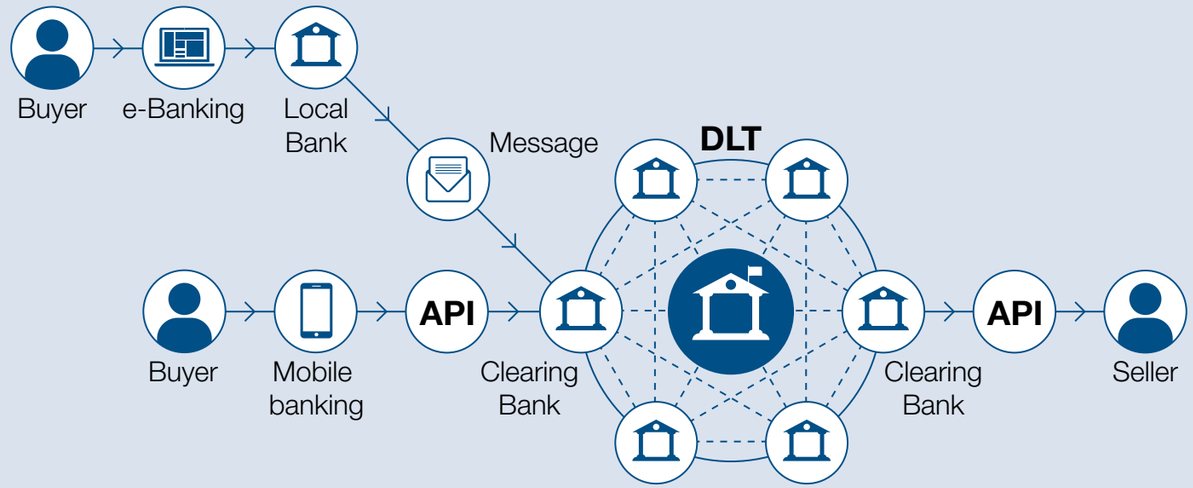
Information Paper

Business Standards and Emerging Technologies

Contents

1. Introduction

For decades, financial industry automation has been based on the exchange of structured financial messages, but this picture is changing rapidly. New automation approaches such as Distributed Ledger Technology (DLT) have emerged to challenge messaging's dominance, while maturing technology, including Application Programming Interfaces (APIs), is being widely deployed in the financial services industry, driven by regulation and competitive forces. In the near future we can look forward to business processes that span multiple automation mechanisms as illustrated below:



Possible future payments system architecture

Here, in one imagined arrangement of a future payments system, we see business processes in which different steps in the value chain are realised using different technologies – mobile banking and eBanking channels, possibly provided by non-bank third-party providers (TPPs); APIs for payment initiation, DLT for clearing and settlement, and conventional messaging for interbank flows.
This interlinking allows appropriate technology to be chosen for each process step, but it brings the risk that data will be truncated, misinterpreted or corrupted in the end-to-end process if care is not taken to ensure overall consistency. Moreover, without some organising principle, the rapid proliferation of new technology solutions in the market risks creating a jumble of competing specifications and interfaces and an avoidable legacy of cost and complexity for the industry.

This paper argues that extending and adapting existing business standards to newer technologies is the best way for the industry to mitigate these risks, and that this can be done in a way that does not compromise the responsiveness of the development process, but rather enhances agility by reducing mapping and point-to-point integration costs.

2. About business standards and ISO 20022

Business standards are needed to automate business processes of more than trivial complexity, and a variety of open and proprietary business standards have evolved over more than four decades to drive the messaging systems that enable today's finance. The need for consistent specifications of process and data is largely independent of the technology platform however, so in this time of rapid technology change and innovation it is also good to revisit the basic ideas and intentions underlying financial business standards.

Today's business standards fall into two broad categories: reference data and transactional standards.

Reference data standards define universal codes for key data elements such as currencies, legal entities, securities, etc. They define both the format of the data (e.g. the length and format of a currency code; the attributes required to describe a currency) and the data itself (e.g. the list of agreed currency codes, 'EUR', 'USD', etc.). Reference data standards ensure consistency for important business data.

Transactional standards formally describe the content of business information exchanged by industry participants to execute business processes, such as payment initiation and securities settlement. They also describe the roles played by different actors in a business process, and the information flows required to achieve a particular automation goal. Transactional standards specify data elements using reference data standards wherever possible to minimise ambiguity. There are many transactional standards but the most modern in terms of architecture, and broadest in terms of business coverage and adoption is ISO 20022.

There are two key aspects to ISO 20022. It is a methodology, a 'recipe' to be followed to standardise financial transactions; and it is a repository of content, the definitions of messages,business concepts, processes and everything else required to describe the transactional context in which the messages are used.

The ISO 20022 methodology is supported by a formal meta-model – a precise definition of the information that must be standardised. The methodology distinguishes four levels as shown in the following table.

The ISO 20022 methodology allows financial concepts, transactions, and information flows to be standardised and maintained according to ISO 20022's strict development and maintenance process. This ensures that the standard is well-defined and consistent. This consistency reduces overall costs and allows best-practice to be distilled from one implementation and re-used in others.

All ISO 20022-published content is freely downloadable from the ISO 20022 Website[2] and/or in the freely downloadable, open source ISO 20022 e-Repository[3] which simplifies analysis and enables automated consumption of specifications.

[1] It is fair to say that these information exchanges are typically realised as ISO 20022 messages today, but they may equally be realised as API calls to a remote resource, or as state changes to a resource shared on a distributed ledger. For this reason, ISO 20022 is evolving to include a more explicit state model, as we see later.
[2] https://www.iso20022.org/
[3] https://www.iso20022.org/e_dictionary.page

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ISO 20022 Level	Description	Examples
Scope level	The scope level describes financial business processes and the roles that participate in them.	- A Payment Initiation Process typically involves, amongst other actors, a Debtor, their (Debtor) Agent (which is a Financial Institution), a Creditor and their (Creditor) Agent. - A Bond Issuance Process involves an Issuer, their (Issuer's) Agent, and one or more Investors.
Conceptual level	**The conceptual level has two distinct packages:**	
Conceptual Level – Static	The static conceptual package contains formally defined financial concepts and the relationships between them. These "static" concepts are described at an "abstract" level, that is, independently of any technology choice or interaction style.	- A cash account is a kind of account. - Accounts have a servicer and one or more owners. - A bond is a kind of security - which is a kind of an asset. - A bond has an issuer and holders.
Conceptual Level – Dynamic	The dynamic conceptual package describes the kinds of transactions that can be made on these financial concepts. Dynamic level transactions are also described abstractly (independently of any technology choice) as exchanges of information between participants in the transaction .	- Account Opening transaction - Securities Issuance transaction - Financial Institution Payment Instruction transaction[1]
Logical level	The logical level defines logical message definitions that can be used by one actor in a financial transaction to instruct or inform another. The data elements specified in logical messages refer to concepts in the static conceptual level for their definitions. This ensures that the semantic of the logical message are well-defined, stable and consistent from one logical message definition to another. Logical level content is messaging specific, but does not impose a particular format or messaging technology.	The ISO 20022 Financial Institution to Financial Institution Customer Credit Transfer (pacs.008) specification describes how a financial institution can instruct a customer credit transfer (a payment.) The data elements in the pacs.008 specification, such as 'Creditor', or 'Instructed Amounted', refer to the semantic content in the conceptual static package above for their definitions. The behaviour of parties with respect to that data within a broader transaction is described in the conceptual dynamic package, which formalised that parties must send and receive specific messages in different business contexts.
Physical level	The physical level is the technical realisation of a logical message definition. It is generated mechanically from the logical definition. Several physical level implementations are possible, which allows ISO 20022 logical definitions to be decoupled from implementation technology.	The mostly widely used physical representation of ISO 20022 messages in practice is eXtensible Markup Language (XML) schema. But ASN.1 is often used for ISO 20022 messaging in the credit cards domain. A standardised JSON schema notation more suited to the API world is currently being added.

3. Open Banking and ISO 20022

‘Open Banking’ refers to the convergence of technology and regulation that will make the financial industry more open and more competitive. It is a trend best exemplified today by initiatives in Europe and the UK.

In October 2015, the European Commission proposal of the revised Directive on Payment Services (PSD2) was adopted by the European Parliament. These rules aim to:

- Protect consumers better when making payments
- Promote the development and use of innovative online and mobile payments
- Make European payment services safer

A similar initiative, the Open Banking Order, was launched in the UK by the Competition and Markets Authority (CMA). This order aims to stimulate competition, standardise technical and functional delivery models and ensure compliance and harmonisation through open collaboration. Both initiatives are being closely followed internationally, and similar legislation will surely appear soon in other jurisdictions.

PSD2 and UK Open Banking represent significant business and technical challenges for the industry. Both effectively break the lock that retail banks hold on customer current accounts by requiring banks to offer API access to account balance and payment initiation services to authorised third parties.

In the case of PSD2, several organisation have undertaken to standardise the APIs banks will implement, including STET[4] , Convenient Access to PSD2 Service (CAPS[5]) and the Berlin Group[6]. In the UK, the Open Banking group[7] has a similar goal, and is working to ensure that its specifications are also PSD2-compliant.

API standardisation is important if open banking initiatives are to deliver on their promise of improved efficiency and fair competition. Without it, each bank must design its own implementation, leading to a great burden of complexity, risk and cost for anyone seeking to create value by aggregating services from multiple banks. Standards are also important to ensure that APIs capture data that is compatible with back-office and downstream processes, otherwise the risk grows that data will be misinterpreted or corrupted as it flows through the financial system.

Many of the implementation specifications and guidelines that have accompanied open banking initiatives have referred to ISO 20022 as the standard that should be used to specify data exchanged by APIs, because ISO 20022 is rapidly replacing proprietary formats for national and international payment systems. This has stirred some controversy amongst implementers, some of whom view ISO 20022 as a messaging standard that does not support the technology paradigm of APIs, and that imposes a heavy governance process. These objections are not entirely unmerited, so the ISO 20022 technical community has worked to evolve the standard to accommodate API users. These evolutions include adding a JSON notation for ISO 20022 at the physical level, adding support for state models at the logical level, and designing a "fast track" registration process more appropriate to agile API development and publication cycles.

This investment is vital to ensure that the common end-to-end business data definitions that have been standardised in ISO 20022 are made available in the open banking paradigm.

[4] See: https://www.stet.eu/en/news/press/press-release-stet-to-launch-a-psd2-api.html
[5] www.caps-services.com
[6] www.berlin-group.org
[7] www.openbanking.org.uk

4. ISO 20022 and APIs

Messaging standards are published centrally, with a comprehensive review process that leads to an annual update. By contrast, API development is done in a much more agile and decentralised way. APIs are designed, developed and validated by the application owner as part of the application development cycle. The nature and structure of API calls will largely depend on the internal data model chosen by the application designer as well as the business processes implemented.

	Messaging	API
Architecture	Entire information set flows between all participants.	Central state maintained as web resources.
Interaction style	Point-to-point asynchronous messaging.	REpresentational State Transfer (REST); stateless operations access and manipulate centrally maintained resources.
Type of message	Messages cover many use cases and apply for different roles	Concise and focused set of API calls.
Development and maintenance	Robust development requiring predefined, precise maintenance cycles.	Rapidly changing, fast and simple implementation environment requiring agile development.
Types of services and applications	Highly automated back office applications.	Services on the edge, lightweight implementations.
Data format	Proprietary or eXtensible Markup Language (XML).	JavaScript Object Notation (JSON), OpenAPI

So how can an API developer take advantage of ISO 20022 to facilitate interoperability? That is, re-use the common business semantic definitions that exist in the standard in an API context, without importing the aspects of the standard that are more suited to messaging?

To achieve this goal fully will require tools and methodologies that are currently under development. The overall approach is to re-purpose existing ISO 20022 components where possible and extend the methodology where necessary[8], as shown in the illustration above.

[8] Ref: Technical Report JSON+WS: JavaScript Object Notation Web Services, ISO 20022 Technical Support Group.

Modelling RESTful APIs in ISO 20022 requires definitions in three of the four ISO 20022 levels, where the logical and physical levels are extended to model API, rather than messaging definitions:

Conceptual Level

At the conceptual level, existing ISO 20022 business components are selected that define the concepts in the business domain. New business components can be created if suitable definitions do not already exist, but the idea is to re-use and enrich wherever possible.

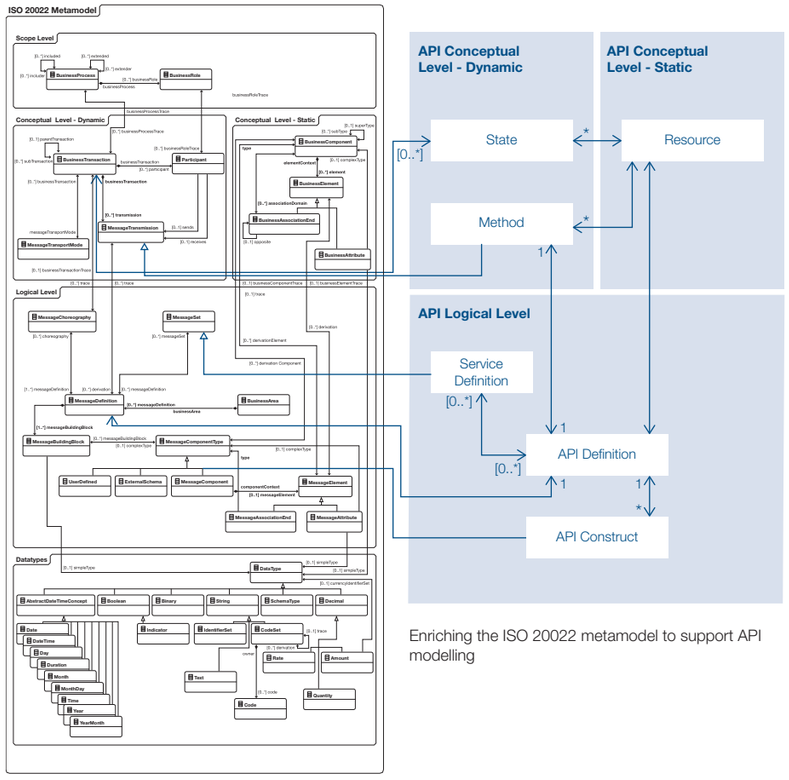
Logical Level

API Resources are modelled similarly to ISO 20022 message components. The business data definitions in these components refer to, and may refine, the definitions found in the business components in the level above. Definitions also include the possible valid states for each resource.

Physical Level

The physical representation of the API request message 'on the wire' can be expressed in a number of ways, of which the most basic is JSON schema. SWIFT is actively exploring support for more full-featured, developer-friendly API development frameworks based on Restful API Modelling Language (RAML[9]) and OpenAPI[10] (formerly "Swagger".)

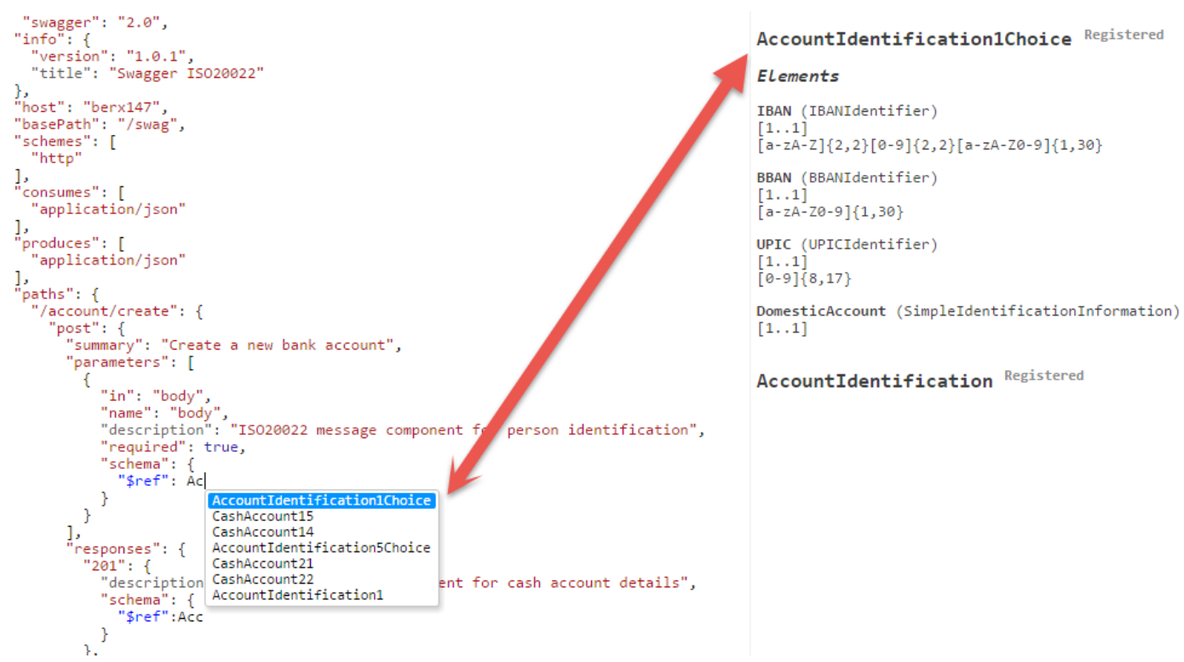
Physical API definitions select just those elements from the logical resource required to complete the interaction with the server, ensuring they remain as lightweight as possible.



Enriching the ISO 20022 metamodel to support API modelling

[9] www.raml.org
[10] www.openapis.org

To simplify the design process and make it more natural for API developers, tools are foreseen to allow API definitions to be created easily from ISO 20022 resources. The screen-shot below illustrates an early prototype:



Prototype tool for modelling API definitions using ISO 20022

Here an API defined using the OpenAPI notation is populated from the ISO 20022 e-Repository using autocomplete. The user types the first letters of 'account' and is presented with relevant structures from which elements can be selected. This is a 'smart' search, presenting the user with the most appropriate candidate component definitions based on meta-data that includes 'rating' information from other developers, and the number of times the definition has been re-used elsewhere. The repository of definitions is hosted centrally and as it is used 'learns' to refine the component definitions it proposes, over time driving convergence onto a set of popular component choices amongst developers participating in the community.

Using these tools and techniques, API developers are able to re-use ISO 20022 structures and semantics, with all the benefits this implies for end-to-end business process consistency, while still working in a recognisable API style, and without compromising agility.

It's important to note at this point that the process described above does not result in standard API specifications, but rather custom API specifications that re-use standard content definitions to facilitate interoperability. SWIFT believes this is the most important use-case to address, but there maybe circumstances where a fully standardisation API specification is the goal (for example, a standard baseline API definition for PSD2). In these cases an API specification could be elevated to become a managed definition in the ISO 20022 repository. However, this would introduce the need for a managed maintenance and release process with appropriate governance, so it is a step to be taken carefully.

5. Business Standards and DLT

Messaging and Open Banking-type APIs are conceptually similar, at least so far as selected data passing between organisations in a well-known format, independent of the private data models of the organisations concerned. Distributed Ledger Technology is something different. DLT data is shared directly between participants, so the distinction between 'internal' data and data exchanged is lost or at least blurred.

SWIFT has written about the application of business standards to DLT before[11] . In the 18 months since that paper was written, DLT implementations have matured significantly and some of the uncertainty that caused that paper to be rather tentative in its recommendations has been resolved.

For example, it is now clear that all major DLT platforms targeting the regulated financial industry will implement some form of data segregation to address privacy concerns. The Bitcoin model of sharing all data across all nodes and depending on anonymity to defend users' privacy has proved a poor fit for financial industry use-cases.

R3's Corda platform eschews the transparency of blockchain and instead shares transaction data only amongst the parties participating in that transaction. Hyperledger Fabric implements 'channels' as a data segregation mechanism, where data is not shared globally but only between participants in the same channel. Digital Asset Holding's platform is also designed to share data selectively, storing only hashes of transactional data in a globally replicated log. Quorum's design to ensure data privacy resembles that of Digital Asset. Only hashes of encrypted private transactions are stored on the ledger and each party builds its private data store for the transactions in which it participates.

Each platform also now includes well-defined mechanisms to specify the data to be shared. Corda uses state objects to represent transaction state that can be coded in any of the Java family of languages, including Java and Kotlin. Hyperledger 'chaincode' currently stores data as tag/value pairs and implements the data structure and behaviour using the go language or a java shim layer. Quorum describes data through smart contracts using Solidity, an object oriented programming language that targets the Ethereum virtual machine. Digital Asset takes a slightly different approach, specifying a new functional language – DAML - optimised for writing smart contracts. However, in all cases, transactions and data are specified in program code.

As DLT matures, it is becoming clear that no DLT platform will replace a significant business process end-to-end in one step. Rather it seems increasingly likely that DLT will take its place amongst other automation technology, including messaging and APIs. As is becoming apparent, some of the first live implementations to reach industrial scale will offer system access to all but the largest participants using ISO 20022 messages[12]. It's also clear that DLT will not replace banks' back-office systems, but will integrate with existing back-office technology using APIs.

This has a couple of implications for the use of standards. The first is that much of the material in the previous sections applies equally to DLT implementations, because many users will interact with DLT via APIs or messages. The second is that for those users that operate DLT nodes and interact with the shared ledger data directly, use of business definitions derived from ISO 20022 will facilitate interactions with internal systems and with other players.

One avenue of exploration for SWIFT Standards is the use of ISO 20022 business definitions to create canonical value objects and state models for DLT deployment. A library of ISO 20022 standardised specifications of common financial instruments such as Letter of Credit or FX Option would accelerate the rollout of DLT by providing a measure of data level interoperability between different DLT solutions. In this case the ISO 20022 physical level will be enriched to generate the high-level language specifications needed for DLT deployment.

[11] See: www.swift.com > whitepapers > Distributed Ledgers, Smart Contracts, Business Standards and ISO 20022

[12] For example, the Australian Securities Exchange (ASX) – See case study 4 here: www.swift.com/news-events/news/swift-iso-20022-implementation-strategies_standard-bearer-for-future-global-payments-systems

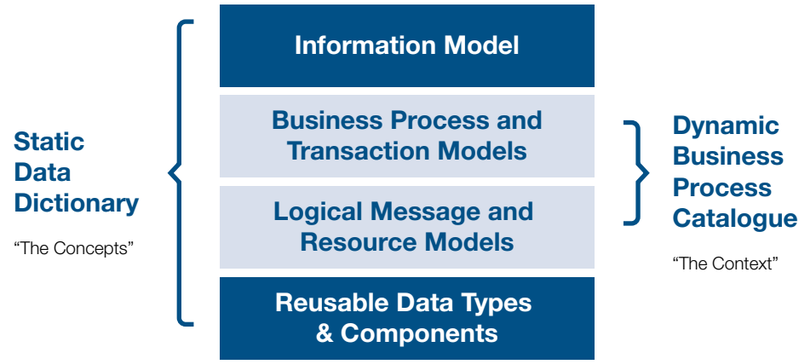
6. Standards for Canonical Models

It should be obvious from the discussions above that the value delivered to industry participants by international standardisation efforts like ISO 20022 is greatly diminished if the standardised transactional data is dumped into a mess of proprietary systems, processes, and data models when it hits each institution in a financial transaction. When this happens, the fidelity and integrity of the data and indeed the entire end-to-end transaction is put at risk. Unless made in an appropriately considered fashion, any change of transaction paradigm from messaging to APIs or DLT[13] seems as likely to exacerbate this risk as it is to reduce it.

Looking at this in a more positive light, the industry is being presented with a great opportunity. If internal representations of financial data, and internal implementations of financial processes are consistent-with, and traceable-to, the international standards that represent the "street model", then end-to-end visibility for effective operations, transparency for CROs and CDOs, and accountability to regulators is assured.

Thus, when investing to deploy new and more efficient technologies, financial industry participants should take the opportunity to learn from, build upon, and apply the freely available standardisation techniques and assets that have been developed in the international standards domain. Doing so will not only improve transparency in interactions with other industry players, but will also alleviate the interoperability and transparency challenges that are commonplace in today's front, middle, and back-offices. Below, we begin to reflect upon how standardised assets and techniques can be applied to internal projects.

These lessons are not just for in-house developments though - to ensure that data is compatible with existing back-office and downstream processes, the industry should encourage financial API and DLT-driven solutions and platforms to include native support for existing industry standards , like ISO 20022.



Applying ISO 20022 standardisation within the enterprise

As introduced in section 2, ISO 20022 is both a repository of standardised content and a standardisation methodology that is used to populate that repository. For more than 12 years, expert contributors from across the industry have been applying the methodology to standardise financial business processes in domains as diverse as retail and wholesale payments, foreign exchange, securities lending, repo transactions, collateral management, securities settlement, asset reconciliation , credit card operations, regulatory reporting, and more[14].

The ISO 20022 methodology is independent of any particular business domain, and industry experts are continually applying it to new business processes. With each new standardisation project, the freely downloadable ISO 20022 repository grows in breadth and value to its users.

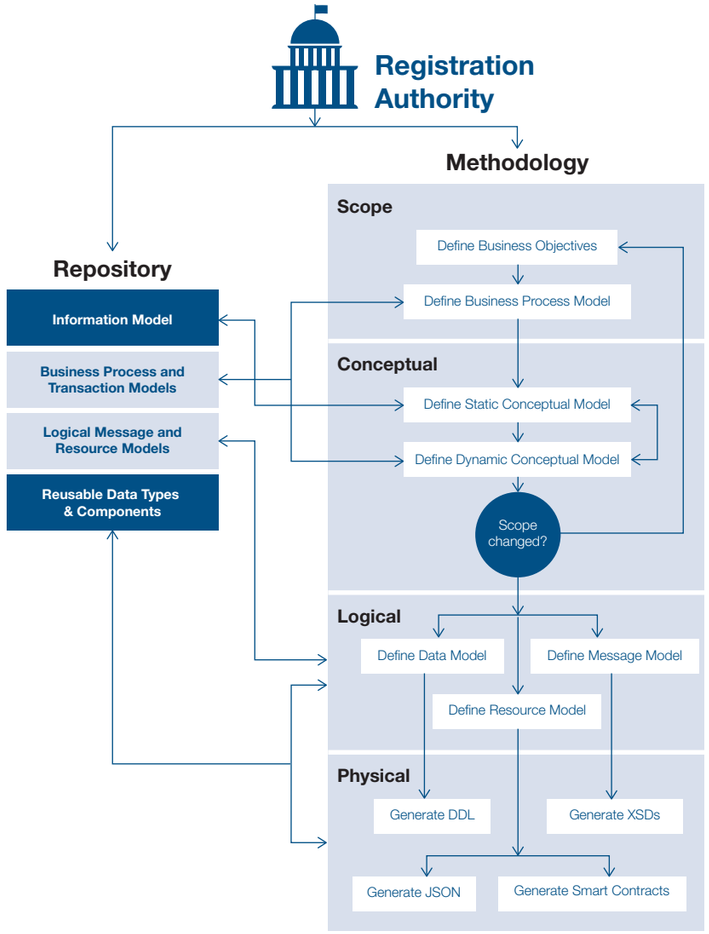
[13] Or more likely, to a combination of messaging, RESTful APIs and DLT!

[14] www.iso20022.org/status_of_submissions.page

To date though, it is not unfair to observe that the ISO 20022 Methodology has been applied almost exclusively to standardised messaging between financial industry participants. Thus, today, the business processes, business concepts and message definitions that have been formalised primarily describe the parts of the process that are shared between institutions.

It is obvious that financial institutions do a lot inside their firewall to complete these business processes though. It is equally obvious that institutions will typically maintain a significantly richer representation of certain pieces of information than they share with their competitors in an ISO 20022-compliant message. One need only speculate briefly about the contents of a complete data model to describe a “Person” to appreciate that a financial institution will never share all details of a valued customer or of a member of their staff with a potential competitor! This fact in no way diminishes the potential value to the industry to have such a data model standardised, so that all ISO 20022-compliant financial back-office systems could treat “Person”-related data consistently.

The published ISO 20022 e-Repository will require significant additional industry investment to standardise internal business processes and to add depth to more “commercially sensitive” areas. Because it is open, freely available though, it may already be enriched by users to build the basis of an internal canonical model. Importantly, an ISO 20022-derived internal model is guaranteed to be consistent with the “street model” for those parts of the transaction that must leave the institution.



The ISO 20022 methodology was designed to bring together business experts from highly competitive institutions across the industry and across the world, to agree on a common way of talking about and of executing the business of finance. The ISO 20022 methodology can also be applied “in miniature”, to the challenge of building out from the ISO 20022 repository across business siloes within the enterprise. Just as the ISO 20022 repository is used to generate standardised contracts for inter-institution transactions, it can be used to generate internally “standardised” contracts for intra-institution transactions that are consistent with what is happening in the broader industry, regardless of the technology platform choice.

Internally applying such a methodical, “model-driven approach ”, based on the same methodology and model that drives the whole industry can help to ensure the fidelity and integrity of individual financial transactions and, ultimately, of the financial system.

Although it is the subject of an entirely different paper, being able to formally trace financial transactional data to ISO 20022’s industry standard semantic model greatly facilitates the increasingly urgent task of applying artificial intelligence and machine learning techniques to the exponentially increasing big data challenge.

Conclusion

The technology of financial industry automation is changing, driven by regulation, customer demand and technology evolution. Value chains are getting longer, with new players intermediating between banks and their customers; banks and other banks; and banks and market infrastructures. Increasingly these interactions are implemented using new technology, including APIs and DLT, alongside conventional messaging approaches.

Like messaging, APIs and DLT share structured data between actors, but unlike messaging, there is currently no agreed approach to standardise this data at an industry level. This brings the risk of data truncation or misinterpretation in business processes with many interactions. The same applies to internal processes, where data may be shared amongst multiple in-house or proprietary vendor systems, each with a different data model.

Developers of new solutions may initially be wary of business standards like ISO 20022, believing they will be locked into overly rigid technical implementations and governance processes. This paper has argued the contrary: that many of the interoperability benefits of ISO 20022 can be retained when implementing new technology, without distorting development practices or technology choices. In fact use of the standard can accelerate projects by providing a ready-made library of industry-agreed definitions for core business concepts, and simplifying integration with existing infrastructure.In networked business, standardisation also brings direct economic benefits. Lowering switching costs reduces friction, leading to more efficient markets for financial services. Standardisation also helps create the conditions needed for software vendors to invest in packaged solutions, reducing time-to-market for financial institutions and lowering overall TCO for the industry.

More work will be required to mature the approaches and tools described in this paper, but the direction is set! SWIFT Standards looks forward to working with the ISO 20022 technical community and implementers to bring the benefits of business standardisation to the next generation of technology.

SWIFT is exploring financial standards for new technologies on multiple fronts. In addition to the work described in this paper to extend ISO 20022, SWIFT’s Standards team also contributes to foundational work defining common terminology and reference architecture for DLT under the direction of ISO TC 307 (DLT & Blockchain). The SWIFT Labs research team also contributes, using standardised business definitions to underpin the design of DLT Proof of Concept solutions for bond issuance, Nostro/Vostro reconciliation and Standing Settlement Instruction distribution.

If you would like to learn more about these efforts, or stay up-to-date with developments, please contact stephen.lindsay@swift.com, or look out for our Standards Forum events, where the topic of standards and technology is always on the agenda.

About SWIFT

SWIFT is a global member-owned cooperative and the world's leading provider of secure financial messaging services. We provide our community with a platform for messaging and standards for communicating, and we offer products and services to facilitate access and integration, identification, analysis and financial crime compliance.

Our messaging platform, products and services connect more than 11,000 banking and securities organisations, market infrastructures and corporate customers in more than 200 countries and territories, enabling them to communicate securely and exchange standardised financial messages in a reliable way.

As their trusted provider, we facilitate global and local financial flows, support trade and commerce all around the world; we relentlessly pursue operational excellence and continually seek ways to lower costs, reduce risks and eliminate operational inefficiencies.

Headquartered in Belgium, SWIFT's international governance and oversight reinforces the neutral, global character of its cooperative structure. SWIFT's global office network ensures an active presence in all the major financial centres.

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