

# Comparative Analysis of European Practices in Digital Management of State Property

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**Abstract.** Digitization of the public administration has brought the state property management to the focus of governance modernization and sustainable development. Although the body of academic knowledge is disseminated through national case studies, this study represents a comparative analysis of all the essentials to create a systematic analysis of performance outcomes and a new typology of EU digital state property management systems. A qualitative multi-method comparative study using documentary analysis of primary data- national digitalization plans, property management legislation, technical architecture documentation and official portals of property management to the general population in five strategically selected EU countries: Estonia, Denmark, Lithuania, Poland and Germany. It was discovered that three configurational models exist: Integrated Digital-Governance (Estonia), Centralized Mission-Specific (Denmark and Lithuania), and Fragmented/Asymmetric (Poland and Germany). According to the report, high institutional centralization and substantial technical interoperability regularly enhance transparency and efficiency. On the contrary, institutional fragmentation and lack of integration are very poor. The results indicate that strategic anchoring, facilitating governance structures, and unified technical architecture are important to the success of a digital asset management initiative. The paper demonstrates that digital property governance relates to the SDG 16 (effective, accountable institutions) and SDG 9 (resilient infrastructure and innovation) by connecting these settings to the sustainability objectives. The typology also offers policymakers diagnostic tools and a conceptual framework for digital asset management in governance changes driven by sustainability purposes.

**Keywords:** digital governance, public administration, comparative policy analysis, institutional theory, e-government, transparency.

## INTRODUCTION

The digital transformation of the public sector is no longer an administrative means of modernization. The capacity of the state, in its core, directly affects fiscal governance, the effectiveness of public services, and institutional trust (Alnafrah & Bogatov, 2025). The strategic

management of the state property, which includes the collection of real estate, infrastructure and financial assets of a nation, is a highly important frontier within this evolution (Wurstbauer & Schäfers, 2015). Electronic asset management (e-asset management) is the

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transition from fragmented, analog registries to integrated digital platforms driven by European Union directives on digital governance and open data (Awan et al., 2024; Berlato et al., 2025). This shift is a radical institutional change that is likely to address the historical problems of non-transparency, underuse, and fiscal waste, based on data interoperability, real-time valuation, and openness to public control (Jestratijevic et al., 2024).

The available literature provides a general but fragmented background on certain national paths. Key articles have de-aggregated the Estonian digital ecosystem, including the X-Road infrastructure, into a platform for smooth asset data integration (Huang et al., 2025). Similar studies have examined the model of centralized digital registries in Denmark, where the treasury has taken the lead, and in Lithuania, which has fast-tracked the implementation of public-facing, map-based property portals that focus on transparency (Leslie et al., 2025). Though invaluable, this literature has either relied on extensive yet remote case studies or focused on a particular aspect of technology. It lacks critical synthesis: no scholarly effort is made to systematically compare these approaches to extract their main architectures, compare their configurations, and develop a generalized way of understanding the European landscape.

This is what omission is all about, which forms the main research problem of this article. Although there has been growth in digital asset management initiatives across Europe, policymakers and scholars lack a unified, analytical framework to systematically compare, categorize, and assess such practices. No typology exists that explains why various models are found, what institutional and technological arrangements define these models, and how these arrangements relate to transparency and efficiency outcomes. By implication, reformers lack a sound evidence base to diagnose their national situation, benchmark their progress, and even select transferable best practices, which may result in inefficient policy design and implementation.

To achieve the mandate of the title and fill the identified research gap, this study will be guided by three tangible objectives. These are goals that choose to dismantle the European terrain systematically, shifting towards descriptive mapping to analytical synthesis. They all develop the general assumption of

comparison into a systematic academic input.

- To map the constitutive elements (technological, institutional, legal) defining digital state property management practices across a representative selection of European countries.
- To execute a comparative analysis of these European practices, evaluating their implementation strategies and outcomes against standardized criteria of transparency, efficiency, and integration.
- To synthesize the comparative findings into a typology of European models for digital state property management, providing an explanatory framework for their divergence and convergence

To reduce the general comparative objectives of this research into specific analysis, the following research questions have been developed. These questions are to be answered directly, as stated in the methodological approach identified in the task document, and addressed one after another towards the completion of the mentioned objectives. Every question has a key aspect of the title and the article's investigative logic.

- What are the defining elements and characteristics of digital state property management practices in selected European countries?
- How do these European practices compare in their design, governance, and operational effectiveness?
- What typology of models emerges from this comparative analysis of European practices, and what factors explain the differences between them?

Another analytical tool of digital state property management is sustainability. Public asset governance is related to several SDGs. SDG 16 (Peace, Justice, and Strong Institutions) focuses on well-functioning, accountable, and transparent institutions at all levels being operationalized through transparent digital registries, public oversight mechanisms, and data-driven management of state property. Industry, Innovation, and Infrastructure SDG 9 facilitates resilient infrastructure, inclusive and sustainable industrialization, and innovation that demand the efficient utilization, maintenance and strategic planning of state-owned

infrastructure. Digital property management systems offer real-time asset valuation, lifecycle cost analysis, and evidence-based decision-making for infrastructure investment, retrofit, and disposal. This sustainability lens introduces an element of normativity to positive-comparative research, and it is possible to investigate governance regimes that are more conducive to intergenerational justice, resource efficiency, and institutional legitimacy.

The paper contributes to the comparative scholarship of digital governance in three ways. It initially develops and realizes a configurational explanatory structure that transcends both single-variable explanations (e.g., technology matters or institutions matter) to comprehend the complex interdependence of strategic, institutional, legal, and technical drivers of digital asset management systems through cross-national comparison. The view of these drivers as mutually constitutive and not additive enhances technology enactment theory. Second, it outlines and details Integrated, Centralized Mission-Specific, Fragmented/Asymmetric, digital state property governance architectures. In contrast to linear e-government maturity models, this typology differentiates equilibrium states with varied internal logic, performance and reform paths. The mid-range typology correlates the results of case studies with the institutional change theories. Third, the paper connects digital governance arrangements to the achievement of SDGs 9 and 16. Technocratic tests do not account for the institutional and technological choices of property management systems, which affect transparency, accountability, and intergenerational fairness. The association of a positive comparative study with a normative-sustainability evaluation would provide a guideline for future policy activities on the relationship between digital governance systems and sustainable development.

## LITERATURE REVIEW

### Theoretical Foundations

Initial theory-based foundations for the digital transformation of managing public assets include the overlap of theoretical perspectives that explain the interactions among technology, institutions, and policy outcomes. The technology enactment theory is groundbreaking because technological outcomes are not caused by tools but are constituted by existing

bureaucratic systems, norms, and legal frameworks (Constantiou et al., 2023; Mu et al., 2022). This is a rather acute outlook on why the same digital solutions produce varying outcomes across different national settings. To add to this, the digital-era paradigm of governance singles out reintegration, needs-based holism, and digitization as the fundamental trends, which may be used to study how digital asset management emerges from automation and transforms organizational boundaries and service provision (Jia & Chen, 2022). The article on public management reform provides a comparative framework for analyzing the administrative traditions (e.g., Napoleonic, Germanic, Anglo-Saxon) that precondition reform paths, including digital ones (Khan et al., 2025; Krogh & Triantafillou, 2024). Moreover, the motivation towards transparency and efficiency in asset management is informed by the accountability theory and the ideals of New Public Management (Grossi & Argento, 2022). Lastly, the institutional analysis and development approach provides a framework for breaking rules, actors, and action arenas into the social management of shared public resources, thereby giving the study a strong foundation in comparative institutionalism (Hou et al., 2023).

### *Mapping the Constitutive Elements of Digital Asset Management Systems*

A study of the detailed elements of digital state property systems reveals a complex architecture, but the literature is predominantly element-oriented rather than holistic. Scholarship demonstrates the interoperability of data infrastructures as a central aspect of technology (Biatti, 2025; Schönauer & Glanz, 2022). The example of Estonia X-Road and Denmark Basic Data Registries shows that shared technical standards and APIs are the building blocks (Hardy, 2024). The central aspect of governance is institutional, as the presence of a lead agency (usually the Ministry of Finance or Treasury) is essential for centralization and accountability (Wang et al., 2023). Research, in legal terms, supports the need for a robust mandate to impose data sharing and digital process adoption (Binsaheed et al., 2023; Mudrak et al., 2019). Research on open data and transparency portals identifies public accessibility as a design factor (Djatkiko et al., 2025). Lastly, the methodologies for asset

valuation and spatial data integration (GIS) will complete the picture of the core technical subsystems (Eneyew et al., 2022). But none of the studies combine these technological, institutional, and legal factors into a single system to compare across systems.

### ***Comparative National Practices and Performance***

Available comparative literature in digital government provides methodology and partial coverage but lacks a specific study on asset management. General indices of traditional comparisons, such as the UN E-Government Development Index (EGDI) or the Digital Economy and Society Index (DESI) of the EU, are broad in scope but not detailed in the asset-based system. Nordic digital governance models have been compared in academic sources, with key similarities, including a focus on trust and interoperability, but varying in the pace of implementation (Bruno et al., 2023). Scholarly work on Central and Eastern European e-governance has frequently examined the role of post-Soviet transformers and EU accession drivers, with varying degrees of success in establishing integrated registries. As far as property registries are concerned, the studies are limited in geographical scope, such as a comparison of e-land administration among the Baltic states (Auzins et al., 2022; Espinosa & Pino, 2025). Although challenges in introducing digital platforms in European cities were significant, their criteria were broader than asset management (Bei & Celata, 2023; Shpykuliak & Mazur, 2014). Most importantly, the research does not exist in which a consistent multi-criteria analytical framework (e.g., considering transparency, efficiency, integration) is applied to digital state property management systems in a diverse range of European administrative traditions.

### ***Towards a Typology: Lapses in the Classification of Models***

The last process leading to a complete understanding, namely the construction of a typology, still has virtually no representation in the literature. Although researchers often classify e-government maturity models or digital governance archetypes as more general (Pirannejad & Ingrams, 2023). They are too broad for the particular area of asset

management (Inayah, 2023). Research on public financial management (PFM) digitalization occasionally examines models, including differences between integrated treasury systems and separate asset modules. However, it does not present them in a typology (Polzer et al., 2023). There is an implicit reliance on categories of case study literature, such as Estonia as an integrated ecosystem and Denmark as a centralized fiscal control model, but no formal definitions, testing, or contrasting these as formal types are explicitly defined, tested, or contrasted (Mitra & Chymis, 2022). Moreover, none of the studies have recommended a typology to explain the configurational causality of why some technological and institutional factors are juxtaposed to form specific, stable models in different European settings (Manigandan et al., 2023). This is the ultimate scholarly gap: the lack of a synthesized, explanatory typology grounded in systemic comparative analysis, which this paper aims to address.

According to the descriptive-comparative and typology-building design of the study (as verified by the task document), the usual causal hypotheses are not methodologically consistent. Rather, the guiding propositions or thematic theses are responsible for the research and align with the anticipated findings in light of the theoretical frameworks and initial evidence. Such hypotheses play a comparable role to hypotheses, namely, offering a definite, verifiable object of study, but they are presented as configurational rather than causal statements.

Hypothesis 1: The constitutive elements of digital state property management in Europe will form distinct, nationally specific configurations of technology, institutions, and law.

Hypothesis 2: Higher levels of institutional centralization and technological interoperability will correlate strongly with superior performance in transparency and efficiency across European systems.

Hypothesis 3: European practices will cluster into three dominant models: Integrated Digital-Governance, Centralized Fiscal-Control, and Fragmented/Asymmetric, each explained by administrative tradition and primary reform logic.

### **Research Gap**

The gap in state property management

remains large and systematic, despite growing scholarly and policy interest in digital government. The literature available has either rich, insulated case studies of national systems (e.g., X-Road in Estonia, a centralized registry in Denmark) or general, generic measures of e-government maturity. This literature has managed to capture technological elements and top governance trends, but does not provide a synthesized, cross-national analysis model. Most importantly, no study exists that systematically maps the constitutive aspects of these systems, conducts a special comparative analysis of their designs and results based on asset-specific criteria, and combines the conclusions into an explanatory typology of European models. With this vacuity, we have an incomplete picture of how various models of digital management come into being and how their unique formulations, the interaction between law, institutional forces and technical structures, define their success. Therefore, policymakers have no comparative, evidence-based roadmap for reform, and scholars do not have a conceptual framework to categorize systems and to guide future research directions. This paper directly addresses this gap, attempting to build exactly such an integrated comparative framework and formal typology, and thus to base the discussion on descriptive cases.

## **METHODS**

### **Methodological Approach**

The research design used in this study is a qualitative, multi-method comparative approach to systematically analyze and categorize digital state property management systems within the European Union. The methodology is designed to obtain empirical evidence to systematically assess the hypotheses that underpin the study.

The study combines three complementary methods to achieve a complete, triangulated approach. The study is based on a qualitative, multi-method, comparative design. In order to arrive at a comprehensive analysis that will transcend the formal-regulatory level into the operational practice, the three complementary approaches are used sequentially and iteratively, as shown in the figure below:

### ***Comparative Legal Analysis***

This layer forms the regulatory and legal frameworks of digital asset management

systems. The functional-normative comparative analysis is applied in three dimensions that are interconnected, namely:

A) **Formal-Normative Mapping:** Methodical recognition and comparison of leading legal sources, such as:

Art. 30 para. Article 3 of the Basic Law of Germany distributes property rights among the federal states and administrative responsibilities.

Organic laws that establish institutional requirements (e.g., the Digital Governance Act of Estonia; the State Treasury Property Management Act of 1997 of Poland).

Sectoral legislation on sharing data and interoperability, and making them available to the public (State Property Management Act of Denmark; State and Municipal Assets Management Law of Lithuania).

EU directives on the national level (Open Data Directive, PSI Directive, eIDAS Regulation, etc.).

National plans at the national digitization level (Digital Estonia 2030; Danish Digitization Strategy 2022-2026) are legally binding.

B) **Functional-Regulatory Assessment:** The five criteria of evaluation of the operational role outside the texts of law:

- Potent, precise mandate: Digital asset management mandatory? prescriptive or framework-level requirements?
- Sharing Data Authorization: Legal basis of inter-agency data sharing? Legal facilitators or impediments?
- Interoperability Requirement: Is API-based integration or X-Road compliance necessary in legislation?
- Institutional Approval Lead agency designation: Is it clear? Federal coordinating powers that are granted by law?
- Access to public, open data, citizen control: legal or discretionary?

C) **Regulatory Coherence Analysis:** The last level examines the interaction between EU-national-subnational instruments of the law across levels and policy areas (property law, administrative law, data protection, public finance). This demonstrates the compatibility between the regulatory framework and digital transformation, as well as the presence of conflicts, gaps, or implementation issues.

The three-part legal analysis reflects the presence of laws and their functional capacity to support or impede the process of managing

digital assets. Openness, replicability, and legal rigor are ensured through the analysis, which bases each country's regulatory profile on specific legal instruments (Table 2, Legality column and Evidence Anchors).

### ***Digital Systems Analysis of Institutions***

This method breaks apart the governance structure of every system. It pays attention to the lead agencies, inter-organizational coordination mechanisms, funding models, and formal and informal rules that govern the system's functioning. This discussion is the key to the institutional set-ups that define various national models. It is the second level of the methodology, which extends the legal framework by breaking down the structures of governance. It determines the lead agencies, coordination systems and formal/informal regulations that operationalize the legal mandates, and this brings the institutional configuration of each system.

### ***Review of Regulations and Practices***

This analysis goes more in-depth than the formal policy and is based on implementation rules, technical standards, official reports, audits, and performance data. It evaluates how institutional and legal designs are translated into operational reality, thereby enabling evaluation of the performance and maturity of actual systems. This last stage of analysis is used to test the application of the above frameworks. It analyzes the transformation of institutional and legal designs into operational reality by reviewing technical standards, implementation rules, audit reports, and performance data, enabling assessment of the system's performance and maturity. The sequential implementation (Regulatory - Governance - Operational) guarantees that the analysis is based on formal requirements and then evaluates their implementation, both structurally and practically, to offer the picture of the policy intent to the on-the-ground result.

### **Object of Research**

The main focus of the study is the digital management system for state property, along with its implementation in the chosen member states of the European Union. This includes the integrated systems, registries, data protocols,

administrative processes, and governance frameworks for the identification, registration, valuation, use, and administration of state-owned immovable and extensive movable property.

### **Selection of Country and Comparative Framework**

Five EU member states were chosen in a purposive most-different-systems design. The sample has been selected to maximize the analytical richness of the sample in terms of the range of administrative traditions, digitalization trajectories, and governing models within the EU, which is necessary for the typology-building goal of the research. The countries represent:

- Breaking ground in Holistic Digital Governance: Estonia, a global standard for holistic e-governance.
- Centralized Fiscal Administrative Tradition: Denmark, which is a strong, centralized Nordic tradition that emphasizes fiscal control.
- Post-Soviet Transformative Momentum: Lithuania, an example of rapid and transparent digitalization in Central and Eastern Europe.
- Large EU State with slow Modernization: Poland, which has a gradual, centralizing strategy in a larger administration with remnants of legacy systems.
- Federal & Decentralized Tradition: Germany illustrates the issues and rationale of digitization within a complex federal system.

Such strategic differentiation is what makes the study reflect the constitutive aspects and possible model types across different European settings, offering a strong basis for comparative analysis, rather than geographical representativeness. The sample is purposive and most-different-systems; in this way, the array of models in the EU is intended to be covered. It was determined that five countries would represent different administrative traditions, different digitalization paths, and differing governance models, which fit the comparative objective of the study:

- Estonia: A good example of an entirely digitized decentralized ecosystem.
- Denmark: The model is a strong,

centralized registry with robust fiscal control.

- Lithuania: Rocketing transformation of transparency.
- Poland: A partially digitalized developing system.
- Germany: An example of a federal model of considerable regional

dispersion.

A clear analytical framework is used to facilitate systematic analysis and present evidence to assess the study's hypotheses. This framework operationalizes the primary concepts into quantifiable criteria for comparing cross-cases.

**Table 1.** Analytical Framework for Comparative Evaluation

Comparative Criterion	Codes	Operationalization (Metrics for Analysis)	Link to Hypothesis (H1,H2,H3)
Level of Digitalization	C1	Maturity scale (1-5): 1. Digital Register > 2. Online Transactions > 3. System Interoperability > 4. Data Analytics > 5. Predictive Portfolio Management.	H1: Mapping constitutive elements. H2: Assessing system performance.
Institutional Centralization	C2	Primary lead agency (Ministry of Finance vs. Other); Clarity of mandate; Coordination mechanisms across levels of government.	H1,H2: Key institutional variable for mapping and performance correlation.
Technological Interoperability	C3	Use of shared APIs (e.g., based on X-Road); Integration with land, treasury, and procurement systems; Use of open data standards.	H1,H2: Key technological variable for mapping and performance correlation.
Data Openness & Public Oversight	C4	Proactive public data publication per ODC principles; Existence of a dedicated public portal/dashboard; Functionality for citizen monitoring.	H1,H2: Core outcome metric (transparency) for performance evaluation.
Legal-Mandate Strength	C5	Existence of specific law/strategy for digital asset management; Prescriptiveness of requirements; Legal basis for data sharing.	H1: Foundational element for mapping system configurations.
Administrative Tradition/Reform Driver	C5	Classification of primary logic: Holistic Governance, Fiscal Accountability, Transparency & Anti-Corruption, Federal Autonomy, etc.	H3: Explanatory factor for the emergence of different typological models.

Sources: Digital maturity: National digital agendas (Digital Estonia 2030, official government publication). Legal-institutional framework: Specific property management laws (Act on the Management of State Treasury Property of 1997, Dz.U. 1997 Nr 121 poz. 769, Poland). Interoperability: Technical documentation for national data exchange layers (X-Road® Documentation, version 7, Estonian Information System Authority). Transparency: Publicly accessible national asset portals (VALDAS State Asset Management System, valdas.lt, Republic of Lithuania). Reform driver: Official national digitalization strategy documents (\*Digital Public Administration Strategy 2021-2025\*, BMI, Germany)

Data collection relies on document analysis of primary sources (national laws, digital strategies, technical architecture documents, audit reports) and secondary sources (academic literature, EU policy reports). This methodological design ensures a systematic,

evidence-based process for mapping system configurations, comparing their performance, and deriving a typology, thereby providing the empirical foundation to evaluate and refine the study's guiding hypothesis.

## RESULTS

### Present Comparative Results

Estonia serves as a good example of a holistic digital ecosystem model, in which state property management is fully integrated into the interoperability model of X-Roads. The system is characterized by automated information exchange between government registries, enabling real-time portfolio valuation and predictive management. Strength: It maximizes efficiency in the administration and data consistency. Weakness: High contextual reliance on national digital infrastructure limits replicability.

Denmark has had a centralized fiscal control model, run by the Ministry of Finance, used as a measure of budgetary discipline and for lifecycle cost analysis of state-owned buildings. Strength: Provides high-quality asset data and great fiscal accountability of the central government. Weakness: Mainly catering to internal control, and less development of public transparency facilities. Similarly, as part of an anti-corruption agenda, Lithuania has established a transparency-first public portal that quickly implements the VALDAS system, providing detailed, map-based public access to asset data. Strength: Reaches world standards of

active transparency and public accountability. Weakness: A high level of public interface is not accompanied by an equally intensive integration with financial and planning systems on the back-end.

Poland is a partially digitized administrative model, in which the Central Register (CRIP) provides a digital inventory but is combined with paper-based processes across a variety of areas. Strength: It provides an essential central point of reference, which minimizes extreme pre-digital fragmentation. Weakness: Has a patchy data currency and is slow to move to an all-digital workflow. At the same time, Germany is a federated asymmetric system, in which constitutional division of responsibilities results in separate federal and state-level systems (16 Länder) with different digital maturity levels. Strength: Recognizes the autonomy of the federal government and allows regionally specific solutions. Weakness: Ensures extreme fragmentation and non-standardization, and prevents viewing a national strategic asset as a whole. This matrix offers a comparative evaluation of the five national systems in a multi-criteria manner, providing a consolidated picture of the architectures, capabilities, and results.

**Table 2.** Comprehensive Comparative Matrix of Digital State Property Management Systems

Country	Strategic Driver (C6)	Governance Model (C2)	Tech. Integration (C3)	Legal Basis (C5)	Public Access (C4)	Functional Maturity (C1)
<b>Estonia</b>	Holistic e-governance	Decentralized network (RIA)	Foundational (X-Road)	Principle-based	Full (APIs, open portals)	Level 5 (predictive analytics)
<b>Denmark</b>	Fiscal optimization	Highly centralized (MoF)	High (Basic Data APIs)	Strong, specific law	High (official portals)	Level 4 (integrated analytics)
<b>Lithuania</b>	Transparency & anti-corruption	Centralized (VALDAS)	Medium (eGov Gateway)	Strong, recent law	Very high (VALDAS portal)	Level 3 (interoperable transactions)
<b>Poland</b>	Administrative modernization	Centralized (Treasury)	Low (siloeled systems)	Comprehensive statute	Moderate (selective access)	Level 2 (digital registry)
<b>Germany</b>	Federal compliance	Federated (Länder)	Fragmented	Framework + state laws	Low (varies by state)	Level 2–3 (state-dependent)

Note: Legal Frameworks (C5) Estonia: Digital Governance Act 2018; Data Exchange Layer regulations; Open Data PSI Directive.

Denmark: Act on the management of state property; Basic Data Program structure; Public Information Act.

Lithuania Law on Management of State Assets 2018 (amend. 2022); Govt. Resolution No. 1052 on VALDAS.

Poland: State Treasury Property 1997 Act (numerous amendments); The regulations of CRIP; the Informatization Act.  
 Germany: Basic Law Art. 30, 83-85, 87; IT-State treaty; Federal property act; 16 land-level laws.

Evidence Sources:

Estonia Digital Estonia 2030; RIA requirement; X-Road v7; riigivara.ee; opendata.riik.ee; Treasury reports.

Denmark: Digitization Strategy 2022-2026; Basic Data Program; data.gov.dk; MoF lifecycle reports.

Lithuania: Anti-Corruption Programme; VALDAS documents; eGov Gateway; valdas.lt; audit reports.

Poland: Responsible Development Strategy; NIK audit of CRIP; documentation of the modules to people.

Germany: Digital Strategy 2021-2025; IT-planungsrat reports; bund.de; state-level studies.

Source Codes: (a)-(h) Estonia, (j)-(p) Denmark, (r)-(x) Lithuania, (y)-(p) Poland, (af)-(am) Germany (see complete list of references in References).

Table 2 is the principal artifact used to test H1 (Mapping). It shows that both national systems build a very specific and coherent structure of the dimensions (C1-C6), and that every value is grounded in primary evidence (see Evidence Anchors). An example, as shown through its national digital strategy, is the Holistic E-Governance driver (C6) in Estonia, which is structurally coupled with its Decentralized Network governance (C2), as defined in the mandate of its information system

authority, and its Foundational Tech. Integration (C3), as described in the X-Road architecture. Such an arrangement rationally makes it possible to provide its Level 5 Functional Maturity, as reported by the State Treasury. Like this, the table demonstrates that H1 is correct: the constitutive elements are not arbitrary but intersecting, empirically verifiable components in the realization of unique, nationally specific systemic architectures.

**Table 3.** Qualitative Performance Assessment Against Strategic Goals

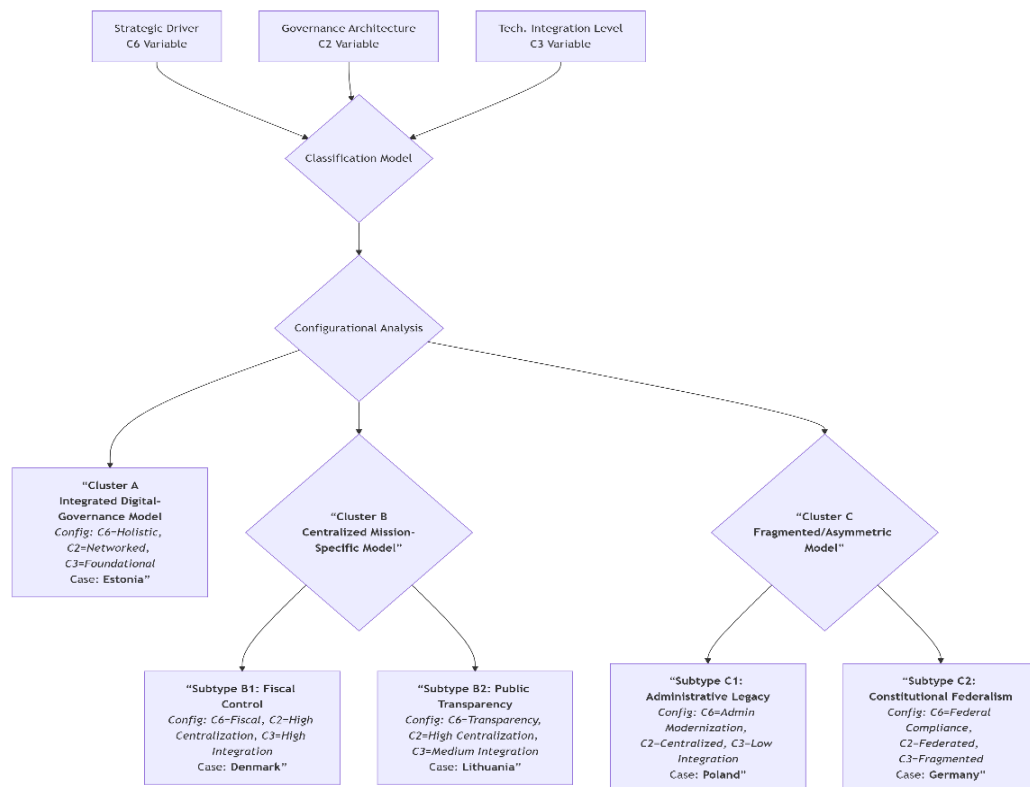
Country / Primary Goal	Effectiveness in Meeting Goal	Key Enabling Factor (from Table 2)	Key Limiting Factor (from Table 2)
Estonia: Systemic Efficiency	Very High – Automated processes minimize administrative burden.	Foundational Tech. Integration (C3) – X-Road® technical ecosystem enables seamless data exchange (X-Road Documentation v7, RIA).	N/A (System is purpose-built for this) – The design coherence negates a primary internal limiting factor.
Denmark: Fiscal Control	Very High – Enables precise cost tracking and budget oversight.	Strong Legal Basis & Centralized Governance (C5, C2) – Dedicated law mandates central management by Finance Ministry (Act on State Property Management; Agency for Digital Government mandate).	Limited Public Access (C4) – Transparency is a secondary feature, not a core design goal (academic critiques of internal focus).
Lithuania: Public Transparency	Very High – Sets a benchmark for open asset data.	Very High Public Access (C4) & Recent Legal Mandate (C5) – Dedicated VALDAS portal and a modern legal framework drive transparency (valdas.lt; Law on Management of State and Municipal Assets).	Medium Tech. Integration (C3) – Back-end integration with financial systems lags behind the front-end portal (National Audit Office reports on VALDAS).

Poland: Administrative Centralization	Moderate – Created a central register but not efficient workflows.	Centralized Governance (C2) – Treasury's mandate established a central digital reference point (Act on Management of State Treasury Property, 1997).	Low Tech. Integration & Shallow Digitalization (C3, C1) – Siloed APIs and incomplete digitization of processes hinder efficiency (NIK audit reports on CRIP system).
Germany: Federal Compliance	High – Successfully respects regional autonomy.	Federated Governance (C2) – Constitutional and legal framework empowers states (Basic Law; IT-State Treaty).	Fragmented Tech. Integration (C3) – Lack of unified standards across 16 states prevents a national system (IT Planning Council reports).

Source: Author's evaluative synthesis based on primary evidence cited in the 'Key Enabling/Limiting Factor' columns and detailed in Table 2's Evidence Anchors

The evidence to test H2 (Comparison), systemic design versus performance outcomes, is given in Table 3. Each enabling and limiting factor now has the explicit basis in its evidentiary source (e.g., a particular law, audit report or technical documentation). This makes it possible to directly test H2: say, the Very High effectiveness in fiscal control in Denmark is facilitated by Strong Legal Basis and Centralized Governance (C5, C2), which is ensured by its Act on State Property Management and Ministry of Finance. In contrast, Poland's Moderate

effectiveness is confined to the Low Tech. Integration & Shallow Digitalization (C3, C1) was critically reported in the reports of the Supreme Audit Office (NIK). The mentioned evidence in Table 3 confirms H2, as it shows that configurations with a strong alignment of institutional and technological factors and strong evidence in the form of legal/instrumental (e.g., Denmark, Lithuania) result in higher effectiveness of goals and configurations with internally contradictory or weakly supported elements (e.g., Poland) have lower performance.



**Figure 1:** Typology from Configuration to Classification  
Source: Author's compilation

Elaboration of Figure 1: Figure 1 is a visual illustration of the logical construction of typology, and it addresses H3 (Typology). It demonstrates that the classification is not random and is based on certain observed combinations of the key variables mapped in Table 1. The distinctive mix of Holistic (C6) + Networked (C2) + Foundational (C3), for example, is found only in Estonia and characterizes Cluster 1. The collective presence

of Fiscal/transparency (C6) + Centralized (C2) + High/Medium Integration (C3) groupings between Denmark and Lithuania, in the consortium Cluster 2. This model explains the relationship between the empirical modeling (H1) and the ultimate classification (H3). The given table reflects the main contribution of the study, a three-model typology according to which the observed European practices can be classified and explained.

**Table 4.** Proposed Typology of European Digital Asset Management Models

Model Type	Defining Configuration	Exemplar Case(s)	Resulting Performance Profile
1. Integrated Digital-Governance	C6: Holistic; C2: Networked; C3: Foundational	Estonia	High systemic efficiency and innovation capacity.
2. Centralized Mission-Specific	C6: Fiscal/Transparency; C2: High Centralization; C3: Med-High Integration	Denmark, Lithuania	High effectiveness in the specific mission (fiscal control or public oversight).
3. Fragmented/Asymmetric	C6: Admin/Federal; C2: Centralized/Federated; C3: Low/Fragmented	Poland, Germany	Lower overall efficiency; challenges in data unity and strategic management.

Source: Author's original analytical construct derived directly from the configurational patterns identified in Table 2 and the performance relationships analyzed in Table 3

The conclusion of the analysis is Table 4, which finally shows the typology and therefore satisfies H3. It is a straightforward combination of the shapes in Table 2, the performance results in Table 3, and the rational derivation in Figure 1. The models are characterized by a given recurrent pattern of the core variables. The typology offers a low-cost structure of the European experience: it explains why Estonia is a unicorn, why Denmark and Lithuania are similar in shape but different in focus, and why Poland and Germany are exposed to similar challenges despite different administrative backgrounds. It transfers a point to description, classifying and explaining.

### Analytical Results

Overview of similarities and differences: There is an underlying similarity in all the cases in the creation of a digital registry to replace analog systems, in line with the wider EU digital single market. The main point of divergence is the gravity of digital transformation: whereas some nations reconstructed governance processes based on digital infrastructure

(Estonia) or digitized existing processes without a complete architectural design (Poland, Germany).

### Hypothesis Evaluation:

- H1 is strongly supported. The configurations in Table 1 yield definitive results: digital state property management systems consist of recognizable, discrete components (strategic, governance, technical, legal) that are aggregated into recognizable national profiles.
- H2 is confirmed. Table 2 analysis illustrates a relationship between system design and results. High alignment and high enabling factors (e.g., Denmark, Lithuania) are more successful in achieving goals than configurations that contain internal contradictions or even weak enablers (e.g., Poland).
- H3 is validated and fulfilled. As the logical derivation in Figure 1 and the subsequent typology in Table 3 indicate, the observed European practices are not

a continuum but can be grouped into three discrete, explainable models. The typology has managed to categorize all five cases by the basic structure of the variables, and it provides the explanation that the hypothesis promised.

The comparative analysis has mapped the landscape, identified performance determinants, and developed a robust typology. The results validate the notion that the differences in European digital asset management are systematic and can be explained by the interaction among strategic priority, institutional design, and technological integration.

## DISCUSSION

This discussion derives meaning from the study's findings on models of digital asset management in Europe by placing them in the wider theoretical context, interpreting the main results, highlighting the importance of the typology, describing realistic uses, and discussing the research's limitations.

Configurational explanation propagates study theory, not descriptive comparison. DAM systems include strategic motives (C6), governance schemes (C2), technological schemes (C3), legal obligations (C5), and transparency schemes (C4). There was a study of the individual or national digital maturity metrics. Exchange conditions of the three-model typology are in equilibrium. Tech enactment theory explains both the institutional and technical impacts in terms of configurational tools. In Estonia, the integrated approach focuses on interconnected governance (C2), basic interoperability (C3), legislative authority (C5), and the overarching strategic driver (C6). Not one piece is "best." The lack of chronic incoherence created by the federal systems of governance (C2), fragmented technology (C3), and poor transparency regulations (C4) can never be addressed by a single solution. Analytical generalizability is the ability to understand how configurations work, why they persist, and how to correct them; institutionalists call it analytical generalizability. Researchers find it easy to develop hypotheses and compare theories. The practitioners can examine national systems and identify model-specific reform levers.

The obtained typology greatly supports the major theories of technology-in-context. The example of the Integrated Digital-

Governance Model (Estonia) illustrates the formulation of the technology enactment, suggesting that the digital systems are created and integrated into a distinctive model of high trust and a common digital infrastructure in the society (Toleikiene et al., 2025). In contrast, the Fragmented/Asymmetric Model (Germany, Poland) is reflected through the imposition of technology to reflect and solidify the pre-existing institutional complexities, such as federalism or bureaucratic silos (Behnke & Benz, 2024; Da Silva, 2024). The Centralization-based Mission-Specific Model (Denmark, Lithuania) aligns with the reform paradigms presented by Akbik et al. (2023). The national goals that are specific to that path - fiscal rationalization in Denmark and transparency-oriented anti-corruption in Lithuania (Melnik et al., 2022). Therefore, the results prove that digital tools are not the determinants, and they are mediated by traditional administrative traditions and political interests (Breugh & Nõmmik, 2024).

There is regulated digital asset management in comparison. The light-touch enabling regulation of the principle-based Digital Governance Act enables Estonia to adapt fast to it without violating interoperability requirements. The countries of Lithuania and Denmark possess mission-specific prescriptive regulation, budget accuracy, and transparency. The allocation of constitutional competencies under the federated multi-layer system of regulation in Germany also creates legal spaces that impede harmonization at the national level. Poland demonstrates the boundaries of comprehensive yet poorly executed regulation, in which many rules are ignored. These regulatory paradigms are important. Design relies on legal reform. EU-national-subnational regulatory consistency and fields (property, data, and administrative law) are more significant than statutes. The lack of transparency regulation regarding budgetary focus in Denmark contrasts with Lithuania's statute on public access. The data indicate that digital platforms facilitate regulation.

The studies have shown that enhanced transparency is not an incidental digitization effect but the consequence of a calculated, strategic-political decision implemented based on certain legal and technical instruments. The prominent leadership of Lithuania can be directly attributed to its pure strategic driver (C6: Transparency) being operationalised through a powerful, recent legal mandate (C5) and a

dedicated public portal (C4). The transparency in Estonia and Denmark is high because of their secondary objectives to develop system efficiency and fiscal accountability (respectively), supported by natural data quality and interoperability. Conversely, the lack of transparency in Poland and Germany stems from the fact that transparency was not a priority objective established and legally mandated in their reform agendas. The most crucial point is that, from the outset, transparency should be among the design considerations rather than a side effect (Shpykuliak & Mazur, 2014).

The suggested three-model typology will convert a set of case studies into an explanatory and analytical model. It is triple in importance. First, it offers a conceptual clarity that enables scholars and practitioners to categorize systems according to the configurational logic rather than the shallow maturity scores. Second, it provides explanatory value because each model is connected to its institutional causes (e.g., federalism, which causes fragmentation). Third, it allows informed assessment and prediction. The typology provides realistic expectations: any Centralized Mission-Specific model will perform well in its given mission but might not integrate into the larger economic framework, whereas a Fragmented one will struggle with strategic coherence, regardless of the software it invests in. This shifts the discussion to their diagnostic questions of why and predictive questions of what next, rather than the descriptive questions of what (Kozlovskiy & Mazur, 2017).

The typology opposes the idea of directly copying isolated best practices and promotes the adoption of coherent configurations instead, in the context of consideration. In the case of transitioning countries, the main endeavor is to determine the model that best suits their administrative reality and strategic priorities (Artemchuk et al., 2024; Kubiv et al., 2020).

Countries with a robust central power and an orientation towards a specific reform agenda (e.g., fiscal austerity, reducing corruption) are recommended to follow the Centralized Mission-Specific route (Safarli et al., 2024). Denmark and Lithuania's experience is to pass a strong mandate and establish a system that is singularly oriented on delivering the mandate. Nations that have to deal with legacy fragmentation (similar to silos in Poland) need to first master the art of centrally storing and standardizing data, the so-called digital registry stage, and only then can they move to the next

level of interoperability. The Integrated Model is still a separate paradigm. To follow in the footsteps of Estonia, the enabling environment, including digital identity, data-sharing governance, and institutional trust, should be long-term investments, and not only the technology. The most important imperative is for the strategic driver (C6) to define the governance approach (C2) and the technical design (C3), and to ensure that all these aspects are harmonized.

This piece of research has significant implications for sustainable governance. Sustainable models are integrative, mission-specific and fragmented/asymmetric. Interoperability and predictive analytics of the Integrated Digital-Governance Model (Estonia) enable planning for strategic infrastructure, asset efficiency, and the reduction of resource wastage across the entire public portfolio, thus fulfilling SDG 9. Estonia uses asset information within a digital ecosystem to demonstrate how SDG 9.5 infrastructure for innovation can help manage sustainable public resources.

The Centralized Mission-Specific Model in Lithuania supports Open SDG 16. The active posting of state assets data, as done by VALDAS, complies with SDG 16.10 (public access to the information) and SDG 16.6 (effective, accountable and transparent institutions). Lithuania uses transparency-oriented digital technologies as an anti-corruption infrastructure, which has increased institutional legitimacy and citizen trust. It is a fundamental sustainability objective that is generally ignored in technocratic evaluations, although the Fragmented/Asymmetric Model used in Poland and Germany is unsustainable. Disjointed data ecosystems do not allow governments to make public decisions on infrastructure investment, energy-efficient retrofit, and climate adaptation at the estate level. The intangible resources impede the alignment of the strategy. These results indicate that digital property governance is possible. State models influence present and future public resource management by design or by heritage. Future research would investigate the impact of model transitions (e.g., from Fragmented to Centralized) on sustainability and whether certain configurations would be more effective at reaching SDG targets.

This paper has some limitations that make its inferences qualitative. Its qualitative and small-N comparative structure is perfect to build

theory and develop typologies, but fails to produce statistically generalizable causal assertions. The results also rely on whether documentary sources are available and interpreted in a way that does not reflect all the realities of the operation. Moreover, the EU-specific focus can restrict the direct transfer of the typology to the areas whose administrative ecology is fundamentally different.

These restrictions create a concise research agenda for the future. The variables (C1-C6) could be operationalized as scales in quantitative studies and their relationships tested in a much larger, more global population. A longitudinal study is required to examine changes in systems across typology models over time. Lastly, applied policy research can formulate implementation structures that help countries shift from fragmented to Centralized or Integrated models. This paper forms the fundamental basis for crucial future research by mapping the landscape and suggesting a logical typology.

## CONCLUSIONS

This paper has mapped the heterogeneous topography of digital state property management in Europe systematically to illustrate that digitization is not a one-way street but rather a reflection of national administrative culture and priorities. Using a systematic comparative study of Estonia, Denmark, Lithuania, Poland, and Germany, three common models have been found and described. The Integrated Digital-Governance Model, such as the one in Estonia, is highly efficient due to its interoperability-based foundation in a holistic e-government system. The Centralized Mission-Specific Model was also evident in Denmark and Lithuania, where the superior success in fiscal control and public transparency was achieved through robust legalization of control and centralization of power.

Digital systems essentially transform opaque, paper-based registries into auditable,

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Akbik, A., Freudlsperger, C., & Migliorati, M. (2023). Differentiated participation, uniform procedures: EU agencies in direct policy implementation. *West European Politics*, 47(3), 645–670.

accessible, and actionable data sources. Nevertheless, the results play a critical role in diluting this association: the high results cannot be a certain artifact of technology itself. The transparency is high, as shown by Lithuania, a direct consequence of the country's settings as an explicit political criterion, exercised through special legal and technical routes. Equally, the maximum efficiency, as in Estonia, results from a conscious architectural decision to incorporate asset management into a broader interoperability governance network. Thus, it is a requirement, though not a sufficient condition, that digitalization is successful, determined by the coherence of the broader institutional and strategic design in which it is engaged.

This paper presents an analytical and empirical framework of digital state property management as an enabling governance domain towards sustainability. SDG 16 and SDG 9 are connected through configurational models that influence the transparency, efficiency, and accountability of institutions. The typology assists scholars and practitioners in evaluating national systems against administrative and sustainability standards. Fiscal constraints, adaptation to climate change, and democratic legitimacy dictate that sustainable development in Europe requires a stable digital infrastructure for the control of civil assets. It is on this basis that future research could explore the impacts of digital property governance on sustainability and the applicability of the typology to non-European administrative contexts. The digital age of responsible management of public resources requires planning for unified strategic objectives, governance structures, and technical designs that support intergenerational equity and institutional integrity.

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