

Smart Governance Framework: A Twin-Process Digital Architecture Enabled by AI Orchestration and Shared Data Interoperability

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Abstract: Existing digital-government maturity models often emphasize internal administrative capabilities, citizen-facing services, or aggregate these dimensions into a single maturity construct, providing limited insight into how the two evolve as an integrated system. This paper develops the Twin-Process Digital Architecture (TPDA). This conceptual framework reconceptualizes digital transformation as the synchronized evolution of internal administrative processes (Track A) and citizen-facing service delivery (Track B). Grounded in Public Value Theory and informed by street-level bureaucracy and co-creation scholarship, TPDA connects the two tracks through an integration layer comprising data interoperability, API-enabled system integration, and AI orchestration. The framework proposes a four-stage joint maturity roadmap - digitization, interoperability, AI integration, and co-creation - and introduces the synchronization gap as a diagnostic concept for identifying uneven development between the two tracks. Positioned as a meso-level complement to macro-level digital-government architectures, TPDA offers a relational perspective on coordinating administrative capacity and citizen-facing services. The paper contributes a conceptual framework, a practical diagnostic roadmap for public managers, and testable propositions for future empirical research.

Keywords: *Smart governance; digital transformation; public value; twin-process architecture; AI orchestration; data interoperability; street-level bureaucracy; citizen trust.*

JEL Classification: H83; O33.

1. Introduction

Three decades of digital government research have produced a sophisticated understanding of how citizens experience online public services, with well-established evaluation dimensions such as accessibility, responsiveness, personalization, and trust. Considerably less attention has been paid to the relationship and synchronization between the two domains, particularly how this relationship reshapes the work of civil servants

who process applications, verify information, and exercise administrative discretion, and how these internal changes, in turn, shape citizens' service experiences. This asymmetry does not reflect a lack of attention to either domain - both have attracted substantial investment and research - but rather a lack of attention to their synchronization: existing frameworks evaluate one side or the other rather than explaining how the two co-evolve or depend on each other.

This asymmetry has practical, well-documented consequences. Digital investment has historically concentrated on citizen-facing functions while back-office operations - including human resources, procurement, and case management - continue to rely on legacy systems and fragmented data (O'Leary et al., 2023). Quantitative evidence further indicates an uneven pattern of technology adoption across these domains: a government-sector cloud migration survey found that 41.4% of organizations reported having citizen-facing web applications primarily in the cloud, compared with 27.6% for back-office applications, a difference of 13.8 percentage points. Complementing this evidence, focus-group research conducted jointly by Deloitte and the National Association of State Chief Administrators found substantial variation in digital maturity across individual back-office functions, even within the same government (O'Leary et al., 2023). This intra-organizational variation indicates that digital transformation does not necessarily advance uniformly across administrative functions, allowing relatively mature citizen-facing services to coexist with less digitally mature internal processes. Comparative reviews indicate that most e-government maturity models emphasize internal technical capability. At the same time, giving limited attention to external, citizen-facing outcomes (Akca Okan, 2024), and that front-office and back-office integration are commonly conflated within a single maturity dimension rather than treated as distinct, interdependent processes (Meyerhoff Nielsen, 2017). The field therefore lacks a conceptual framework that explicitly models the co-evolution of bureaucratic modernization and citizen-facing service delivery while specifying the interdependencies between these two domains rather than treating them as separate or implicitly connected dimensions. Accordingly, the research gap is not simply

missing dimensions, but an underdeveloped relational structure that explains how these dimensions interact and evolve together. Although existing approaches provide valuable insights into digital maturity, institutional transformation, digital infrastructure, and citizen-facing service quality, they offer limited specification of how internal administrative capabilities and citizen-facing service delivery can be coordinated within a common organizational service system. TPDA addresses this gap by conceptualizing the two domains as analytically distinct yet interdependent tracks, linked through a shared integration layer that serves as the primary coordination mechanism, and by introducing a joint maturity logic for assessing the degree of alignment and co-development between them.

To bridge this divide, this paper introduces the Twin-Process Digital Architecture (TPDA), which conceptualizes smart governance not as a linear pipeline from back office to front office, but as two distinct, interdependent processes - internal administrative optimization (Track A) and citizen-facing service delivery (Track B) - coordinated through a shared integration layer comprising AI orchestration, common data registries, and a unified digital platform. Public value, in Moore's (1995) sense, emerges not from digitizing either process in isolation but from their synchronized co-evolution. TPDA is deliberately generic and context-independent, intended as a conceptual scaffold adaptable across jurisdictions with varying levels of digital maturity rather than a blueprint tailored to a single country's institutional conditions.

This paper makes three contributions to the digital government literature. *First*, it introduces a dual-track framework that reconceptualizes civil-servant-facing and citizen-facing digitalization as parallel, interdependent processes rather than

sequential stages. *Second*, it specifies a shared integration layer - AI orchestration, data interoperability, and platform integration - as the mechanism that keeps the two processes synchronized, moving beyond frameworks that acknowledge integration without explaining how it is achieved. *Third*, it develops a four-stage joint maturity roadmap that replaces the conventional “infrastructure first, services later” logic with the synchronized progression of institutional capabilities and citizen-facing services.

2. Methodological approach

This paper adopts a conceptual, theory-building approach rather than an empirical or systematic-review design. TPDA was developed through a targeted synthesis of recent scholarship on smart governance, e-government maturity, digital transformation, and public administration, with particular attention to studies published between 2020 and 2025 and indexed in Scopus or Web of Science. The search identified recurring conceptual limitations in the relationship between internal administrative transformation and citizen-facing service delivery; it was not intended to produce an exhaustive or reproducible systematic-review corpus. The review prioritized studies that propose, apply, or critically examine digital-government maturity, capability, or readiness models, while excluding purely technical infrastructure studies without substantive organizational or citizen-facing content. The framework was developed through four analytical stages: (1) Identifying and reviewing the relevant literature; (2) Selecting Public Value Theory as the primary theoretical anchor, supplemented by street-level bureaucracy and co-creation scholarship; (3) Comparing the emerging dual-track structure with adjacent frameworks, particularly Digital-Era Governance and Algorithmic State Architecture, and using the comparison

to construct the proposed framework; and (4) Developing the worked example presented in Section 5 deductively to illustrate the internal logic of TPDA. Accordingly, the paper reports no primary data and makes no claim of empirical validation.

3. Literature review and theoretical foundations

3.1. From e-government to smart governance

The conceptualization of digital government has evolved considerably since electronic government first emerged in the policy discourse of the 1990s, moving from digitizing paper-based transactions toward a broader vision of public-sector transformation. Contemporary scholarship defines smart governance as the strategic integration of digital innovation, data-driven decision-making, participatory mechanisms, and adaptive regulation to improve the efficiency, transparency, responsiveness, inclusivity, and sustainability of public administration (Almulhim & Yigitcanlar, 2025) - an organizational and institutional transformation that technology enables rather than constitutes.

A synthesis of peer-reviewed scholarship published between 2020 and 2025 points to three recurring dimensions of smart governance: digitalization of administrative processes, open data and information transparency, and collaborative citizen participation. The first most directly concerns the internal functioning of public administration, whereas the latter two primarily concern government-citizen-society interactions, reflecting an implicit imbalance in the literature that this paper seeks to address.

3.2. Maturity models and their limitations

Maturity models have long served as the dominant framework for assessing digital

government evolution. A systematic mapping of e-government maturity models published between 2010 and 2022 found that most frameworks remain oriented toward agencies' internal capabilities while giving comparatively limited attention to the external factors shaping digital government outcomes. The review also concludes that the field still lacks consensus regarding the dimensions that define digital maturity (Akca Okan, 2024). A more fundamental critique, advanced by Meyerhoff Nielsen (2017) in an analysis of governance failure within Government 3.0, argues that existing models routinely conflate front-office service delivery with back-office integration rather than treating them as distinct yet interdependent dimensions - a critique this paper's twin-track argument directly extends. Industry analyses also indicate that back-office functions frequently lag citizen-facing digital services, producing fragmented systems and organizational silos that constrain data integration (O'Leary et al., 2023). International frameworks display a related asymmetry: the OECD's (2020) Digital Government Policy Framework distinguishes four foundational dimensions - digital by design, a data-driven public sector, government as a platform, and openness by default - from two transformational, citizen-facing dimensions, but does not explicitly specify a staged mechanism ensuring the two advance together rather than allowing foundational investment to outpace transformational outcomes. Addressing this limitation is a central objective of TPDA's joint maturity roadmap.

3.3. Theoretical anchor: Public Value Theory

Public Value Theory provides a theoretical foundation for addressing a limitation of existing maturity models. Moore's (1995) foundational formulation places public value at the center of public management by strategically aligning operational

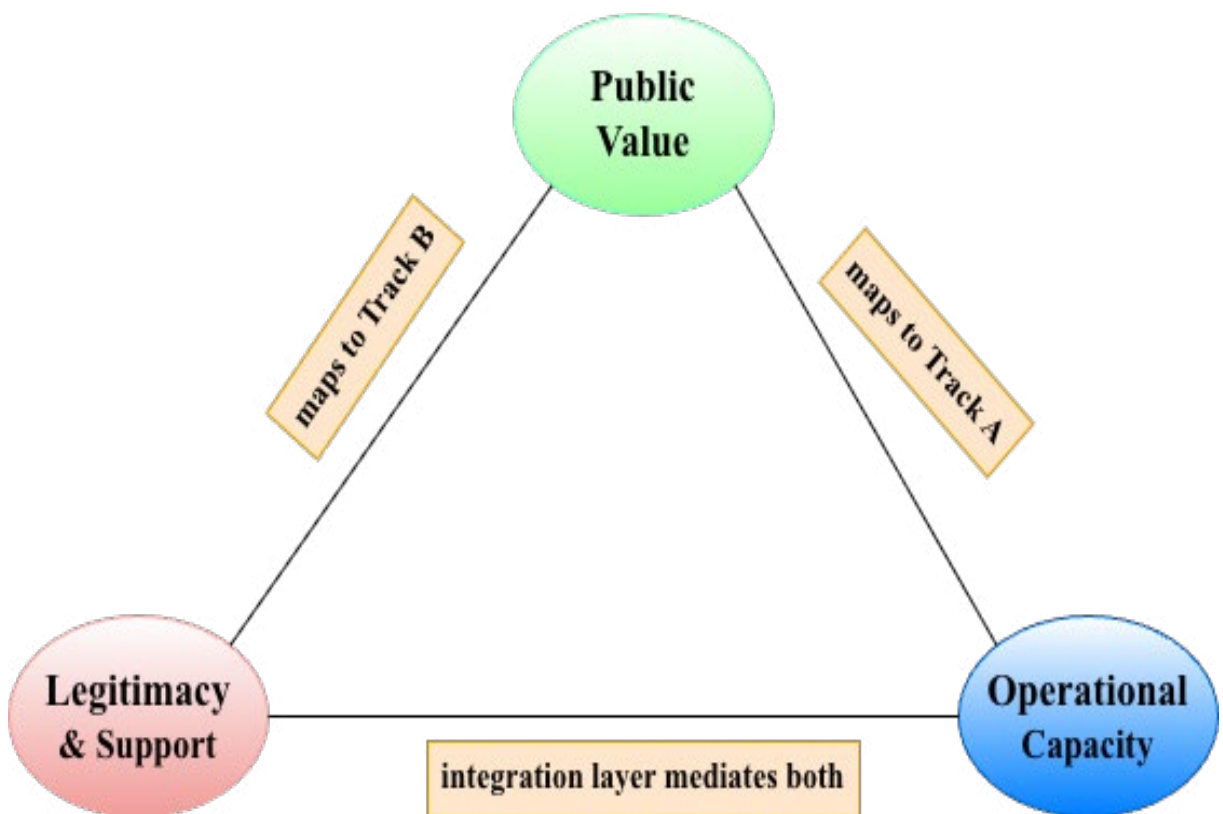
capacity, legitimacy, and political support to create substantive value. TPDA draws on this logic without treating the three elements as a one-to-one mapping onto its architectural components. Track A (internal process optimization) corresponds primarily to operational capacity, reflecting the organizational capability to process cases efficiently, reliably, and with appropriate decision support. Track B (citizen-facing delivery) corresponds primarily to legitimacy and political support, insofar as accessible, responsive, transparent, and accountable service delivery can shape citizens' perceptions of government performance and standing. The third dimension-substantive public value-is not represented as a separate track. Instead, TPDA conceptualizes it as an outcome that emerges when improvements in operational capacity and citizen-facing legitimacy are effectively connected and translated into benefits citizens experience. The integration layer therefore functions not as a substitute for the third dimension of Moore's strategic triangle, but as the architectural mechanism that connects capabilities developed in Track A with service-facing outcomes in Track B. This distinction allows TPDA to retain the multidimensional logic of Public Value Theory while adapting it to a dual-track digital transformation architecture. Accordingly, improvements in either track in isolation may strengthen a particular dimension of government capability or service delivery without necessarily generating corresponding public value. TPDA's central proposition is that synchronized development across the two tracks, supported by effective integration, creates stronger conditions for realizing public value.

Recent street-level bureaucracy scholarship extends this argument by positioning civil servants as the operational link between the two tracks - the "face of government" for citizens (Gofen et al., 2025). A theoretical

synthesis of street-level bureaucracy and co-creation literatures argues that each corrects a limitation of the other: street-level bureaucracy research has traditionally paid limited attention to citizens' agency in service encounters, while co-creation research has often overlooked the discretionary constraints under which civil servants operate (Gofen et al., 2025). This synthesis grounds TPDA's claim that public value requires equal analytical attention to civil servants' working

conditions and citizens' service experiences - precisely what the dual-track architecture is designed to formalize. *Figure 1* illustrates the conceptual mapping of TPDA's components onto Moore's (1995) Strategic Triangle framework. Track A accounts for Operational Capacity, Track B represents Legitimacy & Support, while the Integration Layer serves as the connecting mechanism to generate Public Value.

Figure 1. Moore's (1995) Strategic Triangle, annotated with the conceptual mapping of TPDA



Note: Track A corresponds primarily to the operational-capacity dimension; Track B corresponds primarily to the legitimacy and political-support dimension; public value is not assigned to either track alone but is conceptualized as an outcome of their synchronized development, facilitated by the integration layer.

Source: Authors' elaboration based on Moore (1995).

3.4. *Adjacent frameworks: Positioning TPDA*

TPDA does not seek to replace existing frameworks but to address a gap they leave insufficiently specified. Digital-Era Governance (DEG; Dunleavy et al., 2006), organized around reintegration, needs-based holism, and digitization, and recently extended to incorporate AI as a “third wave” of digital-era governance (Dunleavy & Margetts, 2025), aligns with TPDA’s emphasis on connecting internal and external processes. However, DEG operates primarily at the level of government-wide restructuring and provides limited guidance on sustaining alignment between internal administrative processes and citizen-facing services within individual agencies as technologies evolve.

More closely related is the Algorithmic State Architecture (ASA), which models AI-enabled government as four vertically interdependent layers—digital public infrastructure (Foundation), data-for-policy capabilities (Intelligence), algorithmic government processes (Process), and citizen-facing GovTech services (Service)—and argues that uneven development across these layers can generate implementation difficulties, drawing on comparative cases from Estonia, Singapore, India, and the United Kingdom (Engin et al., 2025). At the time of writing, Engin et al. (2025) is available as a preprint; accordingly, the comparison with ASA is used primarily to position TPDA conceptually rather than as an empirical or evidentiary foundation for the framework. ASA and TPDA share a concern with integration but differ in scope and analytical orientation. ASA is a macro-level, vertically organized architecture whose primary unit of analysis is the state. In contrast, TPDA is a meso-level, horizontally oriented framework focused on aligning internal and citizen-facing digitalization within individual public organizations. This meso-level positioning is

also consistent with peer-reviewed scholarship that distinguishes micro-, meso-, and macro-level perspectives on artificial intelligence in public administration, recognizing that AI-related actors, organizational processes, and institutional arrangements may require analysis at different levels (Criado et al., 2025).

TPDA can therefore be understood as operating at a more granular organizational level than ASA, focusing on coordinating internal administrative processes and citizen-facing service delivery within individual public services. It does not address macro-level issues such as national data sovereignty or national AI governance; its theoretical foundation instead lies in the public value tradition rather than infrastructural architecture. The literature reviewed above therefore positions TPDA as a complementary meso-level framework that specifies how internal administrative transformation and citizen-facing digital service delivery may be coordinated within public organizations. *Figure 2* illustrates the relative positioning of TPDA on the Analytical Scope vs. Orientation matrix. The TPDA framework fills the meso-level, relational quadrant left underspecified by macro-level architectures.

Taken together, the literature leaves the relationship between internal administrative processes and citizen-facing service delivery insufficiently specified in terms of unit of analysis and design. TPDA addresses this gap by modeling their coordination explicitly at the organizational level.

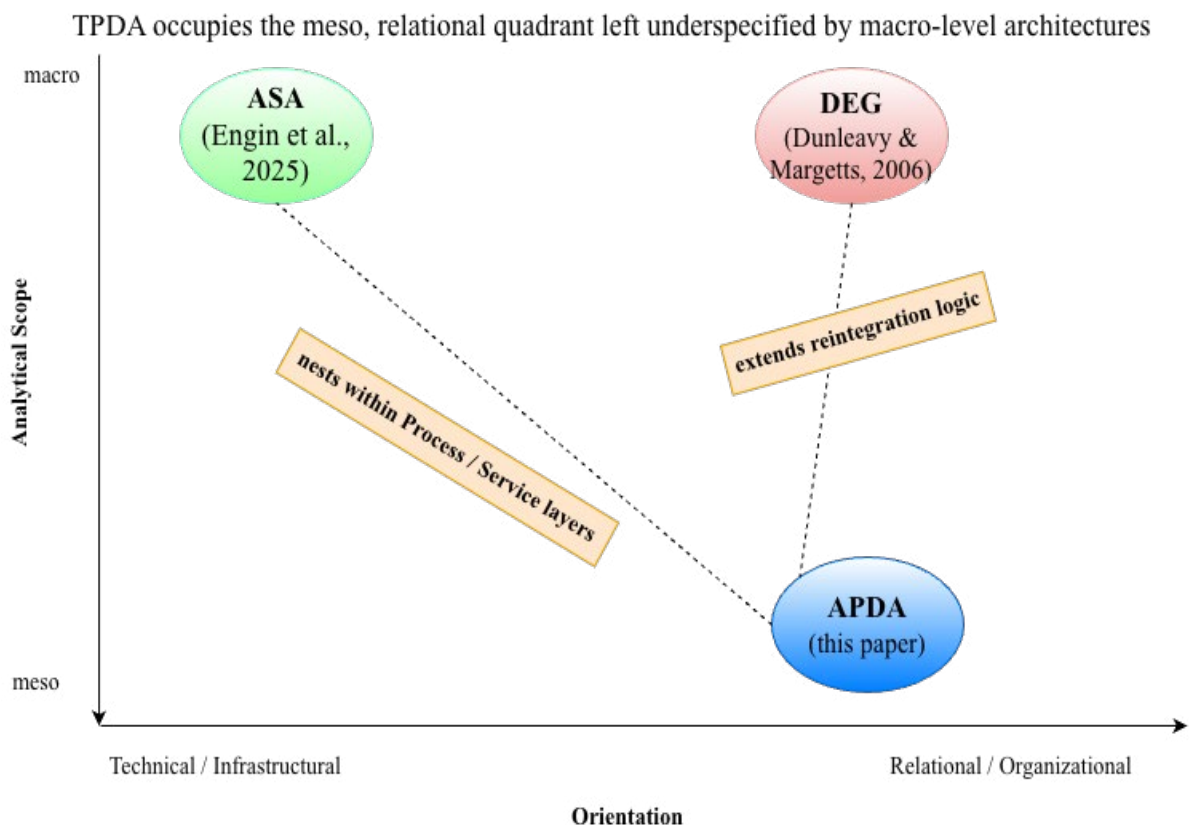
3.5. *Citizen trust as a moderating condition for AI orchestration*

Because AI orchestration forms part of TPDA’s integration layer, citizen trust is a relevant boundary condition rather than an assumed outcome. Evidence indicates that trust in AI-supported government decisions is higher

when systems are perceived as transparent and efficiency-enhancing and lower when fairness or privacy concerns are salient (Ingrams et al., 2022). This matters particularly for Track B capabilities such as personalization and proactive communication, which depend on citizens' willingness to accept AI-mediated use of their data. TPDA therefore treats trust as a contextual condition that may shape

the extent to which Track B capabilities contribute to perceived legitimacy and public value, without assuming a single causal pathway. Its precise role, including possible moderating or mediating effects, remains an empirical question. Proposition P5 formalizes one testable moderating relationship, while *Table 1* presents trust only as an illustrative construct for future operationalization.

Figure 2. Positioning TPDA relative to adjacent frameworks



Note: ASA (Engin et al., 2025) and DEG (Dunleavy et al., 2006) operate at the macro level; TPDA occupies the meso, relational space both leave underspecified.

Source: Authors' elaboration based on Dunleavy et al. (2006) and Engin et al. (2025).

4. The twin-process digital architecture: Framework development

4.1. Core design logic

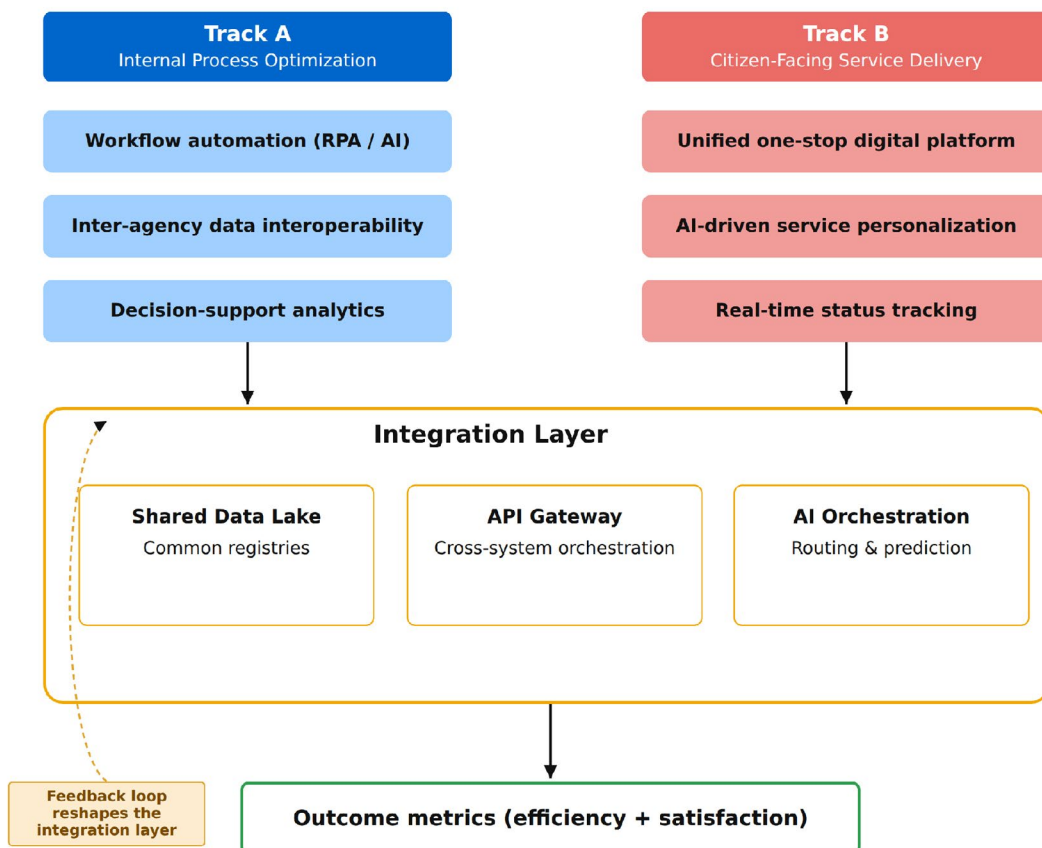
TPDA's central design principle treats

civil-servant-facing and citizen-facing digitalization as two parallel, interdependent tracks rather than sequential stages within a single pipeline. Existing maturity models are limited because they either conflate or

sequentially order processes that are more appropriately understood as distinct yet interdependent. TPDA therefore replaces sequential progression with parallel synchronization as the organizing logic of digital transformation. Asymmetric digital development, though under-theorized, is well documented in the literature in both directions: citizen-facing functions may advance considerably while internal functions such as HR and procurement remain digitally immature (O’Leary et al., 2023), or internal process automation may advance while citizen-facing procedures remain paper-

based, producing the familiar experience of information submitted online being manually re-entered by staff. TPDA addresses both patterns by representing internal and citizen-facing processes as explicit, parallel, interconnected tracks, coordinated through the AI-enabled integration layer described below, making such imbalances more readily identifiable and providing a basis for addressing them. The overall architecture of TPDA is presented in *Figure 3*, showing two parallel development tracks (Track A and Track B) directly connected through a central Integration Layer.

Figure 3. The Twin-Process Digital Architecture (TPDA)



Note: Track A and Track B advance in parallel and are connected through a shared integration layer; outcome metrics feed back into the integration layer’s ongoing redesign.

Source: Authors’ elaboration (2026).

4.2. Track A: Internal process optimization

Track A modernizes internal administrative processes through three interrelated components. Workflow automation - robotic process automation (RPA) and AI-assisted document processing - focuses on routine, rule-based tasks that have historically consumed substantial civil-servant time despite requiring little discretionary judgment. Inter-agency data interoperability addresses the structural fragmentation of government information across systems with distinct standards and governance arrangements. Decision-support analytics refers to data-driven tools that enable civil servants to exercise professional judgment more consistently and with more comprehensive information, while preserving human oversight of discretionary decisions. Conceptually, Track A represents the operational-capacity dimension of Moore's (1995) strategic triangle, providing the organizational capability needed to create public value.

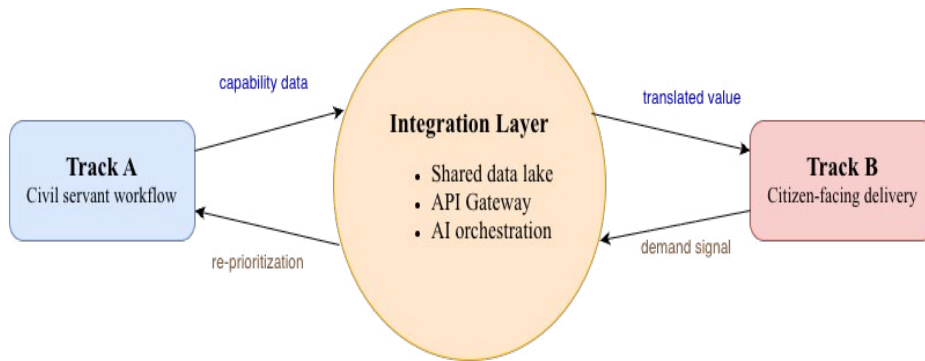
4.3. Track B: Citizen-facing service delivery

Track B focuses on the citizen-facing dimension of digital service delivery through three interrelated components. A unified digital platform, serving as a "one-stop" access point, addresses the well-documented problem of fragmented government websites organized around administrative structures rather than citizens' needs. AI-driven service personalization tailors service pathways, communications, and recommendations to individual circumstances, aiming to improve both efficiency and citizens' perceptions of responsiveness. Real-time status tracking addresses the opacity of administrative processes after submission, reducing

procedural uncertainty. Conceptually, Track B represents the citizen-facing, legitimacy dimension of Moore's strategic triangle, enhancing accessibility, responsiveness, and transparency.

4.4. The integration layer

The integration layer aligns Track A and Track B through three interrelated components, preventing them from evolving as disconnected digital initiatives. Shared data lakes and common registries provide the interoperability backbone: data generated through Track A - case status, verification outcomes, timestamps - supports Track B's real-time status tracking and personalization, while data from citizen interactions on Track B feeds back into Track A's decision-support analytics. An API gateway enables discrete internal and external systems to exchange information without requiring tightly coupled or monolithic systems. AI orchestration provides the routing and predictive logic that coordinates decision-making across the two tracks - for example, identifying cases for expedited processing or determining which citizens should receive proactive updates. In essence, the integration layer translates Track A's operational capabilities into Track B's citizen-facing value while feeding Track B's demand signals back into Track A's prioritization; without it, the two tracks risk evolving into independent initiatives that share an organizational context but fail to inform one another meaningfully. The bidirectional data exchange mechanism between Track A and Track B mediated by the Integration Layer is illustrated in detail in *Figure 4*.

Figure 4. The integration layer as a bidirectional coordination mechanism

Note: Capability data generated by Track A is translated into citizen-facing value on Track B, while demand signals from Track B feed back into Track A's prioritization logic.

Source: Authors' elaboration (2026).

4.5. Feedback loop and systemic properties

TPDA is conceived as a cyclical rather than linear system: performance information from both tracks-internal process efficiency and citizen satisfaction-is continuously fed back into the integration layer to support ongoing refinement, in contrast to the fixed-sequence progression assumed by many existing maturity models. Synchronization is therefore a dynamic capability sustained through continuous feedback and adaptive adjustment rather than a stable condition that, once achieved, persists automatically

- a property that follows directly from the framework's grounding in Public Value Theory, since public value is relational rather than a fixed organizational attribute.

4.6. Concept definitions and suggested measurement indicators

Table 1 summarizes TPDA's core constructs together with working definitions and illustrative operational indicators, intended not as validated measurement scales but as examples of how the constructs may be operationalized in future empirical research.

Table 1. Core TPDA constructs and illustrative measurement indicators

Concept	Conceptual definition	Operational definition	Suggested measurement indicator(s)
Track A (Internal Process Optimization)	AI- and technology-enabled processes through which an agency automates and enhances internal operations: workflow management, inter-agency data handling, and decision-support analytics.	Observable degree to which internal case-handling and workflows are digitized, automated, and connected to shared agency data, positioned on the four-stage roadmap.	% of case types with fully digital workflows; share of routine administrative tasks supported by RPA/ AI; average internal processing time; number of internal systems connected to shared registries.

Concept	Conceptual definition	Operational definition	Suggested measurement indicator(s)
Track B (Citizen-Facing Service Delivery)	Technology-enabled channels through which citizens access, request, and receive public services and information.	Observable degree to which citizen-facing delivery is unified, personalized, and transparent, positioned on the same roadmap.	% of services on a single portal; citizen satisfaction score; average citizen-facing turnaround time; rate of proactive status notifications.
Integration Layer	Technical and organizational mechanisms - shared data lake, API gateway, AI orchestration - connecting Track A and Track B via bidirectional exchange.	Extent to which agency systems draw on and contribute to common registries and cross-system APIs rather than operating as isolated silos.	Number of active cross-agency APIs; % of data fields drawn from shared registries vs. re-entered manually; system interoperability index.
AI Orchestration	Subset of the integration layer responsible for algorithmically routing, prioritizing, and predicting workload and service needs across both tracks.	Degree to which AI-based routing/prediction links Track A workload management with Track B personalization, rather than operating within a single track.	Proportion of decision points served by predictive/triage algorithms; share of notifications triggered by AI-detected status changes; symmetry of AI deployment across tracks.
Data Interoperability	Extent to which data captured in one part of the system can be accessed, reused, and trusted by another part without re-entry or reconciliation.	Adherence to a “once-only” principle, whereby information is supplied or generated once and reused across relevant systems.	% of data fields reused vs. duplicated; number of shared registries/standards in use; API call volume between tracks; data reconciliation error rate.
Synchronization Gap	Differential in developmental stage between Track A and Track B for a given agency, located on the diagnostic matrix (<i>Figure 7</i>).	Absolute difference between an agency’s Track A and Track B stage scores (Stages 1-4).	Stage-differential score Stage A - Stage B ; frequency/duration of nonzero-gap periods; qualitative classification (aligned, Track-A-led, Track-B-led).

Concept	Conceptual definition	Operational definition	Suggested measurement indicator(s)
Public Value Outcome	Joint realization of operational efficiency and citizen-perceived legitimacy, consistent with Moore's (1995) strategic triangle.	Composite outcome combining internal efficiency metrics with citizen trust/satisfaction metrics, treated jointly rather than independently.	Composite index of cost/time savings with citizen satisfaction/trust; complaint/appeal rate; repeat-usage or channel-retention rate.
Citizen Trust in AI-Mediated Services (Moderating Condition)	The extent to which citizens perceive AI-mediated government services and decisions as trustworthy, transparent, fair, and accountable, influencing their willingness to accept and rely on AI-supported service delivery (Ingrams et al., 2022).	The degree to which citizens accept and are willing to rely on AI-mediated service pathways; conceptualized as a moderating condition affecting the strength of the relationship between data interoperability and public value outcomes.	Survey-based trust index; perceived transparency and fairness scores; willingness to use AI-mediated services; opt-out or appeal rate for AI-mediated decisions.

Source: Authors' elaboration (2026).

5. Implementation roadmap: A joint maturity path

The TPDA roadmap comprises four stages, each advancing Track A and Track B in parallel - A defining feature of the roadmap and its principal departure from existing maturity

models, which typically conceptualize development as a single, linear progression toward digital maturity. *Table 2* summarizes the four stages and their corresponding focuses for Branch A, Branch B, and the integration layer at each stage, while *Figure 5* illustrates the parallel development flows.

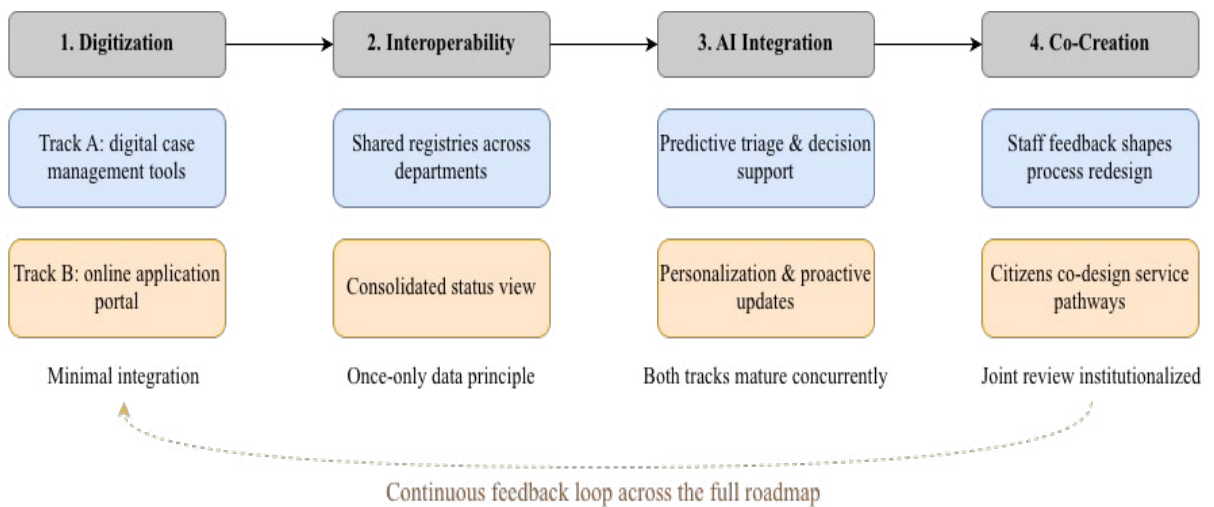
Table 2. Joint Maturity Roadmap of the Twin-Process Digital Architecture

Stage	Track A (internal)	Track B (citizen-facing)	Integration layer focus
1. Digitization	Digital case management replaces paper files	Online application portal replaces in-person submission	Minimal; tracks largely independent
2. Interoperability	Shared case registries across departments	Consolidated status view drawing on shared registry	Once-only data principle; shared data lake established

Stage	Track A (internal)	Track B (citizen-facing)	Integration layer focus
3. AI Integration	Predictive triage and decision-support analytics	Personalized service pathways; proactive status updates	AI orchestration and API gateway connect both tracks' data flows
4. Co-creation	Front-line staff feedback shapes process redesign	Citizens jointly evaluate and refine service pathways	Joint review mechanisms institutionalized; feedback loop matures

Source: Authors' elaboration (2026).

Figure 5. The four-stage joint maturity roadmap



Note: Track A (blue) and Track B (terracotta) components advance together at each stage, connected by a continuous feedback loop rather than a one-directional sequence.

Source: Authors' elaboration (2026).

Stage 1 (Digitization). Track A and Track B are digitized largely independently: civil servants gain digital case-management systems, and citizens gain online application services, but integration remains minimal. This corresponds to the foundational phase identified in the e-government literature, but carries a well-documented risk of siloed systems requiring costly later integration; comparative evidence indicates that infrastructure advancing governance creates accountability gaps, while citizen-facing services advancing data infrastructure yield

quality improvements that are difficult to sustain (Engin et al., 2025).

Stage 2 (Interoperability). Interoperability mechanisms enable Track A and Track B to exchange data across organizational boundaries. The “once-only” principle - that citizens should supply the same information to government only once - serves as a practical benchmark, since achieving it depends on cross-agency and cross-track data sharing. This stage typically requires the most substantial institutional and legal groundwork, since data sharing raises issues

of jurisdiction, accountability, and ownership that technical solutions alone cannot resolve.

Stage 3 (AI Integration). Building on Stage 2's interoperability foundation, this stage introduces predictive routing, personalization, and decision-support capabilities across both tracks in parallel. The defining feature of this stage is concurrent development: introducing AI on only one track risks reproducing, in a more sophisticated form, the very asymmetry TPDA seeks to prevent - a highly capable internal decision-support system with little visible citizen value, or an advanced citizen-facing chatbot disconnected from underlying administrative processes.

Stage 4 (Co-creation). The final stage moves beyond interoperability and AI integration toward genuine co-creation, in which citizens and civil servants jointly design and refine service processes rather than maintaining a provider-recipient relationship, reflecting the street-level bureaucracy/co-creation synthesis in which public value is created through both civil servants' discretion and citizens' active agency (Gofen et al., 2025).

Joint staging is intended to reduce two forms of asymmetry identified in adjacent frameworks: service innovation that outpaces foundational data and governance capacity, and infrastructure investment that fails to translate into citizen-facing value (Engin et al., 2025). TPDA therefore requires Track A and Track B to advance in parallel, while allowing the pace and institutional form of implementation to vary by context.

6. Illustrative application

6.1. Worked example: Municipal business licensing

This section illustrates the TPDA framework through a hypothetical municipal business-licensing service. The example is constructed deductively from the framework's concepts

and maturity stages and is presented solely to demonstrate its internal logic and diagnostic utility; it is not an empirical case study of any actual jurisdiction. Consider a mid-sized municipality in which a prospective business owner must obtain a license involving zoning verification, a fire-safety inspection, a health permit, and a licensing fee - historically administered by separate departments, each maintaining its own system and requiring applicants to submit overlapping documentation repeatedly.

At *Stage 1*, the municipality introduces an online application portal (Track B) alongside internal case-management software (Track A). However, the four departments' systems remain disconnected, and the portal functions merely as a submission channel, with information manually transferred downstream - the "superficial digitization" configuration described earlier, in which an attractive front end conceals a back office that operates much as before.

At *Stage 2*, a shared case registry accessible to all four departments is established, together with once-only data collection, allowing an applicant's core business information to be submitted once and reused automatically across departmental reviews. The citizen-facing portal is updated to draw a consolidated status view directly from this shared registry, eliminating the need to contact departments separately.

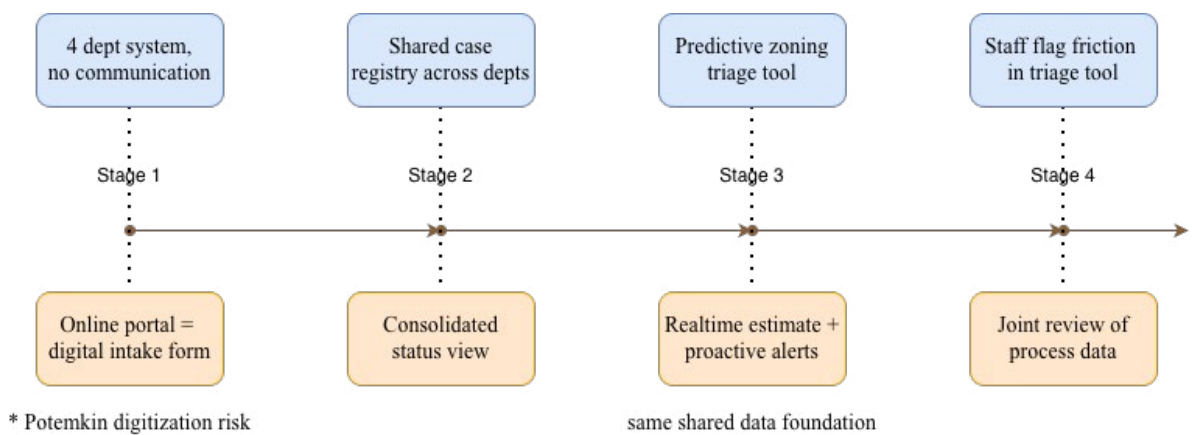
At *Stage 3*, an AI-supported decision-support tool on Track A identifies applications likely to encounter zoning issues based on historical case patterns, letting staff attention concentrate on cases requiring greater judgment; on Track B, the same shared data lets the portal provide continuously updated processing-time estimates and proactively notify applicants when departmental reviews are completed. Both capabilities depend on the same shared data foundation - built as

isolated point solutions, an internal triage system and a citizen-facing tracker would risk reproducing, on more sophisticated infrastructure, the asymmetry TPDA is designed to overcome.

At *Stage 4*, applicants and front-line staff jointly review aggregated process data to identify bottlenecks neither group could fully recognize independently-applicants flagging

unclear documentation requirements, staff flagging application categories the AI triage system consistently misclassifies-operationalizing the co-creation principle beyond one-way satisfaction surveys or internal process audits. *Figure 6* depicts the operational transformation of Track A and Track B across the four roadmap stages using the municipal business-licensing example.

Figure 6. Track A and Track B developments for the illustrative municipal business-licensing case across the four roadmap stages



Source: Authors' elaboration (2026).

The walkthrough illustrates TPDA's diagnostic logic: digital maturity is assessed not only by service sophistication but also by the alignment of Track A and Track B and the effectiveness of the integration layer connecting them. A municipality with Stage 3 internal AI triage but a Stage 1 citizen portal would therefore be diagnosed as asymmetrically developed, a pattern that composite maturity scores may obscure.

The converse configuration-a sophisticated citizen portal layered over fragmented or largely manual internal review-can likewise leave underlying processing bottlenecks unresolved. TPDA attributes this pattern to a Track A-Track B synchronization gap rather than treating interface quality as a sufficient

indicator of service maturity.

6.2. A published case: U.S. state unemployment insurance modernization

Section 5.2 adds a published case to show that the type of asymmetry represented by TPDA can occur in practice. It draws only on secondary government and program sources and serves as contextual illustration, not empirical validation of the framework.

U.S. state unemployment insurance (UI) systems illustrate the type of asymmetry addressed by TPDA. Before and during the COVID-19 pandemic, state UI agencies faced significant challenges from aging information-technology infrastructure and rapidly increasing demand for digital

services. Many state systems continued to rely on legacy mainframe technologies, including COBOL-based systems, while agencies simultaneously expanded digital channels for citizens to submit and manage claims (U.S. Government Accountability Office [GAO], 2022). This technological and organizational mismatch became especially pronounced during the pandemic. GAO reported that the national improper-payment rate for UI increased from 9.2% of payments, approximately \$8.0 billion, in fiscal year 2020 to 18.9% of payments, approximately \$78.1 billion, in fiscal year 2021 (GAO, 2022). In 2022, GAO subsequently placed the UI system on its High-Risk List, citing persistent weaknesses in program design, information-technology infrastructure, and program-integrity controls (GAO, 2022).

Viewed through the TPDA framework, this case fits a Track-B-led or externally driven pattern in which improvements in digital access and service channels are constrained by weaknesses in the underlying administrative infrastructure. The case therefore illustrates the broader diagnostic problem that TPDA seeks to formalize: improvements visible at the citizen-facing interface do not necessarily imply equivalent modernization of the internal processes and infrastructure required to sustain them. The difficulties encountered during the pandemic further demonstrate how weaknesses in internal processing capacity and information systems can constrain service performance when external demand increases sharply.

The subsequent modernization response is also relevant to TPDA's integration-layer concept. The U.S. Department of Labor's Open UI Initiative has promoted modular and API-oriented approaches intended to replace reliance on monolithic legacy systems with interoperable components that can be upgraded or replaced independently

(Bafundo, 2023). From a TPDA perspective, this approach aligns with strengthening the integration layer by improving interoperability between system components rather than treating citizen-facing interfaces and internal administrative systems as isolated investments.

The U.S. UI case should not be read as a test of TPDA because the underlying sources were not designed to measure its constructs. It nevertheless provides contextual evidence that citizen-facing digital expansion can coexist with weaknesses in internal infrastructure and that interoperability-oriented modernization can address part of this mismatch.

7. Discussion: Theoretical and practical implications

7.1. Theoretical contribution

TPDA's principal theoretical contribution is an alignment perspective on public value creation in digitally enabled government. Rather than assuming that citizen-facing digitization or internal modernization independently produces public value, the framework theorizes value creation as contingent on the coordinated development of operational capacity and citizen-facing legitimacy. Shared registries, API-based interoperability, and AI-enabled orchestration are specified as contemporary mechanisms for maintaining that alignment.

The framework also connects street-level bureaucracy and co-creation scholarship to digital-government maturity by treating civil servants' operational conditions and citizens' service experiences as interdependent design concerns (Gofen et al., 2025). This provides a meso-level basis for examining how digital transformation reshapes the service relationship rather than treating either side in isolation.

TPDA's relationship to the Algorithmic State

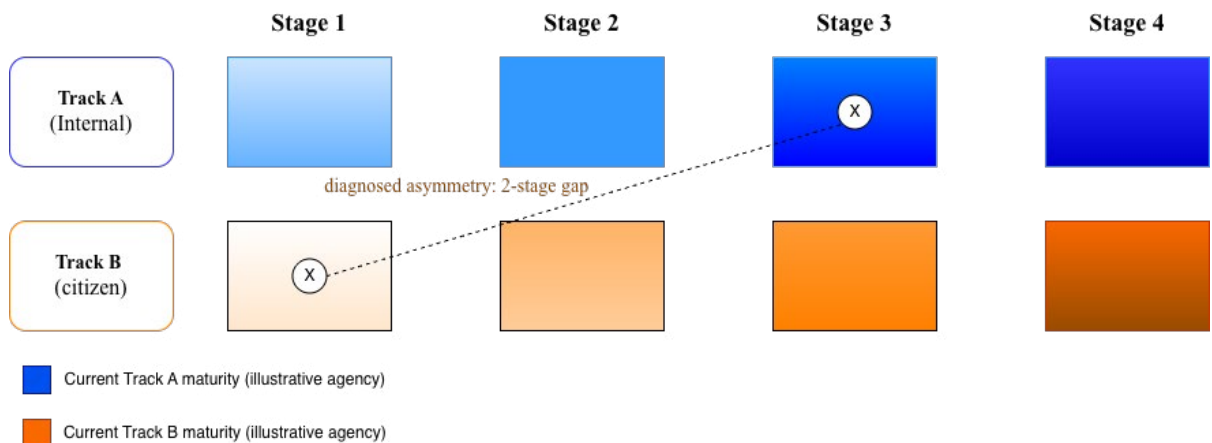
Architecture (Engin et al., 2025) further clarifies a division of analytical labor: ASA provides a macro-level account of how national infrastructure, data capabilities, algorithmic processes, and citizen-facing services interact as an integrated system, while TPDA provides a meso-level account of how relationships between civil servants and citizens can be modeled, diagnosed, and designed within individual public services nested inside that broader architecture. This lens also helps explain a pattern in ASA's own comparative cases - the United Kingdom's service-driven transformation pathway and India's foundation-driven pathway built on biometric identity infrastructure (Engin et al., 2025) - as instances of asymmetric development between internal and external tracks operating at the national rather than organizational level, suggesting that TPDA's

dual-track logic may generalize, at least as a diagnostic heuristic, to the macro level examined by ASA, a proposition that would require dedicated comparative research beyond the scope of this conceptual paper.

7.2. Practical implications

For public managers, TPDA is primarily a diagnostic tool. Its two-track, four-stage matrix allows agencies to locate internal and citizen-facing capabilities separately and identify whether transformation is aligned, Track-A-led, or Track-B-led. This makes uneven development visible in a way that single composite maturity scores may not (O'Leary et al., 2023). *Figure 7* illustrates the diagnostic matrix tool, which enables public managers to identify and visualize synchronization gaps and developmental asymmetries between the two tracks.

Figure 7. The TPDA diagnostic matrix



Note: Plotting an agency's current position on Track A and Track B against the four-stage roadmap makes any asymmetry between internal and citizen-facing digital maturity visible.

Source: Authors' elaboration (2026).

The framework also has implications for resource allocation. Joint staging cautions against privileging politically visible citizen-facing initiatives or, conversely, back-office modernization without corresponding service

improvements. Shared data standards, APIs, and other integration-layer capabilities should therefore be treated as cross-track investments rather than residual technical components.

The institutional mechanism for financing integration will vary. Centralized digital-government systems may support common infrastructure directly, whereas decentralized settings may require pooled funding, interagency agreements, or comparable arrangements. TPDA calls for coordinated investment, not a single budgeting model.

7.3. Limitations

TPDA remains a conceptual, pre-empirical framework. Its central claim that synchronized development is associated with stronger public value outcomes requires empirical testing, and the four-stage roadmap should not be interpreted as a universally optimal implementation sequence. The stage-differential measure $|\text{Stage A} - \text{Stage B}|$ is likewise a diagnostic heuristic, not a validated interval-scale metric; future research should test whether the stages are empirically distinguishable and whether equal numerical distances represent comparable capability gaps. Context independence also limits prescriptive specificity in resource-constrained or institutionally heterogeneous settings. Finally, TPDA brackets important questions of algorithmic accountability, explainability, transparency, and human oversight; it should complement, not substitute for, governance frameworks addressing responsible AI design and deployment.

A further limitation concerns the comparison with the Algorithmic State Architecture (ASA). Engin et al. (2025) remained a preprint at the time of writing, so the TPDA-ASA comparison is provisional and may require revision after formal publication. This does not alter TPDA's independent grounding in Public Value Theory, street-level bureaucracy, and co-creation scholarship, while peer-reviewed work on micro-, meso-, and macro-level AI in public administration supports its organizational-level positioning (Criado et al., 2025).

7.4. Testable propositions for future research

To render TPDA's claims falsifiable, the propositions below translate its arguments into testable form using the constructs and indicators summarized in *Table 1*; they are offered as a starting set rather than an exhaustive list.

P1. Agencies with a smaller synchronization gap (a smaller absolute stage differential between Track A and Track B, per the diagnostic matrix in *Figure 7*) will report higher public value outcomes than agencies with a larger gap, holding overall digital maturity constant.

P2. The strength of an agency's integration layer, proxied by its data interoperability level, positively moderates the relationship between Track A maturity and Track B service quality, such that internal process improvements translate into stronger citizen-facing gains where interoperability is high.

P3. Greater asymmetry in AI-enabled capabilities between Track A and Track B will be associated with weaker perceived service coherence and lower perceived legitimacy, particularly where AI-mediated interactions are salient to citizens.

P4. Joint, parallel progression of Track A and Track B through the four-stage roadmap will be associated with higher public value outcomes than sequential, infrastructure-first or service-first progression, controlling for total digital investment.

P5. The positive relationship between Track B capability and public value outcomes will be stronger in institutional contexts with higher baseline citizen trust in AI-mediated government services than in contexts with lower baseline trust.

8. Conclusion and future research

This paper developed the Twin-Process Digital Architecture (TPDA) to conceptualize internal administrative transformation and citizen-facing digitalization as parallel, interdependent processes. Grounded in Public Value Theory and informed by street-level bureaucracy and co-creation scholarship, TPDA specifies an integration layer linking the two tracks and a four-stage roadmap for diagnosing their alignment. In doing so, it occupies a meso-level analytical space that complements macro-level frameworks such as the Algorithmic State Architecture.

The framework now requires empirical validation. Priorities include comparative case studies of aligned and asymmetric transformation pathways; studies combining civil-servant and citizen perspectives within the same service; cross-jurisdictional tests of the four-stage roadmap; and development of a validated dual-track maturity measure. Future work should also examine how national infrastructure, institutional arrangements, and AI-governance requirements condition agencies' capacity to synchronize the two tracks.

As AI and shared data infrastructures become more deeply embedded in public administration, aligning internal capability with citizen-facing service delivery becomes a central governance problem. TPDA offers a conceptual and diagnostic basis for studying that alignment; whether synchronized development consistently produces greater public value remains a question for empirical research.

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