Beyond Interoperability: Conceptualizing the European Judicial Data Space as a Socio-Techno-Legal Infrastructure

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ABSTRACT

Data-oriented justice is often portrayed as a set of digital applications and services designed to enhance judicial cooperation, efficiency, and access to justice within the European Union. This paper offers a different interpretation. It approaches the emerging European Judicial Data Space (EJDS) as a socio-techno-legal information infrastructure in the making. Drawing on information infrastructure theory and socio-legal analysis, the paper examines how the EJDS is likely to develop from an installed base of existing legal instruments, technical standards, organizational arrangements, and digital justice infrastructures. The analysis focuses on three illustrative examples: e-CODEX, the European Criminal Records Information System and its third-country nationals extension (ECRIS/ECRIS-TCN), and JUDEX. These examples show that interoperability in European digital justice is not simply a technical design objective, but an iterative process of legal, semantic, organizational, and institutional change and alignment. They also show that judicial data infrastructures evolve incrementally, through adaptation, reuse, and reconfiguration of existing components, rather than through linear implementation according to a single blueprint. The paper argues that the EJDS should therefore be understood as a layered and evolving assemblage of legal, technical, and institutional elements.

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Its development raises important questions of governance, accountability, standardization, legal diversity, and institutional control. Building a European judicial data infrastructure is not only a matter of technical interoperability or regulatory compliance; it requires reflexive, inclusive, and adaptive governance capable of sustaining trust, procedural fairness, and public value across diverse justice systems.

1. INTRODUCTION

In recent years, the European Union has intensified efforts to digitize justice systems across Member States, framing these developments as crucial to enhancing access to justice, procedural efficiency, and cross-border judicial cooperation.[1] The European e-Justice Strategy 2024–2028 emphasizes the digitalization of cross-border judicial cooperation, access to justice, the use of legal data and datasets, and the development of artificial intelligence in the justice domain.[2] DigitalJustice@2030[3] builds on these objectives and translates them into more concrete actions, including the creation of an IT toolbox intended to lower implementation barriers for Member States and the establishment of a European Legal Data Space to provide accessible, reusable, and searchable data on legislation and case law across the EU. These initiatives signal a clear drive towards common digital tools, cross-border interoperability, and more extensive use of legal and judicial data. Yet they also raise questions that cannot be addressed by technical design or legal compliance alone. Building digital justice infrastructures involves institutional coordination, legal interpretation, semantic alignment, governance choices, and long-term maintenance across highly diverse national justice systems.

This paper starts from the broader infrastructural problem of connecting diverse justice systems, legal frameworks, technical tools, and institutional practices across Europe. It uses the term European Judicial Data Space (EJDS) to conceptualize a possible future European data infrastructure for justice. The paper argues that such an infrastructure should be understood not simply as an extension of existing digital services, nor as a single platform for data exchange, but as an emerging socio-techno-legal information infrastructure. While the announced European Legal Data Space is primarily concerned with improving access to and reuse of legal information, such as legislation and case law, the EJDS concept developed here points to a broader and more operational perspective. It concerns the conditions under which judicial data can be securely exchanged, interpreted, reused, and governed across institutions, procedures, and jurisdictions. In this sense, the EJDS would extend beyond making legal data available: it would require legal, technical, organizational, and semantic

1 European Commission, *Communication from the Commission to the European Parliament, the Council and the European Economic and Social Committee and the Committee of the Regions, Digitalisation of Justice in the European Union: A Toolbox of Opportunities*, COM(2020) 710 (Brussels, December 2, 2020); Council of the European Union, *European e-Justice Strategy 2024–2028*, C/2025/437 (Brussels, November 17, 2023).

2 Council of the European Union, *European e-Justice Strategy 2024–2028*, 1–13.

3 European Commission, *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, DigitalJustice@2030*, COM(2025) 802 final (Brussels, November 20, 2025), 7–8.

conditions that allow judicial data to circulate in ways that remain procedurally meaningful, institutionally accountable, and compatible with the normative commitments of justice.

The paper therefore approaches the EJDS as a potential information infrastructure in the making. This means that it is not assumed to emerge from a single blueprint or from the implementation of a new technological system alone. Like other large-scale public infrastructures, if built, the EJDS is likely to develop from an installed base of existing legal instruments, technical standards, organizational routines, governance arrangements, and digital justice systems. This installed base includes, among others, EU infrastructure and systems (e.g., e-CODEX, ECRIS and ECRIS-TCN, JUDEX), national case-management systems, authentication mechanisms, semantic standards, and EU legal instruments governing data exchange, digitalization, and data protection. These components have different histories, purposes, and institutional logics. They were not originally designed as parts of one coherent judicial data infrastructure, but they shape the possibilities and constraints of any future EJDS.

The EJDS perspective also reframes interoperability. In EU digital justice policy, interoperability is often presented as a technical objective: the capacity of systems to exchange information securely and efficiently. In judicial practice, however, interoperability is also legal, semantic, organizational, and institutional. Judicial and justice-administration categories are not merely data fields. They are embedded in procedural rules, institutional practices, evidentiary standards, and national legal traditions. Therefore, making them interoperable requires more than common technical formats. It requires ongoing work of alignment among meanings, responsibilities, standards, infrastructures, and governance arrangements.

The contribution of the paper towards a European Data Space for Justice is conceptual and analytical. Conceptually, it develops the notion of the EJDS as a socio-techno-legal information infrastructure rather than as a discrete digital system or policy label. Analytically, it examines how previous and emerging EU justice infrastructures reveal different models of interoperability and different forms of infrastructural development. The analysis focuses on three illustrative examples. e-CODEX shows the development of a federated and negotiated infrastructure for cross-border judicial communication. ECRIS and ECRIS-TCN illustrate the power and limits of standardized data exchange in a more narrowly defined criminal justice domain. JUDEX provides a modular and service-oriented model for supporting digital exchanges across judicial cooperation instruments. Together, these examples show that the EJDS is likely to evolve through adaptation, reuse, and reconfiguration of existing components rather than through linear implementation from a single design. This has important implications for how the EJDS should be envisaged to be governed, standardized, maintained, and made accountable over time.

The paper uses the concept of assemblage in a limited sense to describe this composite and evolving configuration. The EJDS is assembled from legal instruments, technical gateways, standards, software components, governance bodies, EU agencies, national administrations, judicial bodies, professional users, and everyday practices of data production and exchange. Treating it as an assemblage does not add a separate theoretical framework; rather, it helps describe the heterogeneous and evolving character of the infrastructure. It draws attention to the fact that the EJDS will be shaped by how these components are aligned, stabilized, contested, and reconfigured over time.

The central argument is that constructing a European judicial data infrastructure is not only a matter of technical interoperability or regulatory compliance. It is also a matter of governance, institutional coordination, legal meaning, accountability, and public value. If the EJDS is to support access to justice, judicial cooperation, and trustworthy data reuse, it must be cultivated as an adaptive infrastructure capable of accommodating legal diversity while sustaining common standards and shared responsibilities. The paper proceeds as follows. Section 2 situates the EJDS within the broader development of European data spaces and EU digital justice policy. Section 3 sets out the information infrastructure framework used in the analysis. Section 4 explains the methodological approach and case material. Section 5 analyses e-CODEX, ECRIS/ECRIS-TCN, and JUDEX as infrastructural trajectories relevant to the EJDS. Section 6 discusses the implications for governance, interoperability, and institutional development. Section 7 concludes by reflecting on the conditions under which the EJDS may become a sustainable and rights-respecting European justice infrastructure.

2. BACKGROUND: FROM EUROPEAN DATA SPACE TO EUROPEAN JUDICIAL DATA SPACE

2.1. EUROPEAN DATA SPACES AS GOVERNED ENVIRONMENTS FOR DATA SHARING

Since 2020, the European Commission has progressively advanced and shaped the idea of creating common European Data Spaces. The European Strategy for Data described the European Data Space as a "genuine single market for data, open to data from across the world – where personal as well as non-personal data, including sensitive business data, are secure and businesses also have easy access to an almost infinite amount of high-quality industrial data".[4] The aim is to overcome "legal and technical barriers to data sharing across organizations, by combining the necessary tools and infrastructures and addressing the issues of trust".[5] The strategy articulated a number of critical domains for this development, including public administration and justice.[6]

Although the European Strategy for Data does not define the European Data Spaces, the European Commission envisages them as a "large-scale modular and interoperable open-source smart European cloud-to-edge middleware platform".[7] They would include (i) data-sharing tools and platforms; (ii) data governance frameworks; (iii) improving the availability, quality and interoperability of data in domain-specific settings and across sectors.[8] Thus, European Data Spaces would not only provide access to quality interoperable data, but would also rely on bringing together relevant

4 European Commission, *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, A European Strategy for Data*, COM(2020) 66 final (Brussels, February 19, 2020), 4.

5 Ibid., 15.

6 The number of domains expended over the years, but this aspect will not be further discussed in this paper.

7 European Commission, *A European Strategy for Data*, 16.

8 European Commission, *A European Strategy for Data*, 4. This has been reiterated in the European Commission Staff Working Document on *Common European Data Spaces*, SWD(2022) 45 final (Brussels, February 23, 2022), 3.

infrastructures and governance rules[9] to facilitate data pooling, access and sharing.[10] Recital 2 of the European Data Governance Act speaks about making "data findable, accessible, interoperable and re-usable (the 'FAIR data principles'), while ensuring a high level of cybersecurity".[11] The 2023 Policy Report on European Data Spaces describes the European Data Spaces as repositories connecting currently fragmented and dispersed data from various ecosystems to create an interoperable layer, a trusted IT environment for data processing, and a set of necessary rules that determine the rights of access to and use of data, permitting data reuse and secondary use of data within and across interest sectors.[12] Once in place, these interoperable data-sharing ecosystems could enable the fluid exchange of data both within and between strategic sectors.[13]

Article 33(1) of the European Data Act reinforces this vision that European Data Spaces should provide "purpose-, sectoral- or cross-sectoral interoperable frameworks for common standards and practices to share or jointly process data" that can be used towards the development of new products and services, research or civil society initiatives. The article also lists a number of essential elements considered key for achieving data interoperability for European Data Spaces.[14] The present European Data Service Support Centre (DSSC) glossary defines a data space as "an interoperable framework, based on common governance principles, standards, practices and enabling services, that enables trusted data transactions between participants".[15]

Taken together, these policies and regulatory sources indicate that European Data Spaces are not merely repositories. They are governed, interoperable environments combining data, standards, technical services, and rules for trusted sharing. This infrastructural understanding is important for the justice domain, where data sharing depends not only on technical access to data, but also on legality, accountability, semantic consistency, and institutional trust.

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9 Ibid.

10 European Commission, *Staff Working Document on Common European Data Spaces*, SWD(2024) 21 final (Brussels, January 24, 2024), 4.

11 Regulation (EU) 2022/868 on European Data Governance and amending Regulation (EU) 2018/1724 (Data Governance Act), OJ L 152 (June 3, 2022), 1–44.

12 Eimear Farrell et al., *European Data Spaces: Scientific Insights into Data Sharing and Utilisation at Scale*, CRC Science for Policy Report, EUR 31499 (Luxembourg: Publications Office of the European Union, 2023), 13.

13 European Commission, *New Report on European Data Spaces*, Joint Research Centre, October 18, 2023, https://data.europa.eu/en/news-events/news/new-report-european-data-spaces-joint-research-centre.

14 The essential elements are (1) a sufficient description in a machine-readable format of the dataset content, use restrictions, licenses, data collection methodology, data quality and existing uncertainty in relation to the data; (2) a public consistent description of the data structures, data formats, vocabularies, classification schemes, taxonomies and code lists; (3) the necessary technical means to access the data (e.g. application programming interfaces, terms of use and quality of service, ways of using the data); and (4) ways of enabling the interoperability of tools for automating the execution of data sharing agreements (e.g. via smart contracts). Regulation (EU) 2023/2854 on harmonised rules on fair access to and use of data (Data Act), OJ L, 2023/2854, December 22, 2023, 1–71.

15 "DSSC blueprint: Building blocks," Data Spaces Support Centre, accessed May 9, 2026, https://blueprint.dssc.eu/?pane=glossary&glossary=1-key-concept-definitions.

2.2. FROM LEGAL DATA SPACE TO JUDICIAL DATA SPACE

With regard to the legal domain, European Commission policy documents and reports envisage the establishment of a European Legal Data Space.[16] This initiative aims to provide seamless access to EU and Member State legislation and case law, support legal research, facilitate data reuse, and improve interoperability among existing online frameworks, including EUR-Lex, N-Lex, and the e-Justice Portal. Such a data space would support legal professionals in decision-making, research, and the development of innovative legal tools. It may also progressively provide access to judicial data suitable for training AI systems and developing AI tools adapted to the justice domain. For this purpose, the European Legal Data Space needs to enable access to downloadable, high-quality, high-volume, and relevant legal content. Common standards for European and national case law and legislation data, such as ECLI and ELI, will be important in this regard. These standards can help identify legal data more easily and, together with machine-readable and searchable formats, facilitate access to relevant information and its reuse.

The European Legal Data Space is primarily concerned with making legal information (legislation, case law, and related legal datasets) more accessible, reusable, searchable, and machine-readable. The EJDS concept therefore sits at the intersection of two policy trajectories: the EU's broader strategy for sector-specific data spaces and the long-standing ambition to develop an area of freedom, security and justice capable of supporting cross-border judicial cooperation. The EJDS, as conceptualized in this paper, refers to a broader operational infrastructure for the secure and accountable exchange of judicial data in the conduct of justice, including data exchanged between courts, competent authorities, legal professionals, and other authorized actors.

2.3. THE EJDS AS AN EMERGING INFRASTRUCTURAL PROJECT

Unlike the more narrowly defined European Legal Data Space, the EJDS would have to integrate a wider range of existing and future infrastructures and practices for judicial cooperation and digital communication. This is why the EJDS is framed here as an enhanced sectoral digital infrastructure. It would not only provide access to national and European legal data, such as case law and legislation, but would also facilitate the secure and trustworthy exchange of judicial data between public authorities, judicial bodies, legal professionals, and other authorized actors. Depending on its governance model and legal safeguards, it may also support its subsequent access or reuse by researchers and private-sector developers, in line with the conditions established by the Data Act.[17] The objective is therefore not merely to achieve technical interoperability, but to create a regulated space that supports data collection, protection, use and reuse, accountability, and transparency while fostering innovation in digital justice services. This shifts the focus from viewing data only as a resource to be accessed, towards understanding data as part of an operational infrastructure embedded in judicial processes.

16 European Commission, *Digitalisation of Justice in the European Union*; European Commission, *Commission Staff Working Document on Common European Data Spaces* (2022); European Commission, *Commission Staff Working Document on Common European Data Spaces* (2024); European Commission, *DigitalJustice@2030*.

17 Regulation (EU) 2023/2854 on harmonised rules on fair access to and use of data (Data Act), OJ L, 2023/2854, December 22, 2023, especially Article 33.

In relation to the European Legal Data Space, the Commission's policy documents remain somewhat abstract and leave open questions concerning architecture, governance, and rights-preserving safeguards. Building the EJDS would require more than connecting European and national databases. It would also require the integration of existing infrastructures that support judicial cooperation, access to justice, legal certainty, and secure communication. Developments that are not primarily technological should not be ignored, because they often prepare the legal, organizational, and procedural ground on which technical solutions later depend.[18] Diversity is a key component of the EU construction, including in the legal domain. Developing a common understanding of national legislative and institutional differences will therefore be essential to support the coevolution of EJDS infrastructure components and preserve the EJDS's evolvability. In this process, stakeholders should recognize that legal, organizational, procedural, and institutional components are as important as technical ones. Without their contribution, the architecture and investment required to build a judicial data infrastructure risk becoming unsustainable.[19]

From a policy standpoint, the EJDS builds on two decades of fragmented but cumulatively significant efforts to digitize justice systems across the EU. These efforts can also be understood as part of a broader movement toward cross-border justice platforms that organize communication, access, and process procedural exchange across jurisdictions.[20] These include (among others) the development of the European e-Justice Portal, ECRIS (and the in-development ECRIS-TCN[21]), the European Case Law Identifier (ECLI), the launch and operationalization of e-CODEX, and the introduction of uniform judicial cooperation procedures and electronic communication between competent authorities (via JUDEX[22]). Each of these initiatives has aimed, in its own

18 Elena Alina Onțanu, "Adapting justice to technology and technology to justice: A coevolution process to e-justice in cross-border litigation," *European Quarterly of Political Attitudes and Mentalities* 8, no. 2 (2019): 54–74.

19 Ibid.

20 Marco Velicogna, "The Rise of Cross-Border Platforms in the European Justice Domain: Lessons from Practice," (paper presented at LEILA Final Conference – *Towards an EU Platform for Judicial Auctions and Going Forward*, November 2023).

21 ECRIS-TCN, the European Criminal Records Information System - Third Country Nationals, facilitates the exchange of criminal records information about non-EU citizens and stateless persons across EU Member States, providing easy access to comprehensive information on an individual's criminal history, regardless of the country where that person was previously convicted. Regulation (EU) 2019/816 establishing a centralized system for the identification of Member States holding conviction information on third-country nationals and stateless persons (ECRIS-TCN) to supplement the European Criminal Records Information System and amending Regulation (EU) 2018/1726, PE/88/2018/REV/1 OJ L 135, May 22, 2019, 1–26.

22 The European Commission is responsible for the creation, accessibility, development and maintenance of reference implementation software which Member States may choose to apply as their back-end system instead of a national IT system (Art. 12 of Regulation (EU) 2023/2844 on the digitalisation of judicial cooperation and access to justice in cross-border civil, commercial and criminal matters, and amending certain acts in the field of judicial cooperation, OJ L, 2023/2844, December 27, 2023). The existing software has been developed based on the e-Evidence Digital Exchange System (eEDES) originally created as part of a voluntary project on the secure exchange of EIOs, MLA requests, and associated evidence in digital format. It standardizes the cooperation processes, secures data transmission, and ensures the integrity and authenticity of exchanged judicial documents. Given the system's growth, the reference implementation and national solutions under all judicial cooperation instruments that provide for it are now known as JUstice Digital EXchange system (JUDEX). The roadmap for the JUDEX development covers the digitalization of judicial cooperation use cases under Regulation (EU) 2023/2844 (Digitalisation Regulation).

way, to address the barriers to cross-border litigation that the EJDS will also have to address such as incompatible procedural rules, linguistic complexity, and limited legal information.[23] The institutional reality underpinning these projects is far from seamless. As Onțanu and Velicogna and Steigenga have shown digitization of justice in Europe is characterized by coevolution processes rather than linear progress.[24] Building a common data space such as EJDS will likely follow similar processes. Law and technology adapt to one another unevenly and under varying national constraints. National digital justice systems, often shaped by their own procedural traditions and political priorities, do not easily align with supranational goals of interoperability or transparency. The result is what Contini and Cordella describe as a fragmented yet networked digital architecture in which shared European infrastructures (such as e-CODEX) interoperate with heterogeneous systems with varied technical capacities and legal standards.[25]

In this regard, the EJDS is likely to inherit a set of unresolved tensions revealed in earlier shared infrastructures at EU level, such as technological standardization and legal diversity,[26] efficiency and fairness,[27] public governance and private involvement (particularly in outsourcing interface design), document management, or authentication services, raising concerns about accountability and control[28] (further discussed in Section 5).

Additionally, the EJDS will have to contend with the broader European regulatory framework on data governance, most notably the General Data Protection Regulation

23 Marco Velicogna, Ernst Steigenga, Sandra Taal, and Arnold Schmidt, "Connecting EU jurisdictions: Exploring how to open justice across member states through ICT," *Social Science Computer Review* 38, no.3 (2020): 274; Burkhard Hess and Xandra Kramer, eds., *From Common Rules to Best Practices in European Civil Procedure*, Oxford, England Christoper (Oxford: Nomos/Hart, 2017); Elena Alina Onțanu, *Cross-Border Debt Recovery in the EU: A Comparative and Empirical Study on the Use of the European Uniform Procedures* (Cambridge: Intersentia, 2017).

24 Onțanu, "Adapting Justice to Technology and Technology to Justice"; Marco Velicogna and Ernst Steigenga. "Can Complexity Theory Help Understanding Tomorrow e-Justice?," in Conference on *Complex Systems*, Law and Complexity session, Amsterdam, September 2016.

25 Francesco Contini and Antonio Cordella, "Law and Technology in Civil Judicial Procedures," in *The Oxford Handbook of the Law and Regulation of Technology*, ed. Roger Brownsword, Eloise Scotford, Karen Yeung (Oxford: Oxford University Press, 2016), 246–268, https://doi.org/10.1093/oxfordhb/9780199680832.013.47.

26 Marco Velicogna, "History of a Digital Institution in the Making: Observing More than 14 Years of e-CODEX, the European e-Justice System," in *Historicity in Organization Studies: Describing Events and Actuality at the Borders of Our Present*, ed. François-Xavier de Vaujany, Kätlin Pulk, and Pierre Labardin (Cham: Springer Nature Switzerland, 2025), 125–57; Onțanu, "Adapting Justice to Technology and Technology to Justice".

27 Dory Reiling, *Technology for Justice: How Information Technology Can Support Judicial Reform* (Leiden: Leiden University Press, 2009); Virginia Eubanks, *Automating Inequality: How High-Tech Tools Profile, Police, and Punish the Poor* (New York: Picador, St Martin's Press, 2018).

28 Marco Velicogna et al., "Connecting EU jurisdictions: Exploring How to Open Justice Across Member States Through ICT," *Social Science Computer Review* 38, no. 3 (2020): 274–294.

(GDPR),[29] the Data Governance Act,[30] and the AI Act.[31] These instruments establish the legal obligations for handling personal (and sensitive) data. While this creates opportunities for rights-preserving data innovation, it also complicates the design of judicial infrastructures, which must now align with overlapping legal regimes and normative expectations.

In summary, the EJDS is a project marked by both promises and complexity. It sits at the crossroads of technological ambition, legal pluralism, institutional fragmentation, and political vision. It will have to navigate the legacy of earlier EU e-justice initiatives while adapting to the emerging paradigm of European data spaces and digital sovereignty. This background supports the analytical move developed in the next section: the EJDS is best understood not as a single platform or policy label, but as an emerging information infrastructure built from an installed base of legal instruments, technical standards, organizational arrangements, and existing digital justice systems. Understanding how such an infrastructure may evolve, and what futures it may enable or foreclose requires technical scrutiny as well as critical, historically informed analysis.

3. FRAMEWORK: THE EJDS AS AN INFORMATION INFRASTRUCTURE

Understanding the European Judicial Data Space requires more than an examination of legal mandates, technical standards, or policy objectives taken in isolation. The EJDS is not yet a clearly bounded operational system, nor can it be adequately described as a single platform to be designed and implemented from above. It is better understood as an emerging information infrastructure: a developing configuration of legal rules, organizational arrangements, technical components, data standards, institutional responsibilities, and situated practices through which judicial data may be exchanged, interpreted, and reused across jurisdictions.[32] This perspective allows the analysis to focus on the conditions under which a European Judicial Data Space can become operationally meaningful, institutionally sustainable, and normatively accountable.

A data space may be defined in general terms as an organized environment for data sharing. It does not consist only of datasets, databases, or software applications. It also includes rules defining who may access data, standards specifying how data is described and exchanged, governance mechanisms allocating responsibility, and technical services enabling secure and trustworthy circulation. In the justice domain, these dimensions are especially significant. Judicial data is legally sensitive, procedurally embedded, institutionally distributed, and often shaped by national legal

29 Regulation (EU) 2016/679 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation), OJ L 119, May 4, 2016, 1–88.

30 Regulation (EU) 2022/868 on European data governance and amending Regulation (EU) 2018/1724 (Data Governance Act), OJ L 152, June 3, 2022, 1–44.

31 Regulation (EU) 2024/1689 laying down harmonised rules on artificial intelligence and amending Regulations (EC) No 300/2008, (EU) No 167/2013, (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1139 and (EU) 2019/2144 and Directives 2014/90/EU, (EU) 2016/797 and (EU) 2020/1828 (Artificial Intelligence Act), OJ L 2024/1689, July 12, 2024.

32 Ole Hanseth and Eric Monteiro, *Understanding Information Infrastructure* (unpublished manuscript, University of Oslo, August 27, 1998); Susan Leigh Star and Karen Ruhleder, "Steps Toward an Ecology of Infrastructure: Design and Access for Large Information Spaces," *Information Systems Research* 7, no. 1 (1996): 111–34.

traditions. A judicial data space is therefore not a "market" for data in the ordinary commercial sense. It is primarily a regulated environment for the exchange, use, and possible reuse of judicial data among public authorities and other authorized actors, under conditions shaped by legality, accountability, trust, and procedural safeguards.

Information infrastructure theory is particularly useful for analyzing this kind of development because it shifts attention from isolated systems to the broader arrangements that make systems work in practice. Hanseth and Monteiro describe information infrastructures as shared, open, heterogeneous, and evolving socio-technical arrangements.[33] Unlike stand-alone information systems, infrastructures do not have fixed boundaries or single points of control. They grow over time, depend on an installed base, and become effective only when they are embedded in organizational routines and institutional practices.[34] Star and Ruhleder similarly emphasize that infrastructures are relational and embedded: they become infrastructure for particular communities of practice when they are taken up, maintained, and made useful in situated work.[35]

This understanding is especially relevant for the EJDS. The EJDS will not emerge on an empty terrain. It builds upon an installed base composed of legal instruments that authorize or constrain digitalization and data exchange, semantic standards, procedural forms, authentication arrangements, and existing EU and national digital justice initiatives. Some of these components will be further analyzed in Section 5. These components were not originally designed as parts of one coherent whole. They have different histories, governance arrangements, technical logics, and institutional constituencies. Yet they shape what the EJDS can become. From an infrastructure perspective, the issue is therefore not whether the EJDS can be designed as a complete system from scratch, but how existing components can be connected, adapted, governed, and sustained over time.[36]

Infrastructures evolve by extending and reconfiguring what already exists, rather than replacing it entirely.[37] This produces both opportunities and constraints. Existing systems may provide technical capabilities, institutional knowledge, trusted relations, and reusable standards. At the same time, they may create path dependencies, incompatibilities, governance ambiguities, and forms of lock-in. In the field of digital justice, this means that earlier choices about procedural forms, data categories, authentication mechanisms, message exchange architectures, service-oriented or jurisdiction-based implementation strategies continue to influence later developments. The EJDS is therefore best understood as a cumulative and evolutionary project, shaped by previous attempts to make European justice systems interoperable. This perspective also helps to clarify the meaning of interoperability. In policy discourse, interoperability is often presented as a technical objective: the ability of systems to exchange information. In judicial administration, however, interoperability is broader and more demanding. It requires not only technical connectivity, but also semantic, legal, organizational, and institutional alignment. Categories such

33 Hanseth and Monteiro, "*Understanding Information Infrastructure*."

34 Ibid.

35 Star and Ruhleder, "Steps Toward an Ecology of Infrastructure."

36 Star and Ruhleder, "Steps Toward an Ecology of Infrastructure."; Hanseth and Monteiro, *Understanding Information Infrastructure*.

37 Hanseth and Monteiro, *Understanding Information Infrastructure*.

as "case," "party," "decision," "claim," or "conviction" may appear straightforward as data fields, but they are connected to different legal meanings, procedural roles, evidentiary functions, and administrative practices across jurisdictions. Making them interoperable is not simply a matter of translating them into a common data format. It involves negotiating what they mean, how they may be used, who is responsible for them, and what consequences follow from their circulation.[38] For this reason, infrastructures in the justice domain should be understood as socio-techno-legal achievements. They are not merely technical backbones supporting legal work. They participate in the reconfiguration of legal and administrative practice by making some categories, actors, and procedures visible and exchangeable, while leaving others difficult to represent or integrate. Bowker and Star's work on classification is helpful in this respect: data infrastructures depend on classifications, and classifications are never neutral.[39] They organize work, distribute responsibility, and shape what can be known and acted upon. In judicial data infrastructures, this classificatory work has particular significance because it may affect procedural rights, institutional accountability, and access to justice.

The paper uses the term assemblage in this limited and pragmatic sense. Drawing on DeLanda's understanding of assemblages as contingent configurations of heterogeneous elements, whose relations generate emergent properties without eliminating the relative autonomy of their components,[40] the EJDS is understood here as an evolving assemblage whose components retain different origins, functions, and degrees of autonomy, while their interaction may generate new infrastructural capacities, dependencies, and constraints. In the field of digital government, Lanzara similarly uses the language of assemblages to show how digital institutions emerge through the combination and recombination of organizational routines, legal arrangements, technologies, and institutional practices.[41] This perspective is particularly relevant to European digital justice, where infrastructures such as e-CODEX have developed through incremental alignment, adaptation, and reconfiguration among distributed actors and systems.[42]

In this paper, however, assemblage is not treated as a separate theoretical framework. It is used as a descriptive and analytical concept within information infrastructure theory to capture the composite and evolving character of the EJDS. The term helps avoid treating the EJDS as either a purely technical platform or a purely legal reform. It highlights instead that the data space will be made through the gradual alignment

38 Geoffrey C. Bowker and Susan Leigh Star, *Sorting Things Out: Classification and Its Consequences* (Cambridge, MA: The MIT Press, 1999); Star and Ruhleder, "Steps Toward an Ecology of Infrastructure."

39 Bowker and Star, *Sorting Things Out*.

40 Manuel DeLanda, *A New Philosophy of Society. Assemblage Theory and Social Complexity* (Continuum: Bloomsbury Publishing, 2006).

41 Giovan Francesco Lanzara, "Building Digital Institutions: ICT and the Rise of Assemblages in Government," in *ICT and Innovation in the Public Sector: European Studies in the Making of E-Government*, ed. Francesco Contini and Giovan Francesco Lanzara (Basingstoke: Palgrave Macmillan, 2009), 9–48.

42 Velicogna, "History of a Digital Institution in the Making"; Marco Velicogna, "Coming to Terms with Complexity Overload in Transborder e-Justice: The e-CODEX Platform," in *The Circulation of Agency in E-Justice: Interoperability and Infrastructures for European Transborder Judicial Proceedings*, ed. Francesco Contini and Giovan Francesco Lanzara (Dordrecht: Springer, 2014), 309–35.

of components that differ in origin, function, stability, and authority, and whose interactions may reshape the infrastructure over time.

This understanding of assemblage is consistent with studies of digital public infrastructures that emphasize cultivation rather than top-down design and implementation. Lanzara shows that digital institutions often emerge through bricolage, layering, adaptation, and reconfiguration rather than linear implementation.[43] Resca, Grisot, and Velicogna, in their study of e-prescriptions as part of smart service provisions in healthcare, similarly show that smart public services depend on infrastructural arrangements that must be built across organizations, technologies, and institutional practices.[44] Their analysis is useful beyond the healthcare domain because it demonstrates that public-sector data infrastructures cannot be reduced to technical integration. They require the gradual construction of shared meanings, responsibilities, routines, and governance capacities.[45] Applied to the EJDS, this framework leads to a more grounded analysis of the European judicial data infrastructures. For example, e-CODEX can be examined as an example of federated and negotiated interoperability, where Member States remain connected through common standards, while retaining control over national systems. ECRIS/ECRIS-TCN can be analyzed as a more standardized model, built around a narrower legal purpose and more predefined data exchange requirements. JUDEX can be examined as a service-based infrastructure for supporting solely digital exchanges across judicial cooperation instruments. Together, these examples do not provide a blueprint for the EJDS. Rather, they reveal different infrastructural trajectories and show the kind of choices, constraints, and governance problems that the EJDS is likely to inherit.

The theoretical contribution of this framework is therefore modest but precise. It conceptualizes the EJDS as an information infrastructure in the making, assembled from existing legal, organizational, and technical components, and evolving through processes of alignment, adaptation, and institutionalization.[46] This allows the analysis to move beyond the idea of interoperability as a technical endpoint and to examine it instead as an ongoing process of infrastructural work. The central issue is not only how judicial data can circulate across borders, but how such circulation can be made legally meaningful, organizationally sustainable, and compatible with the normative commitments of justice.

4. METHODOLOGY AND CASE MATERIAL

Approaching the EJDS as an emerging information infrastructure requires a research strategy capable of examining together legal, technical, organizational, and governance arrangements. The present study adopts a qualitative and interpretive

43 Lanzara, "Building Digital Institutions"; Giovan Francesco Lanzara, "Between Transient Constructs and Persistent Structures: Designing Systems in Action," *The Journal of Strategic Information Systems* 8, no. 4 (1999): 331–49.

44 Andrea Resca, Miria Grisot, and Marco Velicogna, "Building Smarter Healthcare for Smart Cities: Investigating the Infrastructural Dimension of Smart Services Provision through an e-Prescription Case Study," in *Setting foundations for the Creation of Public Value in Smart Cities* edited by Manuel Pedro Rodriguez Bolivar, (Switzerland: Springer International Publishing, 2019), 117–35.

45 Ibid.

46 Hanseth and Monteiro, *Understanding Information Infrastructure*; Lanzara, "Building Digital Institutions"; Lanzara, "Between Transient Constructs and Persistent Structures"; Star and Ruhleder, "Steps Toward an Ecology of Infrastructure".

approach grounded in desk research and selective analysis of existing judicial (data) infrastructures. It does not aim to provide a comprehensive technical evaluation or an empirical assessment of system performance. Its purpose is more limited: to reconstruct how the EJDS may develop from an installed base of existing European and national e-justice initiatives, and to identify the infrastructural choices, constraints, and governance issues that such a development is likely to involve.

The analysis draws on policy documents, legal instruments, technical documentation, project materials, scholarly literature, and evaluation reports concerning European data spaces and digital justice. These sources are used to examine how the legal, organizational, and technical conditions for a possible EJDS may take shape. To ground the conceptual discussion, the paper focuses on three illustrative infrastructural examples: e-CODEX, ECRIS/ECRIS-TCN, and JUDEX. The choice is strategic rather than statistically representative: each example illustrates a different infrastructural trajectory within European digital justice: federated interoperability, standardized data exchange, and modular service-oriented implementation. The analysis of these examples is not based on new primary data collection. It relies on publicly available documentation, project outputs, legal and policy materials, scholarly studies, and in the case of e-CODEX, empirical insights from embedded research conducted by scholars involved in the infrastructure's development and governance processes.[47] This combination of sources makes it possible to reconstruct how these infrastructures were conceived, developed, governed, adapted, and institutionalized over time.

The cases are analyzed through the information infrastructure framework developed in Section 3. The analysis focuses on four dimensions: first, the installed base on which each infrastructure builds; second, the model of interoperability it embodies; third, the governance arrangements and institutional responsibilities it establishes; and fourth, the tensions or constraints it reveals for the future development of the EJDS. The DSSC building blocks are used only as a practical reference for identifying relevant organizational, governance, legal, and technical dimensions of data spaces, not as an additional theoretical framework.

The methodological ambition of this section is therefore deliberately limited. It does not claim that e-CODEX, ECRIS/ECRIS-TCN, and JUDEX provide a complete empirical basis for predicting the EJDS developments. Rather, it uses these cases as instructive examples of infrastructural development in European digital justice. They make visible the kinds of legal, semantic, organizational, and technical work that the EJDS will likely require if it is to become a sustainable and accountable judicial data infrastructure.

5. ANALYSIS: INFRASTRUCTURAL TRAJECTORIES TOWARD THE EJDS

The EJDS cannot be approached as a singular system or a stable technological artefact. Building on the information infrastructure framework developed above, this section analyses the EJDS as an emerging infrastructure likely to develop from an installed base of existing legal instruments, technical standards, organizational arrangements, and digital justice systems. The focus is not on predicting a final architecture, but on identifying the infrastructural trajectories from which the EJDS may draw.

47 Velicogna, "History of a Digital Institution in the Making"; Velicogna et al., "Connecting EU Jurisdictions".

Seen through this lens, the EJDS is likely to grow from existing components, each of which has its own history, governance model, technical logic, and institutional politics. What may appear as technical innovation is therefore better understood as a process of layering, adaptation, realignment, and reuse, in which earlier choices both constrain and enable future possibilities.[48]

The section examines three illustrative infrastructural examples: e-CODEX, ECRIS/ECRIS-TCN, and JUDEX. Each reveals a different model of interoperability and a different mode of infrastructural development. Together, these examples show how the EJDS is likely to evolve through the connection and reconfiguration of existing components rather than through implementation from a single blueprint.

5.1. E-CODEX: NEGOTIATED INTEROPERABILITY AND CULTIVATED INFRASTRUCTURE

e-CODEX offers an important example of infrastructure as a negotiated and cultivated arrangement. Initially conceived in 2010 as part of an EU co-funded project, deployed by piloting Member States from 2013, and later formalized by Regulation (EU) 2022/850,[49] e-CODEX provides a federated infrastructure for cross-border judicial communication. Its trajectory reveals the difficulty of developing common digital procedures across legal systems that vary in procedural rules, terminology, organizational arrangements, and technical capacities.[50]

Originally, e-CODEX was created as a software solution to facilitate the cross-border electronic exchange of data in civil and criminal judicial cooperation. In its early form, it consisted of two main software elements: a gateway for exchanging messages with other gateways, and a connector providing functions related to the exchange of messages between national IT systems. The gateway was based on eDelivery, a building block of the Connecting Europe Facility maintained by the European Commission. The connector supported functions such as electronic signature verification, message handling, and proof of delivery. This architecture allowed Member States to connect existing national systems to a common cross-border exchange layer without requiring the replacement of domestic infrastructures.

From the beginning, however, e-CODEX was not only a technical messaging system. It also involved the development of procedural and semantic assets. Data schemas for digital forms were created for specific civil and criminal procedures, and business process models and XML data structures were developed to support common interpretation of exchanged data across countries. These semantic assets were developed for several civil and criminal justice use cases, including European civil procedures, criminal mutual assistance instruments, registers interconnection, and

48 Hanseth and Monteiro, *Understanding Information Infrastructure*; Lanzara, "Between Transient Constructs and Persistent Structures"; Contini and Lanzara, *Circulation of Agency in E-Justice*; Velicogna, "History of a Digital Institution in the Making."

49 Regulation (EU) 2022/850 on a computerised system for the cross-border electronic exchange of data in the area of judicial cooperation in civil and criminal matters (e-CODEX system), and amending Regulation (EU) 2018/1726, OJ L 150, 1.6.2022: 1–19.

50 Velicogna, "Coming to Terms with Complexity Overload"; Velicogna, "History of a Digital Institution in the Making"; Velicogna & Steigenga, "Can Complexity Theory Help Understanding Tomorrow e-Justice?."

maintenance obligations.[51] In this sense, e-CODEX illustrates that interoperability requires more than secure message transmission. It also requires agreement on the meaning, structure, and procedural use of the data being exchanged.

The Circle of Trust agreement was a crucial non-technical component of this arrangement. It supported legally valid communication among participating authorities by enabling mutual recognition of electronic data, documents, and signatures before e-CODEX was formally institutionalized under Regulation (EU) 2022/850. This trust arrangement shows that the infrastructure depended not only on software components, but also on legal and organizational commitments among participants.[52]

Regulation (EU) 2022/850 formalized e-CODEX as a decentralized and interoperable system for cross-border communication in judicial cooperation. Under the Regulation, the system is composed of e-CODEX access points, digital procedural standards, supporting software products, documentation, and related assets. Each access point includes a gateway and a connector. The gateway enables secure exchange of information with other gateways using common protocols. The connector links national systems to the gateway and supports functions such as message structuring, logging, integrity verification, authenticity checks, and the creation of time-linked evidence of receipt. The system is now progressively extended to support cross-border cooperation instruments in civil, commercial, and criminal matters.

The governance trajectory of e-CODEX is equally significant. Before its handover to the European Union Agency for the Operational Management of Large-Scale IT Systems in the Area of Freedom, Security and Justice (eu-LISA), e-CODEX was managed by a consortium of Member States and organizations with EU program funding. This project-based arrangement allowed experimentation, piloting, and gradual alignment among participating actors, while also raising questions about the long-term governance of the European e-Justice community and the sustainability of cross-border digital justice infrastructures.[53] The transfer to eu-LISA marked a shift from project-based governance to formal institutionalization. It also responded to the need for long-term sustainability, maintenance, and coordination of the infrastructure beyond the original project setting.

The development of e-CODEX reveals a persistent tension between centralization and decentralization in EU digital justice. On the one hand, e-CODEX provides a shared technical and semantic layer for cross-border judicial communication. On the other hand, it remains federated rather than unified, relying on national access points, domestic systems, and trust mechanisms. This architecture reflects the need to respect Member State autonomy while still enabling common procedures and reliable exchange. e-CODEX also reveals the limits of standardization in a legally plural environment. Procedural harmonization through shared forms, common standards,

51 These use cases include, among others, the European Small Claims Procedure, the European Order for Payment procedure, the European Account Preservation Order, the transmission of Mutual Legal Assistance requests and European Investigation Orders, mutual recognition of financial penalties, the Interconnection of Insolvency Registers, the Business Registers Interconnection System, and cross-border recovery of maintenance obligations under the EU 2009 Maintenance Regulation and the 2007 Hague Child Support Convention.

52 Velicogna and Steigenga, "Can Complexity Theory Help Understanding Tomorrow e-Justice?".

53 Taal et al., "Connecting the European e-Justice Community."

and digital procedural models can support cross-border cooperation, but it must still interact with diverse national procedural systems and organizational practices.[54]

From an information infrastructure perspective, e-CODEX is best understood as a cultivated infrastructure rather than a system designed and implemented once and for all. Its development occurred through phased pilots, experimental interoperability, iterative realignments, and gradual institutionalization. Delays, renegotiations, and reversals were not simply implementation failures. They were part of the infrastructural work required to align legal meanings, technical components, governance arrangements, and national systems across a distributed European legal environment.

The e-CODEX trajectory also shows that governance ambiguity is not incidental to infrastructure development. Questions concerning responsibility for updates, interpretation of standards, data protection compliance, and long-term maintenance became part of the work of stabilizing the infrastructure. For the EJDS, this suggests that governance arrangements must be designed not only for technical operation, but also for managing uncertainty, institutional diversity, and future adaptation.

For the EJDS, e-CODEX illustrates the possibilities and limits of federated interoperability. Its installed base consists of gateways, connectors, procedural standards, semantic assets, trust arrangements, and national systems. Its interoperability model preserves Member State autonomy while requiring common protocols and mutual recognition mechanisms. Its governance trajectory, from project consortium to eu-LISA, shows how experimental infrastructures can become institutionalized over time. At the same time, e-CODEX reveals the costs of such a model: alignment is gradual, implementation is uneven, and legal, semantic, and organizational differences remain persistent sources of complexity.

5.2. ECRIS: STRUCTURED DATA EXCHANGE AND THE LIMITS OF UNIFORMITY

The European Criminal Records Information System (ECRIS), operational since 2012, represents a different infrastructural trajectory from e-CODEX.[55] While e-CODEX developed as a federated infrastructure for cross-border judicial communication across multiple procedures, ECRIS was designed for a more narrowly defined purpose: the structured exchange of information on criminal convictions between Member States. Anchored in strong legal mandates and common data categories, it illustrates a more standardized model of judicial data exchange.[56]

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54 Onțanu, "Adapting Justice to Technology and Technology to Justice"; Velicogna, "History of a Digital Institution in the Making."

55 ECRIS was established by Council Decision 2009/316/JHA of 6 April 2009 on the establishment of the European Criminal Records Information System (ECRIS) in application of Article 11 of Framework Decision 2009/315/JHA, OJ L 93, April 7, 2009, 33–48. Framework Decision 2009/315/JHA set out the organisation and content of the exchange of information extracted from criminal records between Member States, OJ L 93, April 7, 2009: 23–32.

56 Before ECRIS was established, national courts and competent authorities could face difficulties obtaining reliable information about previous convictions handed down in other Member States. ECRIS was intended to make such information available in a structured, timely, and comparable form, so that previous convictions could be taken into account in new criminal proceedings where legally relevant.

ECRIS is a decentralized IT system based on national criminal-record databases. It allows central authorities in Member States to exchange information extracted from national criminal records through interconnecting software, common protocols, and a common communication infrastructure using an encrypted network. National authorities do not have direct online access to criminal-record databases in other Member States. Instead, the system enables structured communication between designated authorities, while each Member State remains responsible for maintaining its own criminal-record database. Member States use common codes for categories of offences and sanctions when exchanging information, while the European Commission provides general support, technical assistance, reference implementation software, and support for the common communication infrastructure.

The 2019 amendments introduced by Directive (EU) 2019/884 altered this governance and technical arrangement by assigning responsibility for the provision, further development, and maintenance of the ECRIS reference implementation to eu-LISA, while the European Commission continued to be responsible for the common communication infrastructure.[57] This shift is significant from an infrastructural perspective because it shows how a system initially organized around cooperation between national authorities and Commission support became increasingly embedded in the EU's broader architecture for large-scale information systems.

ECRIS primarily facilitates the exchange of criminal-record information concerning EU nationals. Its original architecture was less effective for identifying previous convictions of third-country nationals, because Member States had to be contacted individually to determine whether relevant conviction information existed. This limitation led to the development of ECRIS-TCN, a centralized system designed to identify which Member States hold conviction information on third-country nationals and stateless persons.[58] The existing decentralized exchange procedure remains relevant: after ECRIS-TCN identifies the Member State or Member States holding relevant information, conviction data can be requested and exchanged through the established ECRIS channels.

ECRIS-TCN is designed to operate with the interoperability components established under Regulation (EU) 2019/818: the European Search Portal (ESP), the shared Biometric Matching Service (sBMS), the Common Identity Repository (CIR), and

57 Directive (EU) 2019/884 amending Framework Decision 2009/315/JHA as regards the exchange of information on third-country nationals and the European Criminal Records Information System, and replaced Council Decision 2009/316/JHA, OJ L 151, June 7, 2019: 143–150. It also adjusted the institutional responsibilities for the ECRIS reference implementation. eu-LISA's governance structure includes a Management Board, an Executive Director, and Advisory Groups focusing on specific large-scale IT systems. For major development projects, temporary governance bodies such as Programme Management Boards may also be established. These arrangements matter because they shape how technical development, Member State participation, and EU-level operational management are coordinated.

58 ECRIS-TCN was established by Regulation (EU) 2019/816 establishing a centralised system for the identification of Member States holding conviction information on third-country nationals and stateless persons to supplement ECRIS, and amending Regulation (EU) 2018/1726, OJ L 135, 22.5.2019: 1–26.

the Multiple-Identity Detector (MID).[59] The ESP enables authorized users to search several EU information systems through a single interface. The sBMS supports the comparison and matching of biometric data. The CIR stores identity data needed to support reliable identification of third-country nationals. The MID helps detect whether the same person is recorded under multiple identities across different EU systems. These components link ECRIS-TCN to the broader EU interoperability framework used in the fields of border management, migration, asylum, police cooperation, and judicial cooperation. This framework also connects systems such as the Schengen Information System (SIS), the Visa Information System (VIS), Eurodac, the Entry/Exit System (EES), and the European Travel Information and Authorisation System (ETIAS).[60]

Because ECRIS-TCN depends on both updates to the existing ECRIS framework and integration with these EU interoperability components, its development has been postponed and is expected to become operational in 2026.[61] This delay is analytically relevant because it shows that standardized infrastructures are not necessarily simple infrastructures. Even when the legal purpose is clearly defined and the data categories are more bounded than in other domains of justice, implementation depends on coordination among legal mandates, national databases, EU agencies, technical interoperability components, and institutional responsibilities.

ECRIS and ECRIS-TCN therefore illustrate a standardization-driven model of judicial data infrastructure. Interoperability is pursued through predefined categories, common codes, specified transmission protocols, and clear legal mandates. This model can support relatively reliable exchange where the domain is narrow and the data categories are clearly defined. Its limits become visible in practice when national differences in recording convictions, classifying offences, or using criminal-record information must be reconciled. ECRIS-TCN adds a further layer of complexity because it connects national judicial data exchange with EU information systems originally developed for border, migration, asylum, and security purposes.

This standardization-driven model differs from the federated model illustrated by e-CODEX. ECRIS/ECRIS-TCN does not aim to support a broad range of judicial procedures through adaptable communication channels. It focuses on a specific category of judicial information and seeks to make its exchange more uniform, reliable, and efficient. This gives the infrastructure a degree of stability, but also limits its

59 Regulation (EU) 2019/818 established a framework for interoperability between EU information systems in the field of police and judicial cooperation, asylum and migration. The European Search Portal enables authorized users to query multiple EU information systems through a single interface; the shared Biometric Matching Service supports biometric matching; the Common Identity Repository stores identity data of third-country nationals; and the Multiple-Identity Detector helps identify possible links or inconsistencies between identities recorded in different EU systems. Regulation (EU) 2019/818, OJ L 135, 22.5.2019: 85–135.

60 These systems support different EU policy areas, including border management, migration, asylum, visa policy, police cooperation, and security. Their connection through the interoperability framework is relevant here because ECRIS-TCN becomes part of a broader data environment extending beyond judicial cooperation alone.

61 The postponement is linked to the technical and organizational dependencies between ECRIS-TCN, the updated ECRIS framework, and the broader interoperability architecture managed by eu-LISA.

flexibility. The narrower the domain and the more clearly defined the data categories, the more feasible standardization becomes. Conversely, the more heterogeneous the legal domain, the more difficult it becomes to rely on a single predefined data model.

For the EJDS, ECRIS/ECRIS-TCN show both the value and the limits of standardization. Their installed base consists of national criminal-record databases, central authorities, common offence and sanction categories, reference implementation software, and EU interoperability components. Their interoperability model is more rule-bound than e-CODEX and depends on predefined categories and tightly specified exchange mechanisms. This can produce efficiency and legal certainty in a narrow domain, but it is less easily transferable to broader areas of civil, commercial, or administrative justice, where legal meanings and procedural roles are more diverse.

5.3. JUDEX: MODULARITY AND FOCUS ON SERVICES

JUDEX illustrates a third infrastructural trajectory within European digital justice. Whereas e-CODEX provides a federated backbone for cross-border judicial communication, and ECRIS/ECRIS-TCN supports standardized exchange of a defined category of criminal justice data, JUDEX develops a modular and service-oriented model for digital judicial cooperation. Its relevance to the EJDS lies in the way it combines common software components, reusable services, and use-case-specific implementation across different judicial cooperation instruments.

The origins of JUDEX can be traced to the Council Conclusions on improving criminal justice in cyberspace of 9 June 2016, in which the Council of the European Union requested the European Commission to develop a secure online portal for electronic requests and responses and the corresponding procedures. The aim was to increase the efficient use of mutual assistance procedures and standardized forms for obtaining electronic evidence. In response, a reference implementation portal was prepared as a secure EU-wide solution for communicating electronic requests and responses concerning e-evidence and related procedures. It was intended to support functions such as the use of standardized forms, optional automated translation, and the tracking and tracing of requests and responses.

The Commission established an expert working group with legal and technical representatives from each Member State and the General Secretariat of the Council of the European Union. Its task was to discuss, review, and agree on the future system's requirements, the legal procedures it would support, and technical specifications. The expert group established, among other aspects, that the initial scope of the future e-Evidence Digital Exchange System (eEDES) would be exchanges of European Investigation Orders and mutual legal assistance requests between competent authorities.

eEDES adopted a decentralized architecture. All software components and databases were installed and run by each Member State, and no exchanged data was stored or managed centrally. The system enabled end users to access a reference implementation portal in their national language, allowing EU judicial authorities to complete digital European Investigation Order and mutual legal assistance forms, sign them electronically, send and receive them as messages, and attach documents where needed. The system relied on a central database of competent authorities, compiled from data provided by the Member States, and reused several IT building blocks developed and maintained by the European Commission, including the EU User

Interface, eDelivery,[62] EU Login,[63] eSignature,[64] eTranslation,[65] and ISA eDocuments.[66] National installations of the reference implementation portal were interconnected through e-CODEX, which served as the technological backbone for cross-border electronic exchange of data in civil, commercial, and criminal judicial cooperation. eEDES was officially launched in December 2019 and remained in piloting mode for European Investigation Orders, mutual legal assistance requests, and associated evidence in digital format.

The development of JUDEX builds on the eEDES experience. The Digitalisation Regulation mandates the European Commission to develop reference implementation software that Member States may use instead of a national IT system for the digitalization of judicial cooperation use cases under the Regulation. The existing software was developed on the basis of eEDES and is intended to standardize cooperation processes, secure data transmission, and ensure the integrity and authenticity of exchanged judicial documents. Given the expanded scope, the reference implementation software and national solutions used under the relevant judicial cooperation instruments are now known as the JUstice Digital EXchange system, or JUDEX.

JUDEX is designed around a modular setup. The software is packaged and delivered separately from e-CODEX components needed to connect JUDEX to the decentralized IT system. This allows Member States to reuse or enhance their existing national judicial communication infrastructures for cross-border purposes. JUDEX is intended to offer core features and services across multiple use cases, while adopting a staggered implementation approach based on gradual digitalization and a "digital-ready instruments first" approach. Within JUDEX, the development of each new use case is expected to follow an expert-group model, combining legal and technical input from Member States and EU-level actors.

The first mandatory exchanges supported by JUDEX were conducted for service of documents and taking of evidence under Regulations as of May 2025.[67] Regulation (EU) 2023/1543 becomes applicable on 18 August 2026, with the European

62 eDelivery is a content-agnostic building block, developed and maintained by the European Commission, that provides technical specifications and standards, installable software, and ancillary services to allow projects to create a network of nodes for secure digital data exchange, https://ec.europa.eu/digital-building-blocks/sites/spaces/DIGITAL/pages/467110114/eDelivery.

63 EU Login is the European Commission's user authentication service. It allows authorized users to access a wide range of Commission web services and websites, using a single email address and password. EU Login implements the single sign-on functionality.

64 eSignature is a set of free standards, tools and services that help public administrations and businesses accelerate the creation and verification of electronic signatures that are legally valid in all European Member States, https://ec.europa.eu/digital-building-blocks/sites/spaces/DIGITAL/pages/467109036/eSignature.

65 eTranslation is an automated translation tool, developed by the European Commission, available to translate text excerpts or complete documents between more than 24 languages.

66 The e-Documents building block provides solutions to handle electronic documents in a way that ensures cross-border interoperability and data security and integrity, in line with the European interoperability programs (ISA) requirements.

67 Regulation (EU) 2020/1784 concerns the service in the Member States of judicial and extrajudicial documents in civil or commercial matters (service of documents) (recast), OJ L 405, December 2, 2020: 40–78. Regulation (EU) 2020/1783 on cooperation between the courts of the Member States in the taking of evidence in civil or commercial matters (taking of evidence) (recast), OJ L 405, December 2, 2020: 1–39.

Production Order and the European Preservation Order to be implemented through JUDEX from that date.[68] The first batch of judicial cooperation instruments under the Digitalisation Regulation is expected to go live in 2028. All twenty-four judicial cooperation instruments mentioned by the Digitalisation Regulation are expected to become part of JUDEX by 2031. DigitalJustice@2030 further presents JUDEX as central to the possible full digitalization of cross-border proceedings in civil and commercial matters.[69]

JUDEX therefore shows how modularity can support gradual infrastructural expansion. By reusing common services and software components across different procedures, it lowers the need to design each digital exchange mechanism from scratch. At the same time, delays in national adoption of reference implementation software are common, often resulting from the complexity of integrating decentralized EU-level digital systems into existing national judicial infrastructures. Although the European Commission provides the software, Member States may face technical adaptations, legal constraints, or preferences for maintaining proprietary systems. JUDEX is no exception: delays were already present for the service of documents and taking of evidence procedures in 2025 and are expected again in relation to the European Production Order and European Preservation Order in 2026. Yet its relative simplicity and modular design provide space for adaptation to national specificities, including adjustable settings and the integration of application programming interfaces.

JUDEX therefore illustrates a different infrastructural trajectory from both e-CODEX and ECRIS/ECRIS-TCN. It does not primarily create a general-purpose interoperability backbone, as e-CODEX does, nor does it rely on the tightly bound standardization of a specific dataset, as in ECRIS. Rather, it operationalizes interoperability through modular services and use-case-specific implementation. Its significance for the EJDS lies in this service-oriented model: common components can be reused across procedures, while Member States retain space to connect them to national systems and practices. At the same time, the gradual expansion of JUDEX across multiple judicial cooperation instruments shows that modularity does not eliminate infrastructural complexity. Each new use case requires further legal, semantic, organizational, and technical alignment.

5.4. TOWARD AN ASSEMBLAGE VIEW OF THE EJDS

The three analyzed examples show that if developed, the EJDS is unlikely to follow a single architectural model or governance principle. It is more likely to emerge as an assemblage of partial infrastructures, shaped by different models of interoperability, different governance arrangements, and different degrees of standardization, modularity, and institutionalization (as shown in Table 1).

Taken together, e-CODEX, ECRIS/ECRIS-TCN, and JUDEX confirm the relevance of the installed-base perspective for understanding the development of the EJDS. The EJDS will not be built once and for all, nor will it emerge from a single design. If built, it will likely develop through a process of layering, adaptation, and recombination of

68 Regulation (EU) 2023/1543 establishes European Production Orders and European Preservation Orders for electronic evidence in criminal proceedings and for the execution of custodial sentences following criminal proceedings, OJ L 191, July 28, 2023: 118–180.

69 Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, DigitalJustice@2030, COM(2025) 802 final, Brussels, 20 November 2025.

existing legal instruments, technical standards, software components, governance arrangements, and national systems. This also means that the EJDS will inherit unresolved tensions from earlier infrastructures: between standardization and legal diversity, central coordination and national autonomy, technical efficiency and procedural fairness, and reuse of data and protection of rights.

The implication is that the EJDS should be governed as an evolving infrastructure rather than as a finished system. Its development will require continuous maintenance, semantic work, institutional coordination, and mechanisms for accountability. Understanding the EJDS therefore means attending not only to its technical architecture, but also to the legal and organizational arrangements through which judicial data are made meaningful, trustworthy, and usable across jurisdictions.

EXAMPLE	INSTALLED BASE	INTEROPERABILITY MODEL	GOVERNANCE	EJDS LESSONS
e-CODEX	Gateways, connectors, digital procedural standards, semantic assets, Circle of Trust, national systems	Federated and negotiated interoperability	Initially project consortium and participating Member States, later institutionalized under eu-LISA	Interoperability requires trust arrangements, semantic alignment, gradual institutionalization, and long-term maintenance
ECRIS/ECRIS-TCN	National criminal-record databases, central authorities, common offence and sanction categories, reference implementation software, EU interoperability components	Standardized and rule-bound data exchange	Member States, European Commission, and eu-LISA	Standardization can support efficiency and legal certainty in narrow domains, but is harder to generalize across legally diverse areas
JUDEX	eEDES, e-CODEX, EU building blocks, reference implementation software, national judicial communication infrastructures	Modular and service-oriented interoperability	European Commission, Member State expert groups, national authorities, and connection through e-CODEX	Modularity supports reuse across procedures, but each use case still requires legal, semantic, organizational, and technical adaptation

Table 1 Infrastructural trajectories relevant to the EJDS.

6. DISCUSSION: LESSONS FOR GOVERNING THE EJDS

The preceding analysis shows that existing European digital justice infrastructures offer important lessons for how the EJDS could be governed, developed, and assessed.

6.1. JUSTICE DATA SPACES AS INFRASTRUCTURES, NOT SYSTEMS

A first lesson provided by the case studies is that justice data spaces should be understood as infrastructures rather than as static or singular systems. As Hanseth and Monteiro argue, information infrastructures evolve over time, grow from an

installed base, and become useful only when they are embedded in organizational practice.[70] The EJDS, if developed, although framed in EU policy discourse as part of a broader move towards data spaces and digital justice, is unlikely to emerge from a single design or implementation process. It will be a layered extension of existing systems, some already mature and institutionalized, others still experimental, unevenly adopted, or under development.

This has important consequences for governance and design. Treating the EJDS as an infrastructure means recognizing that it must work with existing institutional complexity rather than attempting to eliminate it. e-CODEX shows the importance of federated arrangements that preserve national autonomy while enabling cross-border communication. ECRIS/ECRIS-TCN shows the value of standardization in a narrow and legally defined domain, but also its limits when data categories and institutional uses become more complex. JUDEX shows how modularity may support reuse across different procedures while still requiring adaptation to national systems and procedural settings. These examples suggest that the EJDS should be designed and governed incrementally, with attention to the diversity of legal traditions, administrative capacities, and existing technical infrastructures across Member States.

6.2. INTEROPERABILITY AS ALIGNMENT, NOT ONLY STANDARDIZATION

A second lesson concerns the meaning of interoperability. In digital justice policy, interoperability is often presented as a matter of secure and efficient data exchange. The three cases show that this is only part of the issue. Judicial interoperability also requires legal, semantic, organizational, and institutional alignment. It depends on whether the actors involved share sufficient understanding of what data categories mean, how they may be used, who is responsible for them, and what legal consequences follow from their circulation.

The comparison between e-CODEX, ECRIS/ECRIS-TCN, and JUDEX illustrates different ways of approaching this problem. e-CODEX relies on common protocols, tools, procedural standards, semantic assets, and trust arrangements to enable communication across decentralized national systems. ECRIS/ECRIS-TCN leans heavily on predefined categories, common codes, and tightly specified data exchange mechanisms. JUDEX depends on modular software and reusable services to support different judicial cooperation instruments. None of these models provides a complete solution for the EJDS. Rather, each addresses a different dimension of interoperability that the EJDS could integrate.

For the EJDS, this suggests that standardization will be necessary but insufficient. Common standards, metadata schemas, data models, and procedural forms can support interoperability, but they cannot by themselves resolve differences in legal meaning, procedural practice, institutional responsibility, or national implementation capacity. The EJDS will therefore require spaces and mechanisms for continuing semantic and institutional work. Data categories, ontologies, access rules, and procedural standards should be treated as living components of the infrastructure, maintained and revised by actors who understand the legal and administrative contexts in which they operate.

70 Hanseth and Monteiro, *Understanding Information Infrastructure*.

6.3. GOVERNANCE THROUGH CULTIVATION AND ADAPTATION

A third lesson is that governance should be understood as cultivation rather than top-down implementation. Large-scale justice infrastructures cannot simply be imposed from above. They must be extended, maintained, adjusted, and institutionalized over time. This is particularly important in the EU legal context, where subsidiarity, procedural autonomy, legal diversity, and national administrative capacities remain central features of the institutional landscape.

The trajectory of e-CODEX is especially instructive. Its movement from pilot project to Regulation (EU) 2022/850 and then to eu-LISA shows how experimental infrastructures can become formalized and institutionalized. At the same time, this process also shows that institutionalization does not remove the need for adaptation. Standards must be updated, semantic assets maintained, trust arrangements preserved, and national systems connected in ways that remain legally and technically reliable.

JUDEX reinforces this point from a different angle. Its modular design may lower implementation barriers and support reuse across different judicial cooperation instruments, but each new use case still requires legal, semantic, organizational, and technical alignment. Modularity may make infrastructural expansion more manageable, but it does not eliminate the work of implementation. For building the EJDS, governance mechanisms should therefore be modular, participatory, and adaptive. They should support common coordination while preserving space for national legal and organizational specificities.

6.4. GOVERNANCE, RESPONSIBILITY, AND ACCOUNTABILITY

The construction of judicial data infrastructures also redistributes responsibility and institutional control. Decisions about standards, access rights, data quality, authentication, semantic categories, software components, and maintenance arrangements are not purely technical. They shape who can participate, who bears responsibility, and how accountability is allocated across EU institutions, Member States, agencies, courts, competent authorities, technology providers, and professional users.

The three cases show different configurations of responsibility. e-CODEX combines national access points, common protocols, trust arrangements, and eu-LISA governance. ECRIS/ECRIS-TCN combines national criminal-record databases, central authorities, common categories, Commission responsibilities, and eu-LISA's role in large-scale IT systems. JUDEX combines Commission-provided reference implementation software, Member State implementation choices, expert-group coordination, and connection through e-CODEX. These arrangements show that the EJDS will not have a single center of control. It will require distributed governance capable of clarifying responsibilities across multiple levels and actors.

This has direct implications for accountability. A judicial data infrastructure must be accountable not only for system availability or cybersecurity, but also for the legal and procedural consequences of data circulation. Questions of data access, reuse, correction, quality, interpretation, and exclusion are especially sensitive in the justice domain. If the EJDS is to support access to justice and trustworthy judicial cooperation, its governance must make responsibility visible and contestable. This requires transparent decision-making procedures, clear allocation of institutional roles, mechanisms for oversight, and safeguards against the concentration of control in opaque technical forums or underregulated private arrangements.

6.5. TEMPORALITY, MAINTENANCE, AND EVOLUTION

A final lesson concerns time. If established, the EJDS should not be treated as a final destination or as a system that can be completed once and for all. The examples analyzed in Section 5 show that digital justice infrastructures evolve through pilots, delays, legal amendments, technical upgrades, organizational realignments, and institutional transfers. e-CODEX developed over more than a decade before becoming formally institutionalized. ECRIS-TCN shows that even a relatively standardized infrastructure can be delayed when it depends on broader interoperability components and updates to existing systems. JUDEX shows that modular expansion across multiple instruments requires staged implementation and repeated adaptation.

This temporal dimension matters for governance. Policy agendas often present digital justice infrastructures through future-oriented promises: seamless cross-border cooperation, efficient data exchange, improved access to justice, and better reuse of legal and judicial data. These promises can mobilize investment and coordination, but they can also obscure the ongoing work needed to sustain infrastructures. Maintenance, semantic updating, legal revision, user support, governance review, and institutional learning are not secondary tasks. They are central to infrastructural durability.

For the EJDS, this means that adaptability should be treated as a core governance principle. The infrastructure will have to respond to changes in EU law, national procedural rules, data protection requirements, AI regulation, technological standards, and judicial practice. It should therefore be governed as an evolving infrastructure that requires periodic review, maintenance, and reconfiguration. The challenge is not simply to build the EJDS, but to cultivate its development in ways that preserve trust, accountability, procedural fairness, and public value over time.

6.6. INTERIM IMPLICATIONS FOR THE EJDS

Taken together, the lessons from e-CODEX, ECRIS/ECRIS-TCN, and JUDEX suggest that, if built, the EJDS should be governed as a layered and evolving infrastructure. It will need common standards, but also mechanisms for semantic interpretation. It will need EU-level coordination, but also respect for national legal and organizational diversity. It will need technical services, but also clear legal responsibilities and accountability mechanisms. It will need modularity and reuse, but also long-term maintenance and adaptation.

The EJDS will therefore succeed not merely if it enables data to circulate across borders, but if such circulation remains legally meaningful, institutionally sustainable, and compatible with the normative commitments of justice. Its development should be assessed not only by the extent of technical interoperability achieved, but also by the quality of the governance arrangements, safeguards, and institutional capacities that make judicial data exchange trustworthy and fair.

7. CONCLUSION

This paper has examined the European Judicial Data Space not as a static system to be implemented, but as a potential emerging socio-techno-legal information infrastructure. The central argument has been that the EJDS should not be understood merely as a platform for data exchange, nor as a technical extension of

existing digital justice services. It is better understood as a developing configuration of legal instruments, technical standards, organizational arrangements, governance responsibilities, semantic resources, and existing digital justice systems.

The analysis has shown that the EJDS is likely to develop from an installed base rather than from a single design. This installed base includes previous and emerging EU justice infrastructures, national systems, procedural instruments, technical standards, and legal frameworks for data exchange and digitalization. The examples of e-CODEX, ECRIS/ECRIS-TCN, and JUDEX illustrate different ways in which this installed base may shape a future EJDS. These examples also confirm that interoperability in European digital justice cannot be reduced to technical connectivity. Judicial data does not circulate in isolation from legal meaning, procedural roles, institutional responsibilities, or national legal traditions. Data categories such as cases, parties, decisions, evidence, or convictions are embedded in legal and administrative contexts. Making them interoperable requires the ongoing alignment of meanings, standards, procedures, responsibilities, and safeguards. For this reason, the EJDS should be assessed not only by whether systems can exchange data, but also by whether such exchanges remain legally meaningful, institutionally accountable, and compatible with the normative commitments of justice.

The paper has also argued that the EJDS should be governed as an evolving infrastructure rather than as a finished system. Its development will require cultivation, maintenance, adaptation, and periodic reconfiguration. Common standards and EU-level coordination will be necessary, but they will not be sufficient. The EJDS will also require mechanisms for semantic interpretation, transparent allocation of responsibilities, participatory governance, long-term maintenance, and accountability across multiple levels and actors. The challenge is therefore not only to build the EJDS, but to sustain it as a trustworthy infrastructure across diverse legal systems and institutional settings.

This has important implications for the governance of digital justice in Europe. If the EJDS is to support cross-border cooperation, access to justice, and trustworthy reuse of judicial data, it must preserve a balance between common European coordination and national legal diversity. It must enable data circulation without flattening legal meaning or weakening procedural safeguards. It must also ensure that technical choices concerning standards, access rights, authentication, metadata, and reuse remain open to legal scrutiny and institutional accountability.

The contribution of this paper is therefore conceptual and analytical. Conceptually, it has developed the EJDS as a socio-techno-legal information infrastructure rather than as a discrete digital system or policy label. Analytically, it has shown how existing EU justice infrastructures reveal different trajectories through which such an infrastructure may emerge: federated interoperability, standardized exchange, and modular service provision. Together, these trajectories suggest that the EJDS will be assembled incrementally, through the adaptation and recombination of existing components, rather than implemented according to a single blueprint.

Future research should examine how these infrastructural dynamics would be experienced by the actors who will use, maintain, and be affected by the EJDS. This includes judicial bodies and their staff, legal professionals, competent authorities, public administrations, technology providers, researchers, and citizens. Further work is also needed on the implications of AI integration, private-sector involvement, data

reuse, transparency mechanisms, and safeguards for procedural rights. As judicial systems become increasingly dependent on data infrastructures, the ethical, legal, and organizational stakes of infrastructural design will become more significant.

Ultimately, the EJDS will not succeed merely because it would enable data to move across borders or because it would be formally endorsed by EU policy. It can succeed only if the circulation of judicial data remains trustworthy, accountable, legally meaningful, and compatible with access to justice and procedural fairness. Therefore, the task is not simply to deliver interoperability, but to cultivate a European judicial data infrastructure capable of sustaining public value over time.

COMPETING INTERESTS

Alexandra Tsvetkova and Marco Velicogna have no competing interests to declare.

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