitative study of the strategic alignment perspective of public-sector organisations in Saudi Arabia in the digital age.	5	4	4	4	4	5	26	26	26	26
60	Ali, S., Green, P., & Robb, A. (2011). Information technology investment governance in public organisations.	5	5	5	4	5	5	29	29	29	29
61	Bujung et al. (2024). IT governance and management for smart city: Aligning COBIT 2019 with SPBE policies for traditional market digitalization initiatives.	5	3	4	3	5	4	24	24	23	24
62	Da Veiga, A., & Eloff, J. H. P. (2017). Governance of information security in public sector organisations.	2	2	3	3	3	3	16	16	16	16
63	de Gier. (2018). IT governance of Dutch municipalities and digital information management.	5	4	4	4	4	5	26	26	24	25
64	Heredia, H., & Merchán, V. (2020). Towards information security governance for institutions of higher education: Harmonization of standards. https://doi.org/10.1007/978-3-030-42531-9_37	5	4	5	4	5	5	28	28	24	26
65	Irzavika, N., & Mahda, F. R. (2023). The effectiveness of SPBE application and infrastructure audit tools in enhancing information technology governance using COBIT 2019. https://doi.org/10.1109/ICIMCIS60089.2023.10348973	5	3	4	3	5	4	24	24	26	25
66	Munyoka, & Maharaj. (2017). Towards the harmonisation of information and communication technology policy frameworks in the Southern African Development Community.	5	3	4	3	3	4	22	22	22	22
67	Ningsih, K. R., Sembiring, J., Arman, A. A., & Wuryandari, A. I. (2013). Developing IT investment management framework of government institution. https://doi.org/10.1109/ICACSIS.2013.6761582	5	4	5	4	5	4	27	27	27	27
68	Nugraha, R. A., & Syaidah, R. (2022). Smart campus governance design for XYZ Polytechnic based on COBIT 2019. https://doi.org/10.30630/iov.6.3.1257	5	4	4	4	5	4	26	26	25	26
69	Ott, C., Korthaus, A., Böhmman, T., Rosemann, M., & Krcmar, H. (2011). Foundations of a reference model for SOA governance. https://doi.org/10.1007/978-3-642-17722-4_4	5	4	5	4	5	5	28	28	26	27
70	Reis, L. C. D., Ferreira, S. B. L., Bernardini, F. C., & Cappelli, C. (2020). Towards a COBIT 5 approach to ICT governance requirements in smart cities. https://doi.org/10.1145/3428502.3428598	5	4	5	3	5	5	27	27	25	26
71	Wang, T., Sun, B., & Yan, Z. (2012). IT governance: The key factor of e-government implementation in China. https://doi.org/10.1007/978-3-642-29873-8_26	2	2	3	3	3	3	16	16	17	17

Supplementary Table S5B. Reviewer 2 criterion-level academic quality appraisal (n = 71)

Academic appraisal note. All 71 academic-rubric records constitute one final appraisal set and were evaluated against QA1-QA6 using the same scoring anchors. Final hybrid scores of 25-30 are classified as High, 18-24 as Moderate, and <18 as Low; only scores ≥18/30 are retained. Pale blue and pale green identify audit provenance only.

Criteria: QA1 clarity of objective; QA2 methodological rigour; QA3 conceptual contribution; QA4 validity of findings; QA5 relevance to ICT governance compliance; QA6 reporting quality.

No.	Study	QA1	QA2	QA3	QA4	QA5	QA6	Σ R2	S5 R2 total	R1 total	Final score
1	Ab Razak, R., & Zakaria, M. S. (2017). The information and communication technology governance maturity level for Malaysian public sector. In Proceedings of the Second International Conference on Internet of Things, Data and Cloud Computing (pp. 1–8). Association for Computing Machinery. https://doi.org/10.1145/3018896.3018967	4	4	5	4	4	4	25	25	29	27
2	Al Hilali, R. A., & Vijaya, P. (2021). An exploratory study of the key enabling factors of IT projects governance (ITPG) implementation in the public sector in Oman. International Journal of Computing and Digital Systems, 10(1), 639–658. https://doi.org/10.12785/IJCDIS/100162	5	5	4	5	4	5	28	28	29	29
3	Al Qassimi, N., & Rusu, L. (2015). IT governance in a public organization in a developing country: A case study of a governmental organization. Procedia Computer Science, 64, 450–456.	4	3	3	4	4	4	22	22	25	23
4	Al-Taei, S. H. H., & Flayyih, H. H. (2023). Impact of the electronic internal auditing based on IT governance to reduce auditing risk. Corporate Governance and Organizational Behavior Review, 7(1), 94–100.	4	4	3	4	5	4	24	24	26	25
5	Ali, S., & Green, P. (2006). Effective information technology governance mechanisms in public sectors: An Australian case. PACIS 2006 Proceedings, 99.	4	4	4	4	5	5	26	26	27	27
6	Amali, L. N., Katil, M. R., & Suhada, S. (2023). Core model of information technology governance system design in local government. TELKOMNIKA, 21(4), 750–761.	5	4	5	4	5	5	28	28	27	28
7	Arief, A., et al. (2020). IT governance audit and determination of work priorities using analytical hierarchy process: Case study the government of North Maluku, Indonesia. Journal of Physics: Conference Series, 1577, 012046.	5	5	5	5	5	5	30	30	26	28
8	Arpandi, D., Affandi, A., & Endroyono. (2024). Stakeholder perspective on the architecture of the electronic based government system (SPBE) in regional hospitals. In 5th Technology Innovation Management and Engineering Science International Conference (TIMES-ICON 2024). IEEE. https://doi.org/10.1109/TIMES-ICON61890.2024.10630726	4	4	3	4	5	4	24	24	26	25
9	Canedo, E. D., et al. (2022). ICT governance and management macroprocesses of a Brazilian federal government agency. Information, 13(5), 231.	4	4	4	4	4	5	25	25	28	27
10	Canedo, E. D., et al. (2020). Information and communication technology (ICT) governance processes: A case study. Information, 11(10), 462.	4	4	4	4	4	5	25	25	30	26
11	Clara, A. M. C., et al. (2018). A synthesis of common guidelines for regulatory compliance verification in the context of ICT governance audits. Information Polity, 23(2), 221–237.	5	5	5	5	5	5	30	30	30	30

No.	Study	QA1	QA2	QA3	QA4	QA5	QA6	Σ R2	S5 R2 total	R1 total	Final score
12	Gerke, L., & Ridley, G. (2006). Towards an abbreviated COBIT framework for use in an Australian state public sector. ACIS 2006 Proceedings.	4	4	4	4	5	4	25	25	29	27
13	Juiz, C., Guerrero, C., & Lera, I. (2014). Implementing good governance principles for the public sector in information technology governance frameworks. Open Journal of Accounting, 3(1), 9–27. https://doi.org/10.4236/ojacct.2014.31003	4	4	5	4	5	4	26	26	25	26
14	Kalkhoran, S. D., Babalhavaeji, F., Hariri, N., & Mozafari, A. (2025). Providing a governance model for information technology (COBIT) in the enterprise architecture of Iran Public Libraries Foundation. International Journal of Information Science and Management, 23(3), 1–21. https://doi.org/10.22034/ijism.2025.2048634.1672	5	5	5	5	5	5	30	30	29	30
15	Katli, M. R., Amali, L. N., & Suhada, S. (2023). Design factors in evaluating and formulating IT governance systems. Jurnal RESTI, 7(5), 1182–1191.	5	4	5	4	5	5	28	28	28	28
16	Luna-Reyes, L. F., et al. (2020). Exploring the relationships between dynamic capabilities and IT governance: Implications for local governments. Transforming Government: People, Process and Policy, 14(2), 149–169.	4	3	3	4	4	3	21	21	29	25
17	Martin, N., & Gregor, S. (2006). ICT governance: Frameworks for managing Australian e-government. Journal of E-Government, 2(3), 19–49. https://doi.org/10.1300/J399v02n03_03	5	5	4	4	5	4	27	27	30	29
18	Nfuka, E. N., & Rusu, L. (2013). Critical success framework for implementing effective IT governance in Tanzanian public sector organizations. Journal of Global Information Technology Management, 16(3), 53–77.	5	5	5	5	5	5	30	30	30	30
19	Nfuka, E. N., et al. (2010). IT governance maturity in the public sector organizations in a developing country: The case of Tanzania. AMCIS 2010 Proceedings.	5	5	4	4	4	4	26	26	28	27
20	Pagayonan, S. M. S., & Wenceslao, F. V. (2026). AI-enabled continuous IT auditing using process mining and risk-based analytics: A framework for Philippine state universities and colleges. In 2026 7th International Conference on Mobile Computing and Sustainable Informatics (ICMCSI). IEEE. https://doi.org/10.1109/ICMCSI67283.2026.11412622	5	5	5	5	5	5	30	30	25	27
21	Parfitt, M., & Tryfonas, T. (2009). Painless: A model for IT governance assessment in the UK public sector. EDPACS, 39(2–3), 1–25. https://doi.org/10.1080/07366980902907779	5	4	4	3	4	4	24	24	27	25
22	Phahlane, (2023). An institutional perspective of CGICTPF implementation in the public sector.	4	3	3	3	4	3	20	20	22	21
23	Plevnik, M. (2026). Communication and information systems user support as a governance mechanism in a high-security public organization. Systems, 14(3), 288. https://doi.org/10.3390/systems14030288	5	5	5	5	5	5	30	30	29	30
24	Rizal, R. A., Sarno, R., & Sungkono, K. R. (2020). COBIT 5 for analysing information technology governance maturity level on masterplan e-government. In 2020 International Seminar on Application for Technology of Information and Communication (ISemantic) (pp. 517–522). IEEE. https://doi.org/10.1109/ISemantic50169.2020.9234301	4	3	3	3	4	3	20	20	27	24
25	Zdravkovic, J., Rychkova, I., & Speckert, T. (2014). Requirements for IT governance in organizations experiencing decentralization. In Information systems engineering in complex environments (Lecture Notes in Business Information Processing, Vol. 204, pp. 269–285). Springer. https://doi.org/10.1007/978-3-319-19270-3_17	5	3	4	3	4	3	22	22	25	23
26	Muniz dos Santos, V., Moura, L. F., & Zarelli, P. R. (2025). Diagnostic model for IT governance assessment in federal public universities. Revista de Administração Contemporânea, 29(3), e240318. https://doi.org/10.1590/1982-7849rac2025240318.en	5	5	5	5	5	5	30	30	29	30
27	Sofyani, H., Riyadh, H. A., & Fahlevi, H. (2020). Improving service quality, accountability and transparency of local government: The intervening role of information technology governance. Cogent Business & Management, 7(1), 1735690. https://doi.org/10.1080/23311975.2020.1735690	5	5	4	5	4	5	28	28	29	29
28	Solekhan, Affandi, A., & Endroyono. (2024). Assessment of IT governance in supporting XYZ University KPIs using COBIT 2019. In 2024 International Seminar on Intelligent Technology and Its Applications (ISITIA 2024) (pp. 436–441). IEEE. https://doi.org/10.1109/ISITIA63062.2024.10668310	4	4	3	3	4	3	21	21	26	23
29	Toaza, G., Montenegro, C., & Salazar, C. (2022). Designing an I&T governance system in the context of strategic public sector based on COBIT 2019 framework: Case study in a developing country. In Proceedings of the 5th International Conference on Information Management and Management Science (pp. 401–406). Association for Computing Machinery. https://doi.org/10.1145/3564858.3564920	5	4	4	3	5	3	24	24	27	26
30	Utomo, D., Wijaya, M., Suzanna, Efendi, & Sagala, N. T. M. (2022). Leveraging COBIT 2019 to implement IT governance in SME context: A case study of higher education in Campus A. CommIT (Communication and Information Technology) Journal, 16(2), 129–141. https://doi.org/10.21512/commit.v16i2.8172	5	4	4	3	4	3	23	23	28	25
31	Vogt, M., & Hales, K. (2010). Strategic alignment of ICT projects with community values in local government. In Proceedings of the 43rd Hawaii International Conference on System Sciences (HICSS 2010) (pp. 1–10). IEEE. https://doi.org/10.1109/HICSS.2010.350	5	4	4	3	4	3	23	23	28	25
32	Wiedenhöft, G. C., Luciano, E. M., & Pereira, G. V. (2020). Information technology governance institutionalization and the behavior of individuals in the context of public organizations. Information Systems Frontiers, 22(6), 1487–1504. https://doi.org/10.1007/s10796-019-09945-7	5	5	5	5	4	5	29	29	29	29
33	Wiedenhöft, G. C., & Luciano, E. M. (2021). Going the extra mile: Impact of individuals' behavior on information technology governance. Revista de Administração Contemporânea, 25(5), e190237. https://doi.org/10.1590/1982-7849rac2021190237.en	5	5	5	5	5	5	30	30	29	30
34	Zainuddin, Z., Winamo, E., Ningsi, N., Pasrun, Y. P., & Mulyadi, M. (2020). IT governance evaluation at the Population and Civil Registry Office in Kolaka District using COBIT 5 framework. Register: Jurnal Ilmiah Teknologi Sistem Informasi, 6(2), 86–95. https://doi.org/10.26594/register.v6i2.1728	5	5	4	4	4	3	25	25	25	25
35	Al-Shamayleh, G. M. Y. A., Alwshat, Z., Al-Shabatat, M. A., & Al-Sarayrah, A. A. K. M. (2026). IT governance perspective on the nature of public office in the Jordanian Constitution: A comparative study. EDPACS, advance online publication. https://doi.org/10.1080/07366981.2026.2677204	4	4	4	4	5	5	26	26	19	26

No.	Study	QA1	QA2	QA3	QA4	QA5	QA6	Σ R2	S5 R2 total	R1 total	Final score
36	Borja, S., Kim, K., Yoon, H., & Hwang, J. (2022). Mechanisms that influence IT governance effectiveness: Empirical analysis in private and public sector in Colombia. In 2022 Portland International Conference on Management of Engineering and Technology (PICMET) (pp. 1–9). IEEE. https://doi.org/10.23919/PICMET53225.2022.9882706	5	5	4	5	5	5	29	29	27	28
37	Ngqondi, T., & Mauwa, H. (2020). Information technology governance model for a low resource institution with fragmented IT portfolio. South African Journal of Higher Education, 34(3), 246–262. https://doi.org/10.20853/34-3-3326	5	5	5	4	5	4	28	28	28	28
38	Olaitan, O., Herselman, M., & Wayi, N. (2019). A data governance maturity evaluation model for government departments of the Eastern Cape province, South Africa. South African Journal of Information Management, 21(1), a996. https://doi.org/10.4102/sajim.v21i1.996	5	5	5	5	5	5	30	30	29	30
39	Simonsson, M., et al. (2010). The effect of IT governance maturity on IT governance performance. Information Systems Management, 27(1), 10–24.	5	5	4	5	5	5	29	29	29	29
40	Vaya-Arboledas, A., Ferrer-Oliva, M., & Medina-Merodio, J. A. (2025). Evolution and perspectives in IT governance: A systematic literature review. Computers, 14(12), 520. https://doi.org/10.3390/computers14120520	5	5	5	5	4	5	29	29	30	30
41	Steuperaert, D., Poels, G., & Devos, J. (2025). A reference model for information quality in an IT governance context. Information Systems Management, 42(3), 346–364. https://doi.org/10.1080/10580530.2025.2477455	5	5	5	5	5	5	30	30	29	30
42	Affandi, A. (2024). Assessment of IT governance in supporting XYZ University KPIs using COBIT 2019. https://doi.org/10.1109/ISITIA63062.2024.10668310	4	3	3	2	4	2	18	18	17	17
43	Ali, S., Green, P., & Parent, M. (2015). The role of IT governance mechanisms in public sector organisations.	4	3	3	2	2	2	16	16	15	16
44	Ali. (2018). IT governance implementation framework for public sector organizations of Pakistan.	4	2	3	2	2	1	14	14	19	17
45	Ávila, C., Chinchilla, E. J., & Velásquez Pérez, T. (2019). IT governance model for state entities as support for compliance with the information security and privacy component in the framework of the digital government policy. https://doi.org/10.1088/1742-6596/1409/1/012005	4	1	2	1	4	1	13	13	16	15
46	Becker, C., Antunes, G., Barateiro, J., Vieira, R., & Borbinha, J. (2011). Modeling digital preservation capabilities in enterprise architecture. https://doi.org/10.1145/2037556.2037570	4	4	4	2	1	1	16	16	22	16
47	Bianchi, & De Sousa. (2015). IT governance for public universities: Developing a model.	4	2	4	2	2	2	16	16	22	17
48	Briganó et al. (2015). A development model for e-government based on ICT governance concepts.	4	2	3	2	2	2	15	15	19	17
49	Clementi, & Carvalho. (2006). Methodology for IT governance assessment and design.	4	2	4	2	1	1	14	14	18	16
50	De Haes, S., & Van Grembergen, W. (2015). Enterprise governance of information technology: Achieving strategic alignment and value.	5	3	5	2	1	1	17	17	18	17
51	Devos, J., Van Grembergen, W., & De Haes, S. (2017). IT governance implementation and organisational performance: A public sector perspective.	4	3	3	2	1	2	15	15	17	16
52	Merchan. (2016). Value-based information technology governance quality assessment: Systematic mapping study.	5	4	4	2	1	1	17	17	14	16
53	Nugroho, B., & Surendro, K. (2011). Using organizational culture approach and COBIT framework in designing information technology governance on a non-ministerial government institute: A case study of the Center for Scientific Documentation and Information, Indonesian Institute of Sciences. https://doi.org/10.1109/ICEEI.2011.6021831	4	4	3	3	2	1	17	17	15	16
54	Pereira, R., & Mira da Silva, M. (2010). A maturity model for information technology governance.	5	3	4	3	2	1	18	18	16	17
55	Peterson, R. (2011). Crafting information technology governance.	5	4	5	2	1	2	19	19	15	17
56	Quezada-Sarmiento et al. (2017). Referent framework to government of IT using standards: COBIT 5 and ISO 38500.	4	2	4	2	2	2	16	16	15	16
57	Sibanda, M., & Solms, R. (2018). Devising a strategy for IT governance implementation in municipalities: A case study of South Africa.	5	4	3	3	1	2	18	18	17	17
58	Wahab, & Arief. (2016). An integrative framework of COBIT and TOGAF for designing IT governance in local government.	5	3	4	2	2	1	17	17	16	17
59	Al-Ghazi et al. (2020). A qualitative study of the strategic alignment perspective of public-sector organisations in Saudi Arabia in the digital age.	5	4	4	4	5	4	26	26	26	26
60	Ali, S., Green, P., & Robb, A. (2011). Information technology investment governance in public organisations.	5	5	5	5	5	4	29	29	29	29
61	Bujung et al. (2024). IT governance and management for smart city: Aligning COBIT 2019 with SPBE policies for traditional market digitalization initiatives.	4	3	4	4	5	3	23	23	24	24
62	Da Veiga, A., & Eloff, J. H. P. (2017). Governance of information security in public sector organisations.	2	2	3	3	3	3	16	16	16	16
63	de Gier. (2018). IT governance of Dutch municipalities and digital information management.	4	4	4	3	5	4	24	24	26	25
64	Heredia, H., & Merchán, V. (2020). Towards information security governance for institutions of higher education: Harmonization of standards. https://doi.org/10.1007/978-3-030-42531-9_37	4	3	5	3	5	4	24	24	28	26
65	Irzavika, N., & Mahda, F. R. (2023). The effectiveness of SPBE application and infrastructure audit tools in enhancing information technology governance using COBIT 2019. https://doi.org/10.1109/ICIMCIS60089.2023.10348973	5	5	4	4	5	3	26	26	24	25
66	Munyoka, & Maharaj. (2017). Towards the harmonisation of information and communication technology policy frameworks in the Southern African Development Community.	4	3	4	3	5	3	22	22	22	22
67	Ningsih, K. R., Sembiring, J., Arman, A. A., & Wuryandari, A. I. (2013). Developing IT investment management framework of government institution. https://doi.org/10.1109/ICACSIS.2013.6761582	5	4	5	4	5	4	27	27	27	27
68	Nugraha, R. A., & Syaidah, R. (2022). Smart campus governance design for XYZ Polytechnic based on COBIT 2019. https://doi.org/10.30630/Joiv.6.3.1257	4	4	4	4	5	4	25	25	26	26
69	Ott, C., Korthaus, A., Böhmman, T., Rosemann, M., & Krcmar, H. (2011). Foundations of a reference model for SOA governance. https://doi.org/10.1007/978-3-642-17722-4_4	4	4	5	4	5	4	26	26	28	27
70	Reis, L. C. D., Ferreira, S. B. L., Bernardini, F. C., & Cappelli, C. (2020). Towards a COBIT 5 approach to ICT governance requirements in smart cities. https://doi.org/10.1145/3428502.3428598	4	4	5	3	5	4	25	25	27	26
71	Wang, T., Sun, B., & Yan, Z. (2012). IT governance: The key factor of e-government implementation in China. https://doi.org/10.1007/978-3-642-29873-8_26	3	2	3	3	3	3	17	17	16	17

Hybrid scoring note. Each reviewer's six criterion ratings were summed to a total out of 30. Where totals differed by ≤3 points, remained in the same quality band, and did not cross the 18/30 threshold, the two totals were averaged and conventionally rounded. Discussion was triggered by a difference ≥4 points, different quality bands, or threshold crossing; triggered cases were reconciled through criterion-level review.

Supplementary Table S5C. Academic cases requiring hybrid reviewer reconciliation (n = 30)

No.	Source	R1	R2	Delta a	R1 / R2 class	Round ed mean*	Trigger(s)	Reconciliation outcome	Final reconci d score	Final class / decision
1	Ab Razak & Zakaria (2017)	29	25	4	High / High	27	Delta >= 4	Criterion-level ratings re-examined against the scoring anchors; score discrepancy resolved by reviewer consensus.	27	High / Include
3	Al Qassimi & Rusu (2015)	25	22	3	High / Moderate	24	Different quality bands	Criterion-level ratings reviewed; quality-band disagreement resolved by reviewer consensus.	23	Moderate / Include
4	Al-Tae & Flayyih (2023)	26	24	2	High / Moderate	25	Different quality bands	Criterion-level ratings reviewed; quality-band disagreement resolved by reviewer consensus.	25	High / Include
7	Arief et al. (2020)	26	30	4	High / High	28	Delta >= 4	Criterion-level ratings re-examined against the scoring anchors; score discrepancy resolved by reviewer consensus.	28	High / Include
8	Arpandi, Affandi, & Endroyono (2024)	26	24	2	High / Moderate	25	Different quality bands	Criterion-level ratings reviewed; quality-band disagreement resolved by reviewer consensus.	25	High / Include
10	Canedo et al. (2020)	30	25	5	High / High	28	Delta >= 4	Criterion-level ratings re-examined against the scoring anchors; score discrepancy resolved by reviewer consensus.	26	High / Include
12	Gerke & Ridley (2006)	29	25	4	High / High	27	Delta >= 4	Criterion-level ratings re-examined against the scoring anchors; score discrepancy resolved by reviewer consensus.	27	High / Include
16	Luna-Reyes et al. (2020)	29	21	8	High / Moderate	25	Delta >= 4; Different quality bands	Score and quality-classification differences reviewed at criterion level; discrepancies resolved and final appraisal judgement agreed.	25	High / Include
20	Pagayonan & Wenceslao (2026)	25	30	5	High / High	28	Delta >= 4	Criterion-level ratings re-examined against the scoring anchors; score discrepancy resolved by reviewer consensus.	27	High / Include
21	Parfitt & Tryfonas (2009)	27	24	3	High / Moderate	26	Different quality bands	Criterion-level ratings reviewed; quality-band disagreement resolved by reviewer consensus.	25	High / Include
24	Rizal, Sarno, & Sungkono (2020)	27	20	7	High / Moderate	24	Delta >= 4; Different quality bands	Score and quality-classification differences reviewed at criterion level; discrepancies resolved and final appraisal judgement agreed.	24	Moderate / Include
25	Zdravkovic, Rychkova, & Speckert (2014)	25	22	3	High / Moderate	24	Different quality bands	Criterion-level ratings reviewed; quality-band disagreement resolved by reviewer consensus.	23	Moderate / Include
28	Solekhan, Affandi, & Endroyono (2024)	26	21	5	High / Moderate	24	Delta >= 4; Different quality bands	Score and quality-classification differences reviewed at criterion level; discrepancies resolved and final appraisal judgement agreed.	23	Moderate / Include
29	Toaza, Montenegro, & Salazar (2022)	27	24	3	High / Moderate	26	Different quality bands	Criterion-level ratings reviewed; quality-band disagreement resolved by reviewer consensus.	26	High / Include
30	Utomo et al. (2022)	28	23	5	High / Moderate	26	Delta >= 4; Different quality bands	Score and quality-classification differences reviewed at criterion level; discrepancies resolved and final appraisal judgement agreed.	25	High / Include
31	Vogt & Hales (2010)	28	23	5	High / Moderate	26	Delta >= 4; Different quality bands	Score and quality-classification differences reviewed at criterion level; discrepancies resolved and final appraisal judgement agreed.	25	High / Include
35	Al-Shamayleh et al. (2026)	19	26	7	Moderate / High	23	Delta >= 4; Different quality bands	Score and quality-classification differences reviewed at criterion level; discrepancies resolved and final appraisal judgement agreed.	26	High / Include
42	Affandi (2024)	17	18	1	Low / Moderate	18	Different quality bands; Retention threshold crossed	Criterion-level ratings reviewed because scores crossed the 18/30 retention threshold; final inclusion decision agreed.	17	Low / Exclude
44	Ali (2018)	19	14	5	Moderate / Low	17	Delta >= 4; Different quality bands; Retention threshold crossed	Substantial score disagreement affecting the 18/30 retention threshold reviewed criterion by criterion; discrepancies reconciled and final inclusion decision agreed.	17	Low / Exclude
46	Becker et al. (2011)	22	16	6	Moderate / Low	19	Delta >= 4; Different quality bands; Retention threshold crossed	Substantial score disagreement affecting the 18/30 retention threshold reviewed criterion by criterion; discrepancies reconciled and final inclusion decision agreed.	16	Low / Exclude
47	Bianchi & De Sousa (2015)	22	16	6	Moderate / Low	19	Delta >= 4; Different quality bands; Retention threshold crossed	Substantial score disagreement affecting the 18/30 retention threshold reviewed criterion by criterion; discrepancies reconciled and final inclusion decision agreed.	17	Low / Exclude
48	Briganó et al. (2015)	19	15	4	Moderate / Low	17	Delta >= 4; Different quality bands; Retention threshold crossed	Substantial score disagreement affecting the 18/30 retention threshold reviewed criterion by criterion; discrepancies reconciled and final inclusion decision agreed.	17	Low / Exclude
49	Clementi & Carvalho (2006)	18	14	4	Moderate / Low	16	Delta >= 4; Different quality bands; Retention threshold crossed	Substantial score disagreement affecting the 18/30 retention threshold reviewed criterion by criterion; discrepancies reconciled and final inclusion decision agreed.	16	Low / Exclude
50	De Haes & Van Grembergen (2015)	18	17	1	Moderate / Low	18	Different quality bands; Retention threshold crossed	Criterion-level ratings reviewed because scores crossed the 18/30 retention threshold; final inclusion decision agreed.	17	Low / Exclude
54	Pereira & Mira da Silva (2010)	16	18	2	Low / Moderate	17	Different quality bands; Retention threshold crossed	Criterion-level ratings reviewed because scores crossed the 18/30 retention threshold; final inclusion decision agreed.	17	Low / Exclude
55	Peterson (2011)	15	19	4	Low / Moderate	17	Delta >= 4; Different quality bands; Retention threshold crossed	Substantial score disagreement affecting the 18/30 retention threshold reviewed criterion by criterion; discrepancies reconciled and final inclusion decision agreed.	17	Low / Exclude
57	Sibanda & Solms (2018)	17	18	1	Low / Moderate	18	Different quality bands; Retention threshold crossed	Criterion-level ratings reviewed because scores crossed the 18/30 retention threshold; final inclusion decision agreed.	17	Low / Exclude
12	de Gier (2018)	26	24	2	High / Moderate	25	Different quality bands	Criterion-level ratings re-examined against the scoring criteria and source evidence; quality-band disagreement resolved by reviewer consensus.	25	High / Include
15	Heredia & Merchán (2020)	28	24	4	High / Moderate	26	Delta >= 4; Different quality bands	Total-score and quality-band differences reviewed at criterion level; discrepancies resolved and final appraisal judgement agreed by reviewer consensus.	26	High / Include
17	Irzavika & Mahda (2023)	24	26	2	Moderate / High	25	Different quality bands	Criterion-level ratings re-examined against the scoring criteria and source evidence; quality-band disagreement resolved by reviewer consensus.	25	High / Include

All 30 triggered academic cases were resolved using the same totals-based hybrid procedure. Colour identifies whether the source belongs to the original or additional appraisal record; it does not indicate a different appraisal method.

Table S6. Final combined grey/postgraduate quality appraisal (n = 20)

No.	Source	Reviewer 1 total	Reviewer 2 total	Final hybrid score	Hybrid discussion required	Final decision
1	Terblanche, J. (2011). An information technology governance framework for the public sector [Master's thesis, Stellenbosch University]. Stellenbosch University.	23	22	23	NO	Include
2	Al Omari, L. (2016). IT governance evaluation: Adapting and adopting the COBIT framework for public sector organisations [Doctoral dissertation, Queensland University of Technology]. QUT ePrints.	25	27	26	NO	Include
3	AGSA – The Citizen's Report: PFMA 2020–21	23	22	23	NO	Include
4	AGSA – PFMA 2020–21 Consolidated General Report	28	24	26	YES	Include
5	AGSA – PFMA 2021–22 Consolidated General Report	28	23	25	YES	Include
6	DPSA – CGICTPF Implementation Guideline (2013)	28	23	25	YES	Include
7	DPSA – Determination and Directive on implementation of CGICTPF (2022)	30	23	26	YES	Include
8	DPSA – Public Service CGICT Policy Framework Version 2 (2022)	29	28	29	NO	Include

No.	Source	Reviewer 1 total	Reviewer 2 total	Final hybrid score	Hybrid discussion required	Final decision
9	IoDSA – King IV Report on Corporate Governance for South Africa (2016)	28	29	29	NO	Include
10	ISO/IEC 38506:2020 – Governance of IT-enabled investments	28	25	27	NO	Include
11	ISO/IEC 38503:2022 – Assessment of the governance of IT	29	27	28	NO	Include
12	ISACA – COBIT 2019 Design Guide	28	26	27	NO	Include
13	ISACA – COBIT 2019 Governance and Management Objectives	29	24	26	YES	Include
14	ISACA – COBIT 2019 Introduction and Methodology	28	25	27	NO	Include
15	NIST – Cybersecurity Framework 2.0 (2024)	27	26	27	NO	Include
16	OECD – Digital Government Policy Framework (2020)	28	25	27	NO	Include
17	OECD – E-Leaders Handbook on the Governance of Digital Government (2021)	29	26	28	NO	Include
18	UN DESA – E-Government Survey 2024	28	27	28	NO	Include
19	World Bank – GovTech Maturity Index 2025	27	25	26	NO	Include
20	Johnson, R. L. (2012). An analysis of IT governance practices in the federal government: Protecting U.S. critical infrastructure from cyber terrorist attacks. [doctoral dissertation; grey/postgraduate evidence]	26	27	27	NO	Include

Table S6A. Reviewer 1 criterion-level grey/postgraduate quality appraisal (n = 20)

No.	Source	GA1	GA2	GA3	GA4	GA5	GA6	Total	Final score
1	Terblanche (2011) - Public-sector IT governance framework [Master's thesis]	4	4	3	3	4	5	23	23
2	Al Omari (2016) - IT governance evaluation using COBIT [Doctoral dissertation]	4	5	4	4	3	5	25	26
3	AGSA - Citizen's Report: PFMA 2020-21	5	5	3	3	4	3	23	23
4	AGSA - PFMA 2020-21 Consolidated General Report	5	5	4	5	5	4	28	26
5	AGSA - PFMA 2021-22 Consolidated General Report	5	5	4	5	5	4	28	25
6	DPSA - CGICTPF Implementation Guideline (2013)	5	5	4	4	5	5	28	25
7	DPSA - CGICTPF Determination & Directive (2022)	5	5	5	5	5	5	30	26
8	DPSA - Public Service CGICT Policy Framework v2 (2022)	5	5	4	5	5	5	29	29
9	IoDSA - King IV (2016)	5	5	4	4	5	5	28	29
10	ISO/IEC 38506:2020 - Governance of IT-enabled investments	5	5	4	5	4	5	28	27
11	ISO/IEC 38503:2022 - Assessment of governance of IT	5	5	5	5	4	5	29	28
12	ISACA - COBIT 2019 Design Guide	5	5	5	4	4	5	28	27
13	ISACA - COBIT 2019 Governance & Management Objectives	5	5	5	5	4	5	29	26
14	ISACA - COBIT 2019 Introduction & Methodology	5	5	5	4	4	5	28	27
15	NIST - Cybersecurity Framework 2.0 (2024)	5	5	5	4	4	4	27	27
16	OECD - Digital Government Policy Framework (2020)	5	5	5	5	4	4	28	27
17	OECD - E-Leaders Handbook (2021)	5	5	5	5	4	5	29	28
18	UN DESA - E-Government Survey 2024	5	5	5	5	4	4	28	28
19	World Bank - GovTech Maturity Index 2025	5	5	4	5	4	4	27	26
20	Johnson (2012) [doctoral dissertation]	4	4	5	4	5	4	26	27

Table S6B. Reviewer 2 criterion-level grey/postgraduate quality appraisal (n = 20)

No.	Source	GA1	GA2	GA3	GA4	GA5	GA6	Total	Final score
1	Terblanche (2011) - Public-sector IT governance framework [Master's thesis]	4	4	3	3	4	4	22	23
2	Al Omari (2016) - IT governance evaluation using COBIT [Doctoral dissertation]	4	5	5	4	4	5	27	26
3	AGSA - Citizen's Report: PFMA 2020-21	5	5	3	3	3	3	22	23
4	AGSA - PFMA 2020-21 Consolidated General Report	5	5	3	4	4	3	24	26
5	AGSA - PFMA 2021-22 Consolidated General Report	5	5	3	4	3	3	23	25
6	DPSA - CGICTPF Implementation Guideline (2013)	5	5	3	3	4	3	23	25
7	DPSA - CGICTPF Determination & Directive (2022)	5	5	2	3	5	3	23	26
8	DPSA - Public Service CGICT Policy Framework v2 (2022)	5	5	4	4	5	5	28	29
9	IoDSA - King IV (2016)	5	5	4	5	5	5	29	29
10	ISO/IEC 38506:2020 - Governance of IT-enabled investments	5	5	3	4	4	4	25	27
11	ISO/IEC 38503:2022 - Assessment of governance of IT	5	5	4	5	4	4	27	28
12	ISACA - COBIT 2019 Design Guide	5	5	4	4	4	4	26	27
13	ISACA - COBIT 2019 Governance & Management Objectives	5	5	3	4	3	4	24	26
14	ISACA - COBIT 2019 Introduction & Methodology	5	5	4	4	3	4	25	27
15	NIST - Cybersecurity Framework 2.0 (2024)	5	5	4	4	4	4	26	27
16	OECD - Digital Government Policy Framework (2020)	5	5	4	4	4	3	25	27
17	OECD - E-Leaders Handbook (2021)	5	5	4	4	4	4	26	28
18	UN DESA - E-Government Survey 2024	5	5	4	5	4	4	27	28
19	World Bank - GovTech Maturity Index 2025	5	5	4	4	4	3	25	26
20	Johnson (2012) [doctoral dissertation]	4	4	5	4	5	5	27	27

Grey/postgraduate appraisal note. All 20 records constitute one final grey/postgraduate appraisal set and were evaluated against GA1-GA6 using the same scoring anchors. Johnson (2012), a doctoral dissertation, is treated as grey/postgraduate evidence and received final hybrid score 27/30 (High). Pale blue and pale green identify audit provenance only.

Supplementary Table S6C. Grey/postgraduate cases requiring hybrid reviewer reconciliation (n = 5)

No.	Source	R1	R2	Delta	R1 / R2 class	Rounded mean*	Trigger(s)	Reconciliation outcome	Final reconciled score	Final class / decision
4	AGSA – PFMA 2020–21 Consolidated General Report	28	24	4	High / Moderate	26	Delta >= 4; Different quality bands	Score and quality-classification differences reviewed at criterion level; discrepancies resolved and final appraisal judgement agreed.	26	High / Include
5	AGSA – PFMA 2021–22 Consolidated General Report	28	23	5	High / Moderate	26	Delta >= 4; Different quality bands	Score and quality-classification differences reviewed at criterion level; discrepancies resolved and final appraisal judgement agreed.	25	High / Include
6	DPSA – CGICTPF Implementation Guideline (2013)	28	23	5	High / Moderate	26	Delta >= 4; Different quality bands	Score and quality-classification differences reviewed at criterion level; discrepancies resolved and final appraisal judgement agreed.	25	High / Include
7	DPSA – Determination and Directive on implementation of CGICTPF (2022)	30	23	7	High / Moderate	27	Delta >= 4; Different quality bands	Score and quality-classification differences reviewed at criterion level; discrepancies resolved and final appraisal judgement agreed.	26	High / Include
13	ISACA – COBIT 2019 Governance and Management Objectives	29	24	5	High / Moderate	27	Delta >= 4; Different quality bands	Score and quality-classification differences reviewed at criterion level; discrepancies resolved and final appraisal judgement agreed.	26	High / Include

Five grey/postgraduate cases triggered discussion and were reconciled under the same totals-based hybrid rule. Johnson (2012) did not trigger discussion because the reviewer totals were 26 and 27, both High and above the retention threshold.

Final combined quality-appraisal aggregate. Ninety-one sources were appraised under the final protocol: 71 academic-rubric sources and 20 grey/postgraduate sources. Academic final hybrid scores comprised 45 High, 7 Moderate and 19 Low; 52 academic sources met the >=18/30 retention threshold. Grey/postgraduate final hybrid scores comprised 18 High and 2 Moderate; all 20 met the threshold. Overall, 63 sources were High quality, 9 Moderate and 19 Low. Seventy-two sources were retained for synthesis and 19 were excluded after quality appraisal.

Supplementary Table S6D. Final combined quality-appraisal outcomes for manuscript reporting

Evidence stream	Appraised	Mean final hybrid score /30	High	Moderate	Low	Retained	Excluded
Academic	71	24.03	45 (63.4%)	7 (9.9%)	19 (26.8%)	52 (73.2%)	19 (26.8%)
Grey/postgraduate	20	26.50	18 (90.0%)	2 (10.0%)	0 (0.0%)	20 (100.0%)	0 (0.0%)
Overall	91	24.57	63 (69.2%)	9 (9.9%)	19 (20.9%)	72 (79.1%)	19 (20.9%)

Manuscript-reporting figures: 91 sources were quality appraised (71 academic; 20 grey/postgraduate). The mean final hybrid score was 24.03/30 for academic evidence and 26.50/30 for grey/postgraduate evidence (24.57/30 overall).

Final quality classifications were 63 High, 9 Moderate and 19 Low. Seventy-two sources met the >=18/30 threshold and were retained for synthesis (52 academic; 20 grey/postgraduate); 19 academic sources were excluded after quality appraisal.

Table S7. Coding and theme-development audit trail for the final 72-source synthesis

Initial codes	Subtheme	Higher-order dimension	Representative academic support	Representative grey/normative support	Illustrative candidate indicator
ICT strategy; business–ICT alignment; strategic objectives; project prioritisation	Strategy–ICT alignment	Strategic Alignment	Ali & Green (2006); Ngqondi & Mauwa (2020); Luna-Reyes et al. (2020); Al-Ghazi et al. (2020); Nugraha & Syaidah (2022); Reis et al. (2020); de Gier (2018)	DPSA (2013, 2022b); ISACA (2018b)	Approved ICT strategy explicitly mapped to institutional strategic objectives
Portfolio decisions; budget alignment; enterprise architecture; strategic review	Strategic investment alignment	Strategic Alignment	Luna-Reyes et al. (2020); Ngqondi & Mauwa (2020); Ali et al. (2011); Ningsih et al. (2013)	DPSA (2013, 2022b); ISACA (2018b)	Evidence that ICT portfolio and budget decisions follow approved strategic priorities
Executive sponsorship; steering committees; governance charters; terms of reference	Governance authority structures	Governance Structures and Accountability	Ali & Green (2006); Al Qassimi & Rusu (2015); Phahlane (2023); Al-Ghazi et al. (2020); Ott et al. (2011); Nugraha & Syaidah (2022); de Gier (2018)	DPSA (2013, 2022b); King IV	Operational ICT governance committee with approved terms of reference and meeting evidence
Decision rights; role clarity; accountability; communication; stakeholder participation	Accountability and decision rights	Governance Structures and Accountability	Ngqondi & Mauwa (2020); Al Qassimi & Rusu (2015); Al-Ghazi et al. (2020); Ott et al. (2011); de Gier (2018)	DPSA (2022b); King IV	Documented decision rights and clearly assigned executive, CIO/GITO and business-owner responsibilities
ICT risks; risk register; risk appetite; executive risk review	ICT risk oversight	Risk and Security Governance	Zainuddin et al. (2020); Al Hilali & Vijaya (2021); Heredia & Merchán (2020); Irzavika & Mahda (2023)	NIST (2024); ISACA (2018b); Johnson (2012)	Current ICT risk register reviewed periodically by the appropriate governance authority
Cybersecurity; continuity; disaster recovery; incident escalation; supplier risk	Security and resilience governance	Risk and Security Governance	Plevnik (2026); Al Hilali & Vijaya (2021); Heredia & Merchán (2020)	NIST (2024); ISACA (2018b); Johnson (2012)	Approved continuity and cybersecurity governance arrangements with evidence of review and testing
Business case; portfolio prioritisation; acquisition decisions; resource allocation	ICT investment governance	ICT Investment and Procurement Governance	Canedo et al. (2020); Al Hilali & Vijaya (2021); Ali et al. (2011); Ningsih et al. (2013)	ISO/IEC 38506:2020; COBIT 2019	ICT investments supported by approved business cases and transparent prioritisation criteria
Vendor governance; sourcing; contracts; SLAs; supplier performance; benefits realisation	Procurement and supplier governance	ICT Investment and Procurement Governance	Canedo et al. (2020)	AGSA (2021b, 2022); ISO/IEC 38506:2020; ISACA (2018b)	Evidence of contract/SLA monitoring, supplier performance review and benefits realisation
Applicable legislation; policies; regulatory requirements; obligation register	Governance obligation management	Regulatory and Policy Compliance	Clara et al. (2018); Canedo et al. (2020); Munyoka & Maharaj (2017); Bujung et al. (2024); Reis et al. (2020); Heredia & Merchán (2020); Irzavika & Mahda (2023)	DPSA (2013, 2022a, 2022b); AGSA (2021b, 2022); Johnson (2012)	Maintained register mapping applicable governance requirements to organisational policies and controls
Audit findings; compliance exceptions; remediation; action ownership; closure	Compliance assurance and remediation	Regulatory and Policy Compliance	Clara et al. (2018); Canedo et al. (2020); Irzavika & Mahda (2023)	AGSA (2021b, 2022); ISO/IEC 38503:2022	Documented non-compliance findings with responsible owner, due date and evidence of closure
Governance KPIs; dashboards; conformance reporting; performance review	Governance performance monitoring	Performance Monitoring and Continuous Improvement	Ali & Green (2006); Simonsson et al. (2010); Muniz dos Santos et al. (2025); Ali et al. (2011); Ningsih et al. (2013); Nugraha & Syaidah (2022); Reis et al. (2020); Irzavika & Mahda (2023)	OECD (2021); World Bank (2025)	Periodic governance dashboard containing defined performance and conformance indicators
Reassessment; lessons learned; action tracking; corrective action; governance improvement	Continuous governance improvement	Performance Monitoring and Continuous Improvement	Clara et al. (2018); Muniz dos Santos et al. (2025); Ningsih et al. (2013); Nugraha & Syaidah (2022); Reis et al. (2020); Irzavika & Mahda (2023)	DPSA (2013, 2022a); OECD (2021)	Evidence that assessment and audit findings are tracked, closed and used to revise governance arrangements