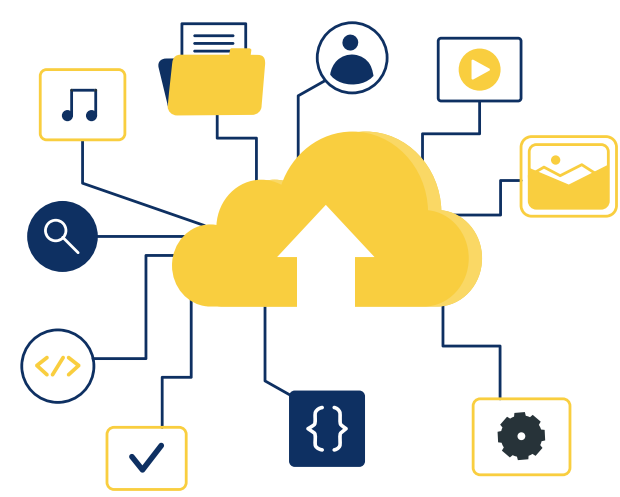


INTEROPERABILITY: THE KEY TO WORKING WITH DATA FROM DIVERSE SOURCES



¿WHAT IS INTEROPERABILITY?

It is the ability of information systems to share data and enable the exchange of information and knowledge between them.

Source: [Royal Decree 4/2010, of 8 January, which regulates the National Interoperability Scheme in the field of Electronic Administration](#)

TYPES AND KEYS TO EFFECTIVE INTEROPERABILITY

Technical interoperability

Systems can exchange data:

- Machine-readable formats: CSV, JSON, XML, RDF, etc.
- Stable, documented, and versioned APIs.
- Non-functional requirements: availability, performance, security, traceability.

Semantic interoperability

Systems understand each other:

- Clear glossaries: definitions, units, rules, examples.
- Controlled vocabularies, taxonomies and ontologies.
- Unique identifiers and standardised reference data.

Organisational interoperability

The processes maintain coherence:

- Clear responsibilities: define, validate, publish, maintain.
- Change management: what changes, how it' is communicated, [how it is versioned](#).
- Incident management: single channel, times, traceability.
- [Operational Commitments \(SLAs\)](#): frequency, quality, maintenance.

Legal interoperability

Data exchange is feasible and compliant:

- Clear licenses and terms of use.
- Compatibility between licenses.
- Compliance with data protection, intellectual property and industry regulations.
- Explicit rules about what can be done.

Source: [European Interoperability Framework \(EIF\)](#).

GLOBAL REGULATORY FRAMEWORK FOR INTEROPERABILITY

European Interoperability Framework (EIF)

Principles and recommendations to improve the interoperability of digital services in European public administration.

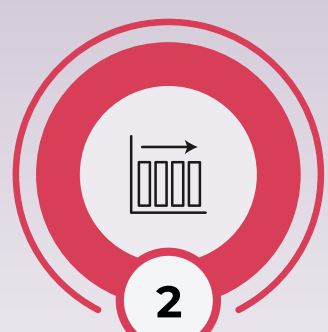
National Interoperability Scheme

Regulatory framework that guarantees technical, semantic and organisational interoperability between Spanish public administrations and with citizens.

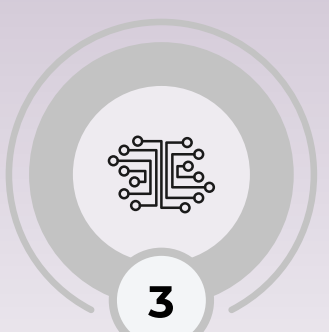
BEST PRACTICES FOR ADDRESSING INTEROPERABILITY



Start by defining the goal



Ensures stable technical minimum



Apply semantics to critical aspects



Establish minimum operating agreements



Pilot with a real case

Source: [Interoperability: The Invisible Art of Connecting Data, Systems, and People](#), datos.gob.es.

INTEROPERABILITY REGULATORY INSTRUMENTS BY SECTOR

OFFICIAL STATISTICS

Technical interoperability

- **SDMX (ISO 17369)**
Global standard for data and metadata exchange.
- **JSON-STAT**
Lightweight format for web visualization and APIs.
- **API**
Automated access points (e.g. ISTAC/Eurostat API).

Semantic interoperability

- **Semantic Assets (ISTAC Model)**
Centralization of DSDs (Data Structure Definitions) and "CodeLists".
- **SIMS**
Quality reporting standard.
- **Vocabularies**
SKOS for thesauri and classifications (CNAE, CNO).

Organizational interoperability

- **GSBPM (Process Model)**
Standardization of production phases (design, collection, dissemination) so that agencies speak the same "process language."
- **GAMSO**
Extension for strategic governance.

Legal interoperability

- **Regulation (EC) 223/2009**
European legal framework.
- **Code of good practice**
Principles of quality.
- **Statistical secrecy**
Strict legal protection of microdata.

SMART CITIES (Smart cities & IoT)

Technical interoperability

- **NGSI-LD**
ETSI standard for real-time context management.
- **IoT protocols**
MQTT, CoAP, LoRaWAN (sensors).
- **Context Brokers**
Central piece (e.g. Orion) that receives and distributes data.

Semantic interoperability

- **Smart Data Models**
Global standardized data models (e.g. attributes of "Container", "Lampost", "Parking Space").
- **SAREF**
Reference Ontology for Household Appliances and Energy.

Organizational interoperability

- **MIMs (OASC)**
Minimum Interoperability Mechanisms to avoid vendor lock-in in public procurement.
- **Open Data Charters**
Openness commitments by default.

Legal interoperability

- **DPIA (impact assessment)**
Process for when treatment may involve high risk (e.g. systematic surveillance of public areas).
- **Ordinances municipal**
Regulation on sensor deployment and privacy.

INDUSTRY 4.0 (IoT & Manufacturing)

Technical interoperability

- **OPC UA (IEC 62541)**
Universal standard for secure machine-to-machine (M2M) communication.
- **TSN (Time Sensitive Networking)**
Networks for limited latency in critical robots/chains.

Semantic interoperability

- **AAS (Asset Administration Shell)**
Standard approach to digitally represent assets (basis for [digital twin](#) in I4.0) and is in the process/series of IEC 63278 standardization.
- **ECLASS**
Standardized Dictionary of Products and Materials.
- **AutomationML**
Plant topology.

Organizational interoperability

- **RAMI 4.0**
Reference architecture that aligns business and asset layers.
- **Data sovereignty**
E.g., IDS/IDSA, GAIA-X; connectors and data space components.

Legal interoperability

- **Data Act**
Regulation for access to data generated by connected products.
- **Trade secrets**
Protection of industrial know-how and algorithms in shared environments.

HEALTH (e-Health)

Technical interoperability

- **HL7 FHIR**
Modern standard (based on web resources) for medical records.
- **DICOM**
Universal Standard for Medical Imaging (X-ray, CT).
- **IHE Profiles**
Technical implementation guides.

Semantic interoperability

- **SNOMED CT**
Global clinical terminology (symptoms, procedures).
- **LOINC**
Codes for laboratory.
- **ICD-11/ICD-10-ES**
Classification of diseases (World Health Organization).
- **EEHRxF (European Electronic Health Record Exchange Format)**
Standardized, machine-readable format/framework for the interoperable exchange of electronic health data between systems, apps, devices, and providers in the EU.

Organizational interoperability

- **Continuity of care**
Referral protocols between levels (primary/hospital).
- **MyHealth@EU (eHDSI)**
EU infrastructure/services for cross-border exchange (e.g. ePrescription, Patient Summary).

Legal interoperability

- **EHDS (Regulation (EU) 2025/327, European Health Data Space)**
EU legal framework that establishes rules and governance for the access, exchange and reuse of electronic health data.
- **General Data Protection Regulation - GDPR (sensitive data)**
Maximum level of protection.
- **Law 41/2002**
Regulation of informed consent and patient access.

GEOSPATIAL (GIS / IDE)

Technical interoperability

- **Servicios OGC**
WMS (mapas), WFS (features/vector).
- **OGC API - Features**
Modern API for sharing geographic entities (features).
- **Formats**
GeoPackage, GeoJSON, GML.
- **IDE Nodes**
Federated Spatial Data Infrastructures.

Semantic interoperability

- **INSPIRE Directive**
Defines mandatory data models for 34 topics (hydrography, cadastre, transport). It is a transversal initiative.
- **GEMET**
Multilingual thesaurus of the environment.

Organizational interoperability

- **GTIDEE**
IDEE working group for technical coordination and proposals.
- **CODIIGE**
IDEE Coordination Board of Directors.
- **Collaborative Maintenance**
Shared basemap update processes.

Legal interoperability

- **LISIGE / INSPIRE**
Legal transposition that requires the publication of cartography.
- **Licensing and reuse terms**
(E.g., open licenses such as CC BY 4.0 where applicable)

TOURISM

Technical interoperability

- **Tourism APIs**
Connection with hotel offer and cultural agenda.

Semantic interoperability

- **UNE 178503:2022**
Semantics applied to tourism (definition of POIs, routes).
- **Schema.org**
Semantic markup for SEO and web visibility.

Organizational interoperability

- **DTI management system**
UNE 178501 Standards.
- **DTI Network**
Network of destinations to share good practices.

Legal interoperability

- **Travel Regulations**
Consumer rights and responsibility.
- **PSD2 (payments/open banking)**
Regulated access to accounts and standards/obligations of interfaces for third parties (impacts on payment integration).
- **Regulation (EU) 2024/1028**
On the exchange of data for rental services for short-term accommodation.

Discover more [content on interoperability](#) in [datos.gob.es](#)