Digital Convergence
USP2030

Best practices for developing, implementing, and managing interoperability standards

Guidelines for practitioners 2025

Digital Convergence Initiative (DCI)

DCI is the global initiative for the digital transformation of social protection systems. Established as part of the USP2030 partnership, the DCI is an open and collaborative platform for governments, development partners, civil society organizations and the private sector united by a shared vision: expanding the coverage of social protection and enhancing its delivery through inclusive, interoperable digital systems.

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List of acronyms

API	Application Programming Interface
BIS	Bank of International Settlements
CRVS	Civil Registration and Vital Statistics
DCI	Food and Agriculture Organization of the United Nations
DICOM	Digital Imaging and Communications in Medicine
DSD	Data Structure Definition
ECB	European Central Bank
FHIR	Fast Healthcare Interoperability Resources
GFSM	Government Finance Statistics Manual
GSMX	Global System for Mobile eXchange
HAPI	HL7 API
HIMSS	Healthcare Information and Management Systems Society
HL7	Health Level Seven
IHE	Integrating the Healthcare Enterprise
IMF	International Monetary Fund
ISO	International Organization for Standardization
NSB	national standards body
OECD	Organisation for Economic Co-operation and Development
PEFA	Public Expenditure and Financial Accountability
PFM	public financial management
RSNA	Radiological Society of North America
SC	subcommittee
SDMX	Statistical Data and Metadata eXchange
SP	social protection
SP-MIS	social protection management information system
ToR	terms of reference
TC	technical committee
WG	working group
XDX	Cross-Enterprise Document Data Interchange

Glossary

Framework	A supporting structure that holds an already established structure, data objects, data types, and functions.
Interface	A point or system where two distinct components – such as a user and a computer, two hardware or software elements, or two systems – connect and interact. Data exchange is not always required for this interaction to occur.
Registry	A system that collects, stores, and organises information for various reasons, including proving eligibility for benefits, land transactions, and patient health records, among other things.
Ballot	A draft version of a specification, resource, or implementation guide that is released for review and feedback by the community, stakeholders, and implementers.
P-Members	ISO members participating in a technical committee.
O-Members	ISO members only observing a technical committee.

Executive summary

The Digital Convergence Initiative (DCI) is a multi-stakeholder effort that aims to enhance social protection (SP) delivery by establishing interoperable standards for systems like social protection management information systems (SP-MISs). Towards this, a study was conducted to identify best practices from public financial management (PFM) standards (PEFA, SDMX, GFSM), healthcare interoperability standards (HL7 FHIR, IHE), and ISO standards to inform the development of DCI standards.

The study identified the following best practices for effective interoperability standards:

- A diverse and extensive pool of experts ensures comprehensive coverage of use cases, enhancing adoption by addressing practical needs, while a **clearly-defined scope** prevents complexity from impeding collaboration, as demonstrated by FHIR's focus on healthcare-specific domains.
- A **robust change management framework**, with clearly-defined processes for proposing, reviewing, and approving updates, ensures consistency and transparency, as seen in FHIR and ISO standards.
- A **precise stakeholder framework**, delineating roles, committee and work group formation, and transparent processes for participation, fosters inclusive and effective governance, as exemplified by ISO's structured model.
- A standard must be maintained as a single, cohesive entity, versioned as a unified bundle to mitigate issues such as cross-dependencies, as achieved by FHIR through **synchronised resource versioning**.
- Once a standard reaches a **critical level of adoption**, the focus should shift to building momentum by implementing incentives, conducting thorough testing, establishing clear metrics, aligning with regulatory requirements, fostering community engagement, and providing practical support to encourage and sustain further adoption.
- Community-driven standards often require **localisation** to reflect local user requirements, supported by tools for profile authoring, testing, validation, and libraries to streamline implementation and prevent fragmentation, as evidenced by FHIR's ecosystem.
- To **support implementation**, it is important to publish comprehensive, open documentation on standards, as well as making available reference examples for implementation and holding regular Connectathon events to ensure the practicability and usability of standards.

- **Sustained community contributions** – through financial inputs to ensure independence from single donors and in-kind inputs such as technical expertise or tools – are essential. Contributors should have opportunities to recover their investments through implementation contracts, the development of compliant solutions, or provision of training, as illustrated by FHIR's commercial ecosystem. These practices collectively ensure that interoperability standards are robust, adaptable, and widely adopted.

These best practices, which are described in more detail in the following sections, provide a roadmap for the DCI to develop standards that enhance SP-MIS interoperability, improve efficiency, and promote inclusivity across diverse SP ecosystems.

1 Introduction

The social protection (SP) sector is increasingly leveraging digital tools and interoperability standards to enhance service delivery, improve efficiency, and ensure inclusivity. The Digital Convergence Initiative (DCI), a multi-stakeholder effort, aims to establish interoperable standards to connect critical systems within the SP ecosystem. To inform this initiative, this study examined successful convergence initiatives to draw out best practices to inform the development of the DCI's interoperability standards, including from:

- **Public finance management** (PFM): e.g. Statistical Data and Metadata eXchange (SDMX), Public Expenditure and Financial Accountability (PEFA)
- **Health:** e.g. Integrating the Healthcare Enterprise (IHE), Health Level Seven (HL7)
- **ISO standards:** e.g. IHE

The study initially planned to look at PEFA, Fast Healthcare Interoperability Resources (FHIR) and IHE. However, during the study it was decided to include the PFM standards, as well as PEFA, because other aspects seem relevant to the work, especially SDMX. Regarding IHE, we documented the practices coming from ISO to highlight the generic nature of the practices, as they applied to ISO standards.

This report outlines the best practices for developing, implementing, and managing interoperability standards based on the lessons learnt from the study of existing standards.

2 Methodology

This study employed a mixed-method approach to identify best practices for developing, implementing, and managing interoperability standards, as outlined in the inception report. The methodology included the following:

- Literature review: Publications, wikis, and case studies on PFM standards (PEFA, SDMX, GFSM), healthcare standards (HL7 FHIR, IHE), and ISO standards were analysed, as well as DCI documentation (e.g. civil registration and vital statistics [CRVS], social registry interfaces). The review focused on governance, adoption, localisation, implementation, and funding mechanisms.
- Stakeholder engagement: Interviews were conducted with experts from PEFA, FHIR, and IHE, as well as DCI stakeholders (e.g. standards committees, steering committees) to gather qualitative insights on governance, consensus-building, and real-world implementation.
- Comparative analysis: Governance models, adoption strategies, and financing were compared across PFM, FHIR, IHE, and DCI using a framework to highlight parallels and divergences, emphasising scalability for SP ecosystems.
- Personal insights and validation: The researchers' observations (e.g. on CRVS data challenges) were incorporated and findings validated using feedback from the DCI and external experts to ensure alignment with SP needs.
- Recommendations: The findings were synthesised into actionable best practices for scope definition, change management, stakeholder engagement, adoption mechanisms, localisation and customisation, implementation support, and funding and sustainability, tailored to DCI's multi-stakeholder context.

Deviations from inception report:

- PFM scope expanded: Initially focused on PEFA, the study was broadened to consider PFM, including SDMX and GFSM, for comprehensive comparability with the DCI's data exchange needs, as PEFA alone lacks a focus on technical interoperability.
- IHE as ISO-aligned: IHE was analysed as an ISO-aligned standard, leveraging ISO's generalisable processes (e.g. multi-stage review) to provide compelling, content-agnostic best practices for DCI's governance model.
- Community-driven standards prioritised: FHIR and IHE were given greater weight due to their community-driven, consensus-based approaches, mirroring DCI's multi-stakeholder context, unlike PFM's provider-driven model, ensuring relevance to SP-MIS interoperability.

This methodology ensured a robust analysis, drawing from diverse standards to inform DCI's interoperable SP systems.

3 Key findings and best practices

This study examines critical aspects of the development, implementation and management of interoperability standards, including:

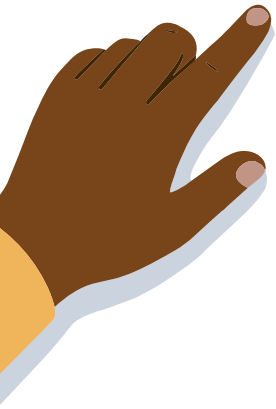
- Scope definition
- Change management
- Stakeholder engagement
- Adoption
- Localisation and customisation
- Implementation support
- Funding and sustainability

The following sections present the findings and best practices for each aspect, drawing from PFM (PEFA, SDMX, GFSM), FHIR, IHE, and ISO standards.

3.1 Scope

Findings

This section outlines the scope of key frameworks and standards relevant to PFM and healthcare interoperability. Each standard or framework serves a specific purpose, often with clearly defined boundaries to maintain focus and coherence. By understanding what is included and deliberately excluded in their scope we can better assess their applicability, limitations, and complementarity in supporting digital public infrastructure.



PFM

PFM encompasses frameworks and standards for managing public finances, ensuring fiscal transparency and efficiency. Three key sub-standards address distinct aspects of PFM, each with a focused scope to support government financial operations:

- PEFA (Public Expenditure and Financial Accountability) is an assessment framework for evaluating the performance of PFM systems, focusing on budget reliability, transparency, and accountability. Developed by nine core partners (including the International Monetary Fund [IMF] and World Bank), PEFA supports PFM by identifying weaknesses (e.g. procurement inefficiencies) and guiding policy, but it does not prescribe technical standards.
- SDMX (Statistical Data and Metadata eXchange) is a data interoperability standard for exchanging statistical data and metadata, particularly for PFM indicators like debt, gross domestic product (GDP), and fiscal balances. SDMX defines Data Structure Definitions (DSDs) and XML/JSON formats to ensure consistent reporting across national statistical offices and international agencies. Its scope is limited to statistical aggregation, excluding operational PFM processes (e.g. budget execution) and comprehensive accounting frameworks.
- GFSM (Government Finance Statistics Manual) is a framework for compiling and reporting government finance statistics, standardising PFM data for fiscal analysis. Managed by the IMF's Statistics Department, GFSM defines classifications (e.g. revenue, expenditure) and accounting principles aligned with international standards. Its scope covers statistical reporting (e.g. government balance sheets), but excludes operational PFM tools and data exchange protocols. GFSM enables cross-country comparisons (e.g. fiscal deficits), but requires national compilers to adapt data to its framework.

FHIR

FHIR, developed by HL7 International, is a data interoperability standard for healthcare interoperability, covering clinical and administrative data exchange. FHIR's mission is to provide a health interoperability solution that would eventually replace older standards, such as HL7 version 2.

FHIR groups its resources into several areas, sorted by ▶ level:

- Level 1: Foundation
  - Base formats, data types, FHIR specification core
- Level 2: Support implementation
  - Security and privacy: AuditEvent, Consent, Provenance
  - Conformance: CapabilityStatement, StructureDefinition
  - Terminology: CodeSystem, ValueSet, ConceptMap
  - Exchanges: Bundle, OperationOutcome, Subscription
- Level 3: Administration
  - Patient, Practitioner, CareTeam, Device, Organisation, Location, HealthcareService, EpisodeOfCare
- Level 4: Record keeping
  - Clinical: CarePlan, Goal, Procedure, Condition, AllergyIntolerance
  - Diagnostics: Observation, DiagnosticReport, Specimen, ImagingStudy
  - Medications: MedicationRequest, MedicationDispense, MedicationAdministration
  - Workflow: Task, Appointment, Encounter, Schedule
  - Financial: Claim, Invoice, Coverage, PaymentNotice, PaymentReconciliation

FHIR excludes non-healthcare domains (e.g. logistics, hospital operations, supply chains) to maintain focus, rejecting proposals to extend beyond health due to its mission and community expertise (e.g. FHIR tooling like HAPI FHIR is health-specific).

IHE

IHE is a ▶ **framework** for integrating healthcare systems, defining profiles that leverage standards like HL7 FHIR, Digital Imaging and Communications in Medicine (DICOM) and Cross-Enterprise Document Data Interchange (XDS) to ensure interoperability. Its scope focuses on using case-driven workflows (e.g. patient data exchange, radiology imaging, laboratory results) across clinical, administrative, and public health domains, excluding non-healthcare processes (e.g. hospital logistics, supply chain).

IHE's reliance on existing standards enables it to rely on tested and tried standards and prevents the number of standards addressing the same needs from increasing.

Best practices

Define a clear and limited scope

Avoid 'scope creep' by specifying what is included (and excluded) in the standard from the outset.

Rationale:	All of the frameworks and standards studied have a clear and stable scope. For example, FHIR systematically refuses scope expansion outside health. However, none of those requests lead to a sustainable stand-alone standard, indicating that even if there is a potential user of a standard, creating and maintaining one that adds value is much more difficult.

Reference existing standards

Adopt and align with established global standards where possible.

Rationale:	Relying on existing standards to build upon or complete the standard is helpful in order to keep the standard clear and limit the scope; every effort spared on elements that are already covered by a standard could be used for additional tasks.

Ensure comprehensive information organisation

Structure the standard as a set of distinct, modular components (e.g. foundation, persons, programs, registries) to organise the content comprehensively.

Rationale:	Standards might have a lot of different resources (FHIR has 140+). Finding the resource you need could be cumbersome if there is no way to 'dive-in' to the content. Organising resources in modules allows for easy navigation, thereby reducing the time spent on reading documents.

Formulate clear syntactic rules

Ensure that the system will speak the same language.

Rationale:	The syntactic foundation should be available and clear enough, so that only one interpretation is possible. All of the standards studied have such rules, even if they are not always as simple to retrieve

Establish a semantic framework with examples or a default data dictionary

Ensure that the systems understand each other's vocabulary.

Rationale:	In the Global System for Mobile eXchange (GSMX), the semantic interoperability layer is fixed by the standard because the subject matter does not require semantic flexibility, therefore the default list of possible values is sufficient, but in FHIR (and, therefore, IHE) the sematic layer is open for customisation in most places. To ensure interoperability, FHIR provides a terminology resource that could be documented in implementation guidelines and shared between servers.

Create a narrative for the supported processes

Ensure that the scope of each interaction is clear.

Rationale:	To achieve a business action, a standard might enforce a service of technical actions forming a process (▶ **e.g. FHIR workflow**). Such a process must be defined and clearly explained if it is expected from the systems implementing the standard.

Provide a workflow and resource examples

Ensure that the implementer has a reference for what the data should look like.

Rationale:	Examples were found for all of the technical standards studied, which allowed the implementer to see valid and likely resources. This can be used as a starting point to understand the basics of a resource before figuring out more advanced use cases.

3.2 Change management

Findings

Overall, change management relates to the release process. The release steps that are used by the standards studied are never far from the ▶ **ISO approach**. Nevertheless, we observed that in the development process for each standard, the stakeholders varied. The release process for standards can be generalised and contains the following steps (**see ▶ Figure 1**):

- **Preliminary stage:** Optional stage – may be used for the elaboration of a new change proposal
- **Proposal stage:** Process to define the working group and create a working draft
- **Preparatory stage:** Working group develops the actual change which is submitted to the committee in the next stage
- **Committee stage:** Internal review of the actual change by the committee members
- **Enquiry stage:** External review of the version, including the change, that has been approved by the committee in the previous stage
- **Approval stage:** Approved by the committee to be included in the next release
- **Publication stage:** Publication and distribution of the new version including the change

All of the frameworks and standards studied bundle their standards under a unique version, even when, as in the case of FHIR, they are organised into several modules and file versioning kept.

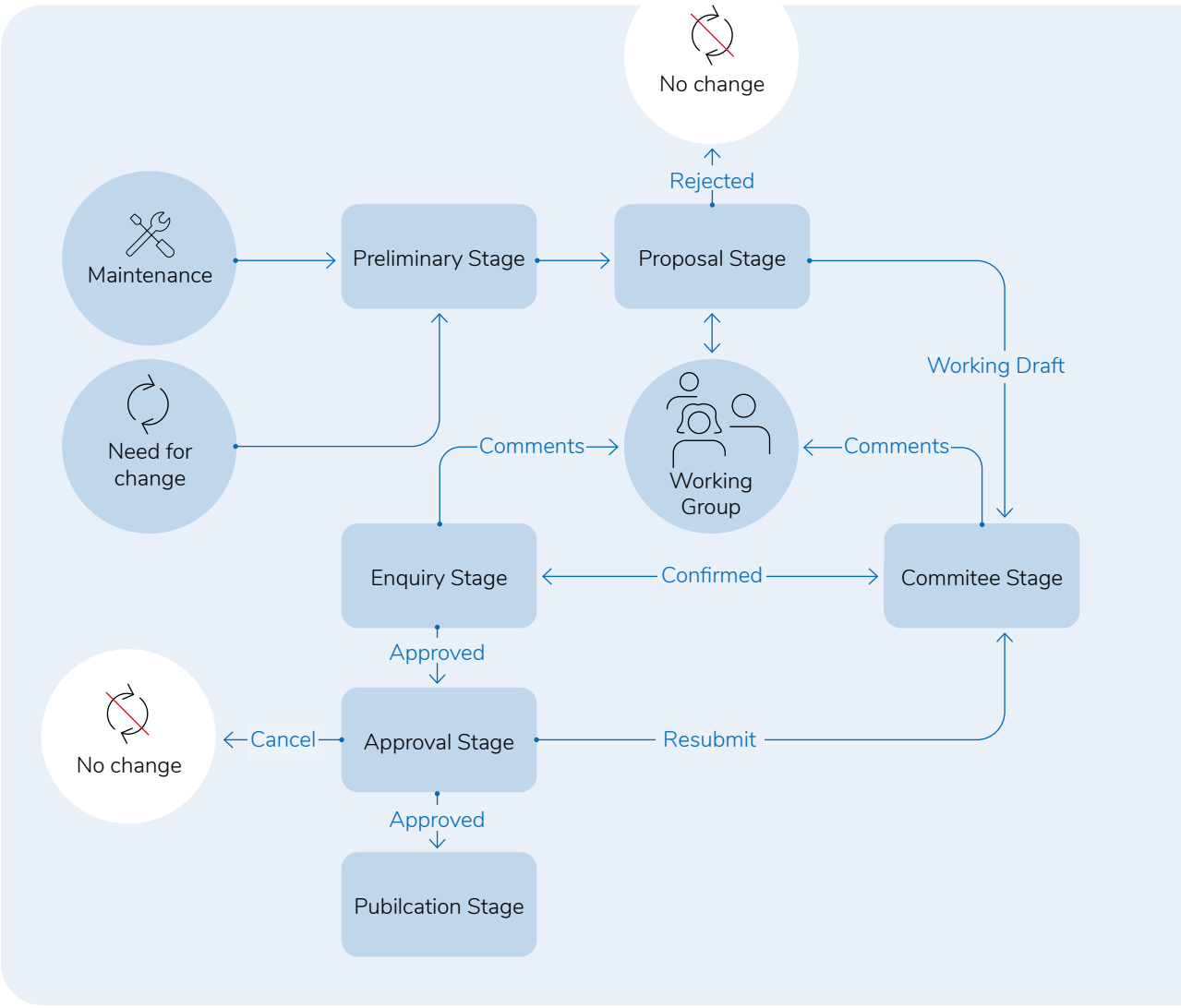


Figure 1. Generic representation of standard development

Best practices

Ensure unified versioning

Bundle all modules and interfaces into a single versioned release to avoid a 'version struggle' within the standard (e.g. DCI v1.0).

Rationale:	Shared by FHIR and SDMX, and seen in FHIR's R4 Release, unified versioning avoids conflicts in interdependent components, ensuring coherence across complex standards.

Make change requests transparent

Manage all requests through a public, trackable platform (e.g. GitHub Issues).

Rationale:	Apparent in FHIR's GitHub Issues and IHE's public feedback, transparent platforms enable broad input, reducing opacity in processes (like PEFA's consultations) and fostering trust.

Provide for a formal multi-stage review

Use a standardised process for all changes.

Rationale:	Common to ISO and HL7, multi-stage reviews (e.g. ISO's Enquiry Stage) ensure rigorous evaluation, adding value to FHIR by preventing errors, although lacking in GFSM's centralised approach.

Document and communicate all changes

Maintain a public changelog.

Rationale:	Present in FHIR's changelogs and SDMX's metadata updates, public documentation builds transparency, addressing gaps in PEFA's less detailed reporting.

Conduct pilot testing before major releases

Validate significant changes with live implementers.

Rationale:	Added value from IHE's Connectathons and FHIR's testing, pilot testing validates changes in real-world scenarios and is shared by SDMX's DSD implementations to enhance usability.

Ensure stakeholder-driven prioritisation

Engage key users early to prioritise essential workflows.

Rationale:	Evident in HL7's Working Group (WG) consensus, but lacking in GFSM's IMF-led model, engaging users early (e.g. FHIR's community input) prioritises essential features and is critical for diverse standards.

Track changes history for sub-components

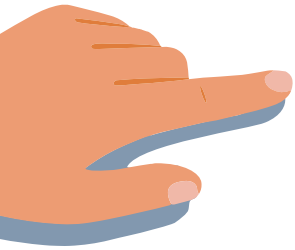
Enable quick assessment of changes.

Rationale:	Lacking in PEFA, but present in FHIR's versionId, tracking history enables quick assessments, adding value to SDMX's DSD versioning to maintain PFM data integrity.

3.3 Stakeholder engagement

Findings

The stakeholders involved in the preparatory stage, committee stage and approval stage are the ones really controlling the standard's content.



ISO

ISO's stakeholder engagement model categorises participants into the following groups (per topic):

- ▶ **Members** (National Standards Bodies [NSBs]):
  - Participating Members (P-Members): NSBs with voting rights on standards development in technical committees (TCs) and subcommittees (SCs)
  - Observer Members (O-Members): NSBs that attend meetings and provide comments, but cannot vote
- Nominated experts:
  - Technical specialists appointed by P-members or A and C-liaison bodies (see next point for definition of A and C liaison bodies) to draft standards in WGs, acting in their personal capacity
- ▶ **Liaison bodies** (A, B, C):

  External organisations contributing inputs:
  - A-liaison bodies nominate experts and actively participate
  - B-liaison bodies have limited roles (e.g. receive reports)
  - C-liaison bodies contribute directly to WGs

This model ensures that P-members control decisions via voting, while experts (often 3–5 times more numerous than P-members per TC/SC) provide technical depth, their influence balanced by P-member approval and diverse representation.

PFM

PEFA's stakeholder model for assessing PFM performance categorises participants into three groups per assessment:

- ▶ **Core partners:** Seven founding partners (European Commission, IMF, World Bank, France, Norway, Switzerland, United Kingdom) and two additional partners (Slovak Republic, Luxembourg since 2019) with voting rights on PEFA framework development and updates, managed by the PEFA Secretariat
- **Country assessors:** Government officials, consultants, and development partner staff (e.g. World Bank) appointed by countries or partners to conduct PEFA assessments and provide technical expertise
- **Stakeholder reviewers:** Civil society, academia, and international organisations that provide feedback during public consultations (e.g. 2014–2016 framework revision), but lack voting rights

This model ensures that core partners control the framework's direction, while assessors (often 5–10 per assessment) deliver technical expertise, their influence balanced by partner oversight and public consultation to align with PFM's global standards.

SDMX has a similar model with seven core partners (Bank of International Settlements [BIS], European Central Bank [ECB], Eurostat, IMF, Organisation for Economic Co-operation and Development [OECD], United Nations Statistics Division [UNSD], World Bank) that can vote, core partner appointed experts working on content, and a user community for feedback.

GFSM has a simpler structure in which IMF's statistical department fully manages the standards and obtains feedback from experts and national compilers.

FHIR

FHIR categorises its community into four groups:

- ▶ **HL7 voting members:**
  - HL7 members and national affiliates
  - Organisations and individuals with paid membership
- Other stakeholders (can contribute and provide feedback):
  - Community members: anyone part of the broader FHIR community
  - Liaison organisations having a memorandum of understanding with HL7

The working group structure is built on the community's expertise, and is not related to their voting rights.

- Chair and co-chair are appointed by WG consensus.
- WG members are anyone that participates in the WG, member or not.
- Specialists are identified by the WG chairs based on experience and contribution.

Voting rights are open, as one only needs to pay the membership fee (or fee per ballot). The broader community that works on the standards (25,000+ contributors) ensures diverse input, enhancing FHIR's quality.

Best practices

Define and publish participation criteria

Ensure transparency about decision makers.

Rationale:	Shared by ISO and HL7, clear criteria (e.g. ISO's P-Members and O-Members) ensure transparent roles, building trust, as seen in FHIR's membership levels.

Reach out to relevant experts

Ensure that the industry's evolving needs are covered.

Rationale:	Apparent in FHIR's 25,000+ contributors, active outreach expands expertise, adding value through IHE's Connectathons to cover industry needs. This is lacking in GFSM's limited national input.

Ensure transparent voting and balloting

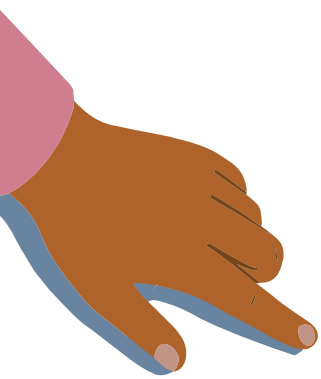
Ensure transparency around decision making.

Rationale:	Key in HL7's balloting and ISO's P-Member voting, shared by SDMX's sponsor consensus, but absent in PEFA's donor-led decisions, transparency fosters accountability.

Publicly archive all meetings and decisions

Ensure that the motives for decisions are transparent.

Rationale:	Present in FHIR's chat (Zulip), FHIR ticking (Jira) and ISO's public directives, archiving decisions enhances trust, adding value in IHE's frameworks by documenting motivations.



3.4 Adoption

Findings

This section looks at the factors driving adoption. It identifies who the audience are and why they are adopting the various standards.

PFM

- The user audience for PFM standards (PEFA, SDMX, GFSM) consists of the governments that report to international organisations (e.g. IMF, World Bank, European Union).
- ▶ **Adoption** is driven either by the will for transparency or because utilisation of those standards is a condition for financial support.

FHIR

- FHIR's audience includes healthcare providers, electronic health record (EHR) vendors, and governments aiming for interoperable health systems.
- The adoption of FHIR standards has several drivers:
- Compliance with US regulations regarding ▶ **patient data exchange**
  - Compliance with IHE
  - Trust in HL7 based on their ▶ **track record** (HL7v2)
  - Actual and forecasted market demand for solution providers
  - Personal/commercial motivation to improve health data exchange
  - Few alternatives with comparable community size
  - ▶ **Ease of localisation**
- The main challenge with adoption is its complexity, due to the complex business field it addresses, meaning that it requires some initial investment and a solid technical background.

IHE

- IHE targets healthcare providers, vendors, and IT integrators implementing interoperable workflows (e.g. imaging). Adoption ensures system integration, driven by testing events like Connectathons, but vendor focus may marginalise smaller stakeholders.

Best practices

It is difficult to draw best practice for adoption, because it depends on the opportunities available. Once a standard reaches a critical level of adoption, it is likely to snowball, therefore, this section is more about possible leverage to overcome the chicken-egg issue in standards adoption. These practices emphasise building momentum through incentives, testing, metrics, ease of interoperability, regulatory alignment, community building, and practical support to bootstrap adoption.

Focus on solving real world issues

Ensure that the standards address real work interoperability issues.

Rationale:	IHE and FHIR are solving real world interoperability issues (the regulators and community members had to choose a solution for data exchange). PFM answers a need for the evaluation, aggregation and comparison of indicators coming from different regions of the world.

Build international indicators using the standards

Increase knowledge of the standard.

Rationale:	PFM adoption is partially driven by the need to provide data to a few international bodies. If there is such a need for data reporting in the new standard business, having the buy-in of international bodies should help with adoption.

Make funding of projects or open-source development conditional on adoption

Develop the ecosystem and community.	
Rationale:	PFM adoption is partially driven by funding attached to the use of the standards. This can be applied to implementation (increase user community) or IT development (tooling, libraries or standard support in existing systems).

Foster and advertise community-driven implementation

Showcase real life examples.	
Rationale:	Existing implementations are often presented in FHIR meetings or Connectathons. While implementation sites might be limited, making the existing one good quality and visible should reassure potential implementers that the standard adds value.

3.5 Localisation and customisation

Findings

This section looks at the degree of possible localisation/customisation (syntactic, semantic, content) of different standards.

PFM

PFM standards allow for varying degrees of localisation:

- PEFA offers limited localisation, as ▶ **its 31 indicators** are globally standardised to ensure comparable PFM assessments (e.g. budget transparency). Countries can contextualise qualitative analysis (e.g. Nepal's 2024 Performance Assessment Report, see PEFA, 2024), but not modify indicators, restricting syntactic or semantic adaptation.
- SDMX supports JSON and XML ▶ **syntax** and semantic customisation through country-specific metadata (e.g. fiscal codes), but content must align with ▶ **global statistical norms**, limiting structural changes.
- GFSM permits semantic localisation by mapping national accounts to its classifications (e.g. revenue categories), with some content flexibility (e.g. accrual adjustments), but syntactic formats are rigid to ensure IMF compliance. Localisation enables PFM alignment with local regulations, but risks inconsistency if not governed well.

FHIR

FHIR standards are very flexible and allow for the following localisation:

- ▶ **JSON and XML** are available syntax in FHIR.
- The terminologies ▶ **resource** and ▶ **services** allow advanced semantic customisation, which could be enforced with profile rules.
- FHIR supports extensive localisation through modular resources (e.g. Patient, Claim) and extensible profiles).
- Content localisation is permitted by extensions that could add culturally or context relevant fields, ensuring flexibility for clinical, financial, and public health needs.

- FHIR offers profiles – customized specifications that define how a specific resource should be used to address particular use cases or requirements. These profiles both constrain and extend the base resources by specifying required elements, fixed values, value sets, and additional rules. FHIR implements profiles through StructureDefinition resources, which formally describe these constraints and extensions, ensuring consistent data exchange and validation across dive. This approach is used for both local customisation, but also for international initiatives that specify in more detail that FHIR is to serve a purpose, such as IHE workflow or the exchange of COVID certificates.
- FHIR profiles are packaged along with business justifications in FHIR's Implementation Guide, which can be shared with partners seeking to adopt specific localised/custom content, thereby helping to maintain interoperability.
- However, localisation requires some level of expertise in FHIR. Community-built tools and languages are used to simplify the task (e.g. ▶ **FHIR Shorthand**). Once someone masters the FHIR localisation approach, making a new profile is quick.

IHE

- IHE enables localisation through profiles (e.g. PIX, ITI-47) tailored to healthcare workflows and through standards like FHIR or DICOM in local formats (e.g. JSON).
- IHE focuses on healthcare integration. Each constraint helps to increase interoperability, but also limits further local customisation. These must be balanced to make their profile useful (bring value and be able to be implemented).

Best practices

Enable over the top localisation

Prevent unmanaged forking of standards.

Rationale:	Lacking in PEFA's fixed indicators, but apparent in FHIR's extensions, controlled localisation prevents forking, ensuring consistency across adaptations.

Enable profile-based localisation

Enable clear content and semantic extensions and constraints.

Rationale:	Profile-based extensions, as clearly demonstrated in FHIR profiles and IHE workflows, provide users with the ability to tailor and customise not only the specific content of the data, but also its underlying semantic meaning. This means that users can define additional data elements, modify existing ones, and specify precise interpretations to ensure that the data accurately reflects their unique requirements and context. Such flexibility is essential when standardised data must be adapted to diverse use cases without losing interoperability. This extension-driven approach is also a core feature of SDMX's metadata framework.

Ensure local profiles bundle

Ensure a coherent set of localisation across resources.

Rationale:	Evident in FHIR's Implementation Guide, bundling ensures coherent localisation, addressing gaps in GFSM's rigid formats to maintain interoperability. A similar structure across local implementation profiles helps professionals to quickly find the require information.

Provide tooling support

Provide easy-to-use profile authoring/validation tools.

Rationale:	Present in FHIR's Shorthand (FSH) and SDMX's SDMXSource, but lacking in PEFA, authoring tools simplify customisation and are critical for usability.

3.6 Implementation support

Findings

This section analyses the existing programming language libraries/mediator/base system with native implementation (database matching the standard data object) and extensive documentation, which could support implementers to speed up the utilisation of standards.

PFM

This section is not applicable for PEFA and GFSM.

- SDMX provides robust tools, including the ▶ **SDMX Registry** (mediator), Java/.NET libraries (e.g. ▶ **SDMX Source**), and native database schemas (e.g. ▶ **Eurostat's SDMX-RI**). Documentation (e.g. ▶ **SDMX User Guide**) supports statistical agencies in implementing DSDs for fiscal data (e.g. IMF's debt reporting).

FHIR

- FHIR offers extensive implementation support, accelerating adoption. Programming libraries (e.g. ▶ **HAPI FHIR for Java**, ▶ **FHIR.js for JavaScript**, ▶ **fhir.resources for Python**) provide native APIs for resources (e.g. Patient, Claim).
- Several mediators (e.g. ▶ **openFn**, ▶ **openHIM**) provide off-the-shelf or low code solutions to integrate the FHIR system with an FHIR ecosystem.
- The FHIR ecosystem already has many applications that are capable of sharing data according to defined FHIR profiles.
- Platforms like HAPI FHIR Server and ▶ **Microsoft Azure FHIR API** enable interoperable systems, with databases (e.g. ▶ **MongoDB**, ▶ **PostgreSQL**) matching FHIR's JSON/XML schemas.
- Extensive documentation (e.g. ▶ **FHIR Specification**, Implementation Guide) includes tutorials, profiles, examples and reference implementations.
- Connectathons and ▶ **Zulip forum** (25,000+ users) support implementers.

IHE

- IHE provides implementation support through profiles, leveraging FHIR, DICOM, and XDS. Libraries (e.g. OpenHIM for FHIR-based profiles) and mediators (e.g. ▶ IHE Gazelle for testing) support integration, with databases aligned to profile schemas (e.g. XDS registries). Extensive documentation (e.g. IHE Technical Frameworks) details workflows (e.g. PIX, ITI-47), with Connectathons validating implementations. However, IHE's reliance on existing tools for standards (e.g. FHIR's HAPI) make native libraries irrelevant.

Best practices

Publish comprehensive, open documentation

Enable rapid on boarding of new members and implementers.

Rationale:	Shared by FHIR's Specification and SDMX's User Guide, open documentation accelerates onboarding, adding value to IHE's Technical Frameworks.

Provide reference examples of implementation

Provide comprehensive examples of the implementation of standards.

Rationale:	Apparent in FHIR's HAPI FHIR and SDMX's libraries, but lacking in GFSM, reference examples speed up utilisation and are essential for practical adoption.

Organise regular Connectathon events

Ensure the practicability and usability of standards.

Rationale:	Events like IHE's Connectathons and FHIR's testing ensure practical application and play a crucial role in validating workflows – something not offered by any in PFM.

3.7 Funding and sustainability

Findings

This section details the funding mechanisms used to develop and maintain interoperability standards.

PFM

- PEFA is sponsored by nine institutions (European Commission, IMF, World Bank, France, Norway, Switzerland, United Kingdom, Slovak Republic, Luxembourg). SDMX is sponsored by seven institutions (BIS, ECB, Eurostat, IMF, OECD, United Nations, World Bank), which are the final users of the data collected. Hence, these sponsors will be the first impacted if funding is not sufficient to maintain the standard in a usable state.

FHIR

- FHIR is financed by membership and training on general FHIR topics. In-kind contributions represent the largest part of funding. In-kind funding is provided by members that are not on the HL7 payroll.
- Even if FHIR does provide training, its scope is intentionally limited to generic topics, thus avoiding competing with members that make a living providing training and support to implementers.
- This creates a complex ecosystem in which members have skin in the game, providing motivation to keep a high level of understanding of FHIR and to provide feedback that could serve their customers. This deep personal/commercial involvement of members is key in the adoption of FHIR standards, as well as adding value and quality to FHIR, because it creates an organic community that needs less steering because the different stakeholders work toward a common goal, even if their motivations are diverse.
- Some members also receive funding from sponsors to work on FHIR, adding another level of complexity to the FHIR funding. As per an interview conducted with Grahame Grieve, an FHIR funder, investment in FHIR is close to 40 million US dollars, but that number is difficult to evaluate, given the amount of in-kind and indirect support.

- This diverse funding would maintain the standard live in difficult times, but an abrupt cut of the funding from an institutional sponsor could still create difficulty for FHIR standards, because of its fixed costs (secretariate, legal framework, infrastructure) and it could also reduce the number of members that have their contribution financed by those sponsors.

IHE

- IHE is funded by ▶ **membership fees**, event revenue (e.g. Connectathons), and ▶ **sponsor contributions** from organisations such as the Healthcare Information and Management Systems Society (HIMSS) and the Radiological Society of North America (RSNA). These sponsorships provide essential support, which enables IHE to continue its mission of improving healthcare interoperability worldwide.

Best practices

Diversify funding sources

Diversify funding sources to include fees, in-kind support, institutional support, events and membership.

Rationale:	Shared by FHIR's membership/in-kind support and IHE's events/ sponsors, diversification (fees, in-kind support, institutional support) reduces reliance, addressing PEFA/SDMX's donor risk.

Publish financial reports

Ensure financial transparency.

Rationale:	Lacking in PFM, but present in HL7's reports, transparency builds trust, which is essential for accountability toward the donors and community.

Encourage community contributions

Ensure resilience in case of funding issues.

Rationale:	Evident in FHIR's in-kind support, community contributions strengthen resilience and add value to IHE's partnerships. This collaboration helps sustain standards, reduces funding requirements, and prevents any single group from having excessive control over the standards committees.

4 Conclusion

The development, implementation and maintenance of interoperability standards is governed by their objectives, context, and adoption mechanisms. Provider-driven standards, developed for specific clients or mandated by external entities, prioritise compliance with predefined requirements, rapid deployment, and alignment with client or donor specifications, often with limited stakeholder engagement. For instance, PFM standards, such as PEFA, SDMX, and GFSM, exhibit provider-driven characteristics, as their adoption is frequently driven by funding conditions or regulatory mandates from organisations like the IMF and the World Bank, with their slower evolution reflecting the maturity of the financial governance domain. Conversely, community-driven interoperability standards, such as HL7 FHIR and IHE, rely on broad stakeholder consensus, diverse technical expertise, and voluntary adoption to achieve scalability and inclusivity across varied contexts.

Effective community-driven standards adhere to several critical best practices.

- A diverse and extensive pool of experts ensures comprehensive coverage of use cases, enhancing adoption by addressing practical needs, while a **clearly-defined scope** prevents complexity from impeding collaboration, as demonstrated by FHIR's focus on healthcare-specific domains.

- A **robust change management framework**, with clearly-defined processes for proposing, reviewing, and approving updates, ensures consistency and transparency, as seen in FHIR and ISO standards.

- A **precise stakeholder framework**, delineating roles, committee and work group formation, and transparent processes for participation, fosters inclusive and effective governance, as exemplified by ISO's structured model.

- A standard must be maintained as a single, cohesive entity, versioned as a unified bundle to mitigate issues such as cross-dependencies, as achieved by FHIR through **synchronised resource versioning**.
- Once a standard reaches a **critical level of adoption**, the focus should shift to building momentum by implementing incentives, conducting thorough testing, establishing clear metrics, aligning with regulatory requirements, fostering community engagement, and providing practical support to encourage and sustain further adoption.
- Community-driven standards often require **localisation** to reflect local user requirements, supported by tools for profile authoring, testing, validation, and libraries to streamline implementation and prevent fragmentation, as evidenced by FHIR's ecosystem.
- To **support implementation**, it is important to publish comprehensive, open documentation on standards, as well as making available reference examples for implementation and holding regular Connectathon events to ensure the practicability and usability of standards.
- **Sustained community contributions**– through financial inputs to ensure independence from single donors and in-kind inputs such as technical expertise or tools – are essential. Contributors should have opportunities to recover their investments through implementation contracts, the development of compliant solutions, or provision of training, as illustrated by FHIR's commercial ecosystem. These practices collectively ensure that interoperability standards are robust, adaptable, and widely adopted.

References

Chang, W., Strawley, C., and Larson, J. 'Standards adoption among health information exchange organizations,' In: *ASTP Health IT Data Brief* [Online], Office of the Assistant Secretary for Technology Policy, Washington, D.C, October 2024, https://www.ncbi.nlm.nih.gov/books/NBK608168/

CMS.gov, 'CMS interoperability and patient access final rule (CMS-9115-F)', [Online], Centers for Medicare & Medicaid Services (CMS), 12 August 2021, https://www.cms.gov/priorities/burden-reduction/overview/interoperability/policies-and-regulations/cms-interoperability-and-patient-access-final-rule-cms-9115-f (accessed 9 January 2025)

Delcroix, P., and Grieve, G., 'FHIR standard management with Grahame Grieve', Zoom meeting, 5 Aug 2025, https://swisstph.zoom.us/rec/share/md64o6kljvEQxcSRCoThxzLtW82HCaKBDRwIE eT5k75rGGdgJADi5XFt3o-K1p4P.DqgGpecGx0abWGZY?startTime=174669007800 0 (accessed 9 January 2025)

Dobre, D., and Delcroix, P., *Best practices for developing, implementing and managing interoperability standards*, Inception Report (unpublished), 2025

Hatem, J., and Eisenberg, F., '2023 Annual report: Report from the Treasurer', [Online], HL7 International, 2024, https://annual-report.hl7.org/treasurer-report/ (accessed 9 January 2025)

HL7 International, 'Understanding the standards process', [Online], Confluence, HL7 International, 26 May 2022, https://confluence.hl7.org/spaces/HL7/pages/66920955/Understanding+the+Standards+Process#UnderstandingtheStandardsProcess-consensus (accessed 9 January 2025)

HL7 International, 'Profiling FHIR', [Online], HL7 FHIR Release 5, 26 March 2023, https://www.hl7.org/fhir/profiling.html (accessed 9 January 2025)

HL7 International, '2025-06-03 PIE WG meeting agenda/minutes', [Online], Confluence, HL7 International, 10 June 2025, https://confluence.hl7.org/spaces/ATT/pages/345545688/2025-06-03+PIE+WG+Meeting+Agenda+Minutes (accessed 9 January 2025)

HL7 International, 'Become a member', [Online], HL7 International, https://www.hl7.org/participate/membership/ (accessed 9 January 2025)

HL7 International, 'Welcome to FHIR', [Online], HL7 FHIR Release 5, https://www.hl7.org/fhir/index.html (accessed 9 January 2025)

HL7 International, 'Welcome to FSH School', [Online], FSH School, https://fshschool.org/ (accessed 9 January 2025)

HL7 International, 'Workflow management communication patterns', [Online], HL7 FHIR CI-Build, https://build.fhir.org/workflow-management.html (accessed 9 January 2025)

IHE International, 'Connectathon', [Online], Integrating the Healthcare Enterprise (IHE), 2025, https://www.ihe.net/events/connectathon/ (accessed 9 January 2025)

IHE International, 'Technical framework', [Online], Integrating the Healthcare Enterprise (IHE), 2025, https://www.ihe.net/resources/technical_frameworks/ (accessed 9 January 2025)

IMF, *Government finance statistics manual 2014*, International Monetary Fund (IMF), Washington, D.C., 2014, https://www.imf.org/external/pubs/ft/gfs/manual/2014/gfsfinal.pdf (accessed 9 January 2025)

ISO, 'Development of international standards', [Online], ISO, https://www.iso.org/sites/directives/current/consolidated/index.html#_Toc165304985 (accessed 9 January 2025)

ISO, 'About ISO members', [Online], ISO, https://www.iso.org/about/members

ISO, 'ISO/IEC Directives, Part 1: Procedures for the technical work – Consolidated ISO Supplement – Procedures specific to ISO', [Online], ISO, https://www.iso.org/sites/directives/current/consolidated/index.html (accessed 9 January 2025)

Lodderstedt, T., Bradley, J., Labunets, A., and Fett, D., 'Best current practice for OAuth 2.0', [Online], Internet Engineering Task Force (IETF), January 2025, https://datatracker.ietf.org/doc/html/rfc9700 (accessed 9 January 2025)

OpenID, 'What are OpenID Specifications', [Online], OpenID Foundation, https://openid.net/developers/specs/ (accessed 9 January 2025)

OSIA, 'The OSIA Initiative', [Online], Secure Identity Alliance (OSIA), https://www.secureidentityalliance.org/osia (accessed 9 January 2025)

PEFA, *PEFA 2016: Framework for assessing public financial management*, Second Edition, PEFA Secretariate, Washington, D.C., February 2016, https://www.pefa.org/resources/pefa-2016-framework (accessed 9 January 2025)

PEFA, *Evaluation of the PEFA program, 2016*, Final Report, prepared by Swedish Development Advisers (SDA) for Secretariat of PEFA, 18 September 2016, https://www.pefa.org/sites/default/files/resources/downloads/Final%20report%20PEFA%20evaluation%20with%20appendices.pdf (accessed 9 January 2025)

PEFA, *Nepal: Public expenditure and financial accountability assessment.* Performance assessment report III (as of 2022), Nepal Ministry of Finance, Public Expenditure and Financial Accountability Secretariat, Government of Nepal, April 2024, https://www.pefa.org/node/5030

PEFA, 'Assessments | List,' [Online], PEFA, https://www.pefa.org/assessments/list (accessed 9 January 2025)

PEFA, 'Partners', [Online], PEFA, https://www.pefa.org/about/partners (accessed 9 January 2025)

PEFA, '1.3 The PEFA performance indicators', [Online], PEFA, https://www.pefa.org/node/4558 (accessed 9 January 2025)

SDMX, 'About SDMX', [Online], Statistical Data and Metadata eXchange (SDMX), 2025, https://sdmx.org/about-sdmx/welcome/ (accessed 9 January 2025)

SDMX, 'Statistical standards: List of available cross-domain code lists', 7 January 2025, https://sdmx.org/sdmx_cdcl/

SDMX, 'SDMX sponsor organisations', [Online], Statistical Data and Metadata eXchange (SDMX), July 2025, https://sdmx.org/about-sdmx/sponsors/ (accessed 9 January 2025)

SDMX, 'SDMX News: SDMX 3.0 JSON and CSV format specifications released for public review', [Online], Statistical Data and Metadata eXchange (SDMX), https://sdmx.org/news/sdmx-3-0-json-and-csv-format-specifications-released-for-public-review/ (accessed 9 January 2025)

SDMX, 'SDMX technical working group (TWG) – Terms of reference', [Online], Statistical Data and Metadata eXchange (SDMX), https://sdmx.org/about-sdmx/twg-terms-of-reference/ (accessed 9 January 2025)

SPDCI, 'Standards Development Process', [Online], Social Protection for Digital Convergence Initiative (SPDCI), 2025, https://spdci.org/interoperability-standards/ (accessed 9 January 2025)

USP 2030, 'USP2030 and the world social summit 2025', [Online], USP 2030, 2025, https://www.usp2030.org/ (accessed 9 January 2025)

World Bank, 'World Bank public financial management', [Online], (accessed 9 January 2025)

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Registered offices:
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Address:

Friedrich-Ebert-Allee 32 + 36
53113 Bonn/Germany
T +49 228 44 60 – 0
F +49 228 44 60 – 17 66
E info@giz.de
I www.giz.de

Dag-Hammerskjöld-Weg 1-5
65760 Eschborn/Germany
T +49 61 96 79 – 0
F +49 61 96 79 – 11 15

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Authors
Patrick Delcroix, Dragos Dobre

Editing
Susan Sellars

Layout / Illustrations:
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Responsible for the content
Ralf Radermacher, GIZ

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E-mail: ▶ **contact@spdci.org**
Website: ▶ **www.spdci.org**

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