Digital Regulatory Reporting

The evolution of global initiatives

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Executive summary

In March-2023 the Financial Conduct Authority (FCA) and Bank of England (BoE) appointed PA Consulting (PA) to investigate the progress of global regulatory reporting initiatives and identify learnings from these initiatives that the FCA and BoE should apply as they continue to deliver their joint Transforming Data Collection (TDC) initiative. This report sets out our findings and analysis from the review of five global digital regulatory reporting (DRR) initiatives.

Digital Regulatory Reporting

For the purpose of this report, we define DRR as new approaches that aim to enhance the overall efficiency of regulatory reporting by simplifying and streamlining processes to reduce errors and improve transparency.

DRR initiatives are typically comprised of two pillars:

1. **Technology**: which typically includes technical initiatives that seek to enable a DRR solution. Examples include: data harmonisation (data models), data types (granular, aggregate data) and technical solutions to share data between firms and regulators (e.g., push/pull reporting); and
2. **Operating Models**: which typically includes the support functions required to sustain ideation, testing, release, and maintenance of the technology solution.

Our approach

PA identified and agreed with the FCA and BoE five global DRR initiatives to analyse. The initiatives were selected based on a variety of factors, including but not limited to, the technology approach taken; their maturity; geographical coverage; the availability of information; and access to key stakeholders involved in the initiative.

The following initiatives were selected and are explored further through this report:

DRR initiative	Data Standards	Underlying data type
1 ISDA CDM	Rosetta DSL CDM	Transactional data
2 AuRep	Data Cubes	Granular information per instrument
3 Project Ellipse	Remodelled ISDA CDM	Granular mortgage data
4 EMIR PoC model	ISDA CDM & ISO20022 Business model	Transactional data
5 BIRD	BIRD Layers	Granular data

Table 1: Summary of DRR initiatives

Desk-based research and qualitative interviews with participants from each initiative were held to inform our analysis which focussed on answering the following questions to inform the TDC plan:

1. What was the technical approach was used to progress the initiative?
2. What was the development and release approach used to progress the initiative? This included: way of working; the approach to testing; and how the DRR solution was released to, and adopted by, industry.
3. What was the operating model design of the initiative? This included: governance and working group models; capabilities required; and 3rd party providers.

Our key findings

From our review, we identified the following key findings that the FCA and BoE should consider as they progress the planning of their TDC Initiative. These are outlined below and explored further within sections 1-3:

Key Finding	Description
1 Common data standards and their associated models	Remain key to the long-term success of any DRR initiative as they enable consistent data reporting. Our research of each initiative and qualitative interviews with key stakeholders confirmed this.
2 Cross industry collaboration	Continues to be a critical success factor. DRR initiatives that have successfully been operationalised all successfully embedded cross industry collaboration and ways of working into their operating model and development and release approach. While the FCA and BoE know this and have adopted a similar model, it is nonetheless important to restate this.
3 Steering Groups and Working Groups	Are key elements of DRR governance structures and to an extent, a structure that is needed to oversee and manage industry collaboration. In almost all initiatives, a cross-industry Working Group was established to develop technical output; while a Steering Group was used to oversee strategy, vision, roadmaps, and make decisions.
4 DevOps/Agile	Is the preferred development and release methodology of DRR initiatives. DevOps and Agile are methodologies commonly used in software development. Whilst DevOps' goal is to enable faster and more frequent delivery of software, Agile PM involves breaking down the development process into small iterative tasks which provide flexibility and adaptability. This is approach is beneficial when scope and project requirements are likely to change during the course of the project. Ultimately, both methodologies enable rapid build, test and release cycles.
5 Operating Model	Used to implement the DRR approach was a key point of variation across the five DRR initiatives analysed. Through our work, we identified common themes in the operating models of operational solutions, including: standards and data definitions being set by regulators (with input from industry) and the DRR solution being hosted and run by a third-party (outsourcing). A 'utility' operating model is most frequently adopted by DRR initiatives, in which a third-party utility is set up to manage standards used for the DRR approach as well as an infrastructure platform.
6 Identifying return on investment/ measuring success	Is not easily assessed as identifying adoption of initiative solutions is a challenge as most are solutions are open source.

Table 2: Summary of key findings

The table below summarises our key findings and their alignment to the initiatives covered in this paper:

Key Finding	ISDA CDM	AuRep	Project Ellipse	EMIR PoC	BIRD
Common Data standards	✓	✓	✓	✓	✓
Cross industry collaborations	✓	✓	✓	✓	✓
Steering Groups/Working Groups	✓	✓	N/A- proof of concept	N/A- proof of concept	✓
DevOps/Agile	✓	✓	✓	N/A- proof of concept	✓
Standards/ Utility Op model	✓	✓	N/A- proof of concept	N/A- proof of concept	✗

Table 3: alignment of key findings with initiatives

Transforming Data Collection

The FCA and BoE have explored approaches to DRR since 2016. In 2021, the regulators jointly set up the 'Transforming Data Collection' ('TDC') programme to build the capabilities for a DRR solution. While we did not directly review the TDC programme as part of this work, based on our knowledge of the programme and discussions with programme leaders from the FCA and BoE it is our assessment that the initiative remains at the forefront of international efforts to achieve the aims of DRR.

The programme is built on strong foundations with many of the findings we identified from our review of global initiatives already embedded within their joint transformation plan. This is evidenced across several areas as set out below.

The key reforms set out within the TDC transformation plan are aligned to the objectives of a DRR (as set out within our definition) and are in-line with areas that global DRR initiatives have been able to evidence progress.

According to TDC, there are 3 key reforms that are central to achieve the transformation plan[4]:

1. **Defining and adopting common data standards:** identifying and describing data in a consistent way throughout the financial sector. These common standards should be open and accessible for use by all who need them.
2. **Modernising reporting instructions:** Improving how reporting instructions are written, interpreted and implemented.
3. **Integrating reporting:** to move to a more streamlined, efficient approach to data collection. This reform includes making data collection more consistent across domains, sectors and jurisdictions, and designing each step in the data collection process with the end-to-end process in mind.

A number of the enablers of success that we identified within global DRR initiatives can be evidenced within the TDC structure.

Based on our findings from global DRR initiatives, we identified a number of common enablers that were key to driving progress across DRR initiatives. The TDC programme also has many of these enablers embedded within their programme structure, including:

1. **Cross industry collaboration** is a founding principle of the TDC;
2. **Steering Groups and Working Groups:** The TDC has set up a robust steering group and working group structure to enable the cross-industry collaboration;
3. **Agile/Scrum project management:** The TDC has adopted an agile development approach by running the programme in 'Phases' with a number of use cases allocated to each phase.
4. **The Governance framework** set up to oversee TDC is structured as follows and consists of Industry representatives alongside BoE & FCA staff. The TDC governance framework includes:
   - **Reporting Transformation Committee:** The Reporting Transformation Committee focuses on overseeing the design of solutions for parts of the reporting process where the Bank, FCA and reporting firms interact directly.
   - **Data standards Committee:** The Data Standards Committee is a forum for stakeholders including reporting firms, trade bodies and relevant standard setting bodies to discuss issues and propose solutions in the area of data standards.
   - **Core Delivery Group:** The Core Delivery Group undertakes the various activities related to the work programme: understanding problems through user research, mapping and investigating possible solutions, and designing aspects of the solutions.
   - **Advisory Group:** Members of the Advisory Group are Subject Matter Experts (SME's). Their role will be to support the Core Delivery Group by reviewing the materials and artefacts produced, participating in solution design workshops and assisting the delivery team in prioritising the user requirements.

The TDC programme is built on strong foundation that is consistent with how other global DRR initiatives have been set up. As the TDC programme considers their strategic plan they should continue to embed the learnings from global efforts to digitise regulatory reporting, as set out further in this report.

There remains significant benefit for regulators and the industry if the stated aims of digital regulatory reporting are achieved.

Contents

1 Technical Approach

In this section we explore the underlying technology and data structures used to develop each initiative and the outcome of each of the DRR initiatives identified.

Key Takeaways

Based on our research and interviews, we believe that the following are key in establishing successful DRR initiatives:

- **Technical feasibility:** DRR is technically feasible. However, developing global solutions remain a challenge owing to nuances in national financial systems that can impact reporting and data definitions, e.g. different definitions of property types affecting reporting in different jurisdictions for mortgages.
- **Data Model:** The first and most crucial step in any DRR solution is creating a data model that harmonises the understanding of regulation across market participants. The result of this harmonisation is consistency in the quality of the data provided by regulated firms.
- Granular data: There is an evident shift towards using Granular data as it improves analysis and reusability of data from the Regulator's side. Obtaining high quality granular data from regulated firms is highly dependent on data standardisation.
- There is no 'one-size-fits-all' technical approach: There are a number of different initiatives undertaken by regulators across the market that streamline regulatory reporting, as such there is no 'right or wrong' technical solution. It is the Regulator's strategy, objectives, and capability that dictate the appropriate solution.

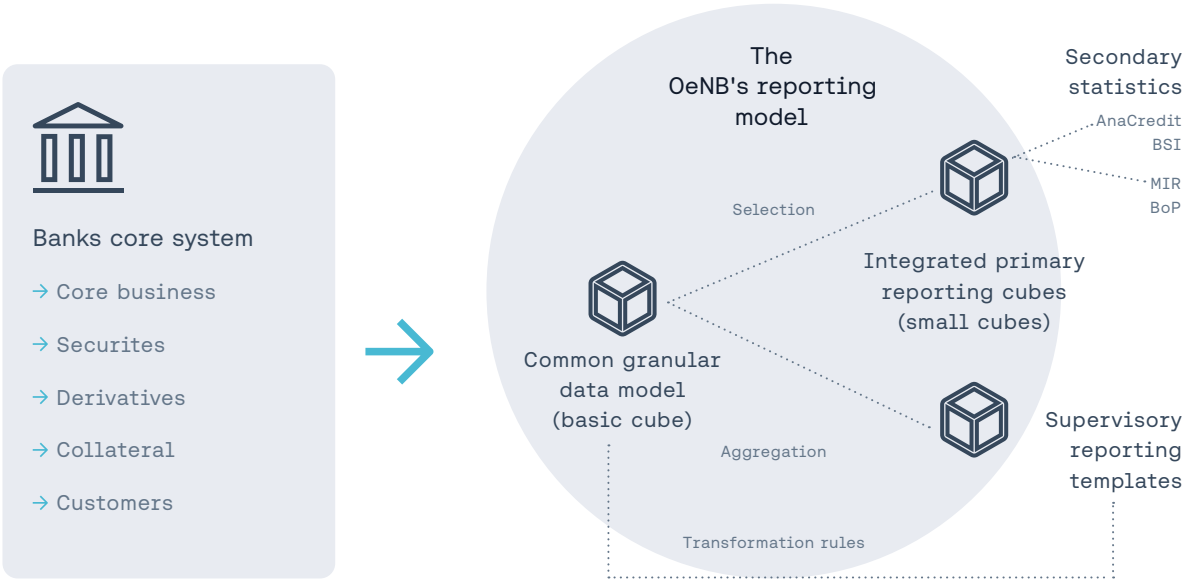

Figure 1.1 Data flow in the OeNB's reporting data model

Below we have detailed the technical approach for each of the five identified case studies:

1.1 Austrian Reporting Services GmbH (AuRep)

Objectives

AuRep runs on ABACUS/GMP[2], a common software platform, which works as the central interface between the banks and the Austrian National Bank (OeNB). The key concept of the OeNB's reporting data model is to create all reporting frameworks covered by the model from this single data source. It all starts with the granular information in the form of basic cubes which contains all information per instrument needed to cover different business aspects.

The concept behind this approach is to collect data at a sufficiently granular level only once and to generate multiple statistics from them, reducing redundancy in the process. This type of data collection enhances integration and lowers the number of reporting frameworks. However, as data becomes increasingly interrelated, processing and analysis may become complex and costly to maintain.

Technical Architecture

Figure 1.1[3] provides a visual representation of the data flow in the reporting model.

The reporting approach adopted by OeNB/AuRep is called 'Data Input Approach' or a 'push approach' which is adopted by the majority of reporting institutions in Austria. What makes AuRep's initiative innovative is that the underlying data is collected in the form of 'data cubes'. These cubes are made up of layers upon layers of information pertaining to a specific instrument (granular data). These cubes are submitted to AuRep where data is enriched, transformed into 'smart cubes', and then provided to the Austrian Central Bank (OeNB) according to a specific regulatory reporting framework. The objective of the OeNB's reporting data model is to formally describe the reporting data flow starting from the core banking system to primary reporting to the OeNB. OeNB is responsible for defining the data models and rules for the data cubes and AuRep is responsible for implementing these models and rules into their software.

Coverage

The coverage of the reporting is both statistical and prudential data, such as: ANACredit, FINREP, Asset Encumbrance, Monetary statistics, Liability data Report, and Financial account & external statistics.

1.2 International Swaps and Derivatives Association (ISDA) Common Domain Model (CDM)

Objectives

The DRR initiative led by ISDA allows regulators to publish reporting rules in executable code that can be automatically read and interpreted by the IT systems of regulated firms. This particular DRR initiative leverages the Common Domain Model (CDM)[4].

The CDM is a digital plan that makes it easy to process different events and actions related to trades in a consistent and organized way from start to finish. It is represented as a domain model and distributed in open source. The product scope of the CDM includes Over The Counter (OTC) derivatives; cash securities; securities financing; and commodities[5]. The foundation of ISDA's CDM model is the coded interpretation of requirements which ensures consistency across all reporting entities.

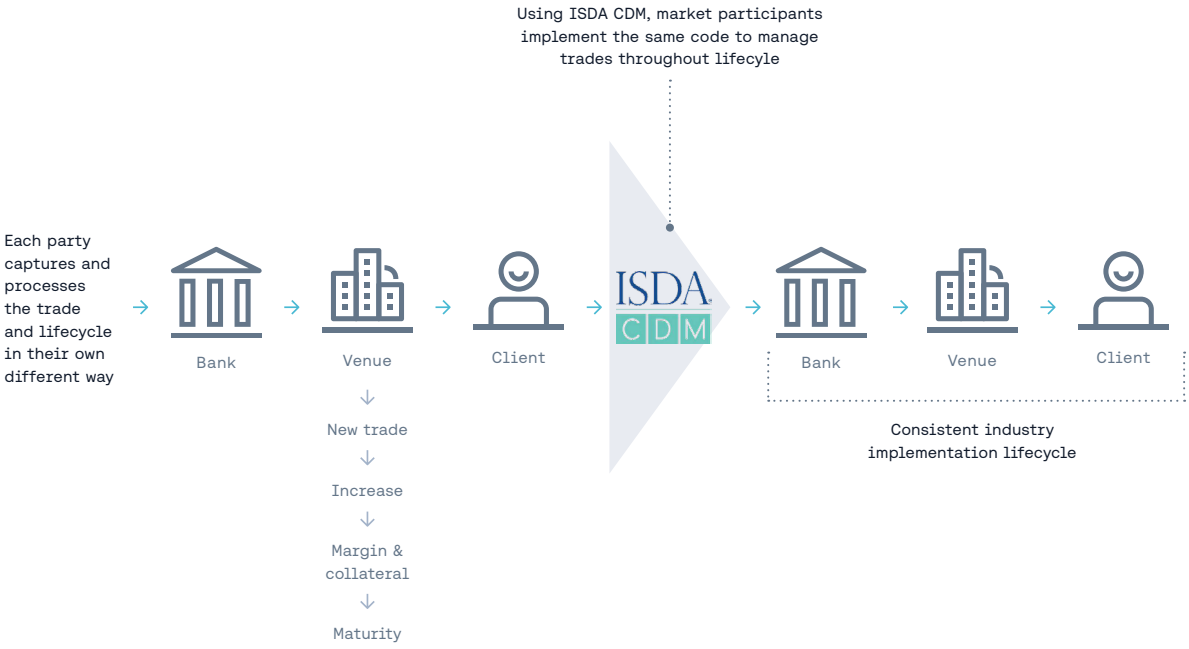

Figure 1.2 ISDA Common Domain Model (CDM)

Technical Architecture

Figure 1.2[6] provides a visual representation of how CDM model standardises trade lifecycles across the industry. ISDA's CDM model is written or expressed in Rosetta DSL[7] language which supports the modelling of the industry's various operational processes to increase consistency and interoperability of their implementations.

During the G-20 TechSprint 2020, ISDA and Regnosys[8]. developed a DRR pilot for derivatives reporting regulations using the CDM According to Leo Labeis[9], founder and CEO of Regnosys, the ability to translate existing standards in the market with the right logic is one of the aims of the ISDA CDM model. It is not to replace, but to complement existing data standards.

It should be noted that the CDM in itself is not a reporting tool, nor is it a specific application or solution for a particular problem but an enabler to a solution. Additionally, ISDA's CDM is not a smart contract nor a Distributed Ledger Technology (DLT), but it is designed to support DLT technology.

Additionally, ISDA have developed (and continue to develop for regulatory frameworks) an extension to the CDM called the DRR model which facilitates CFTC regulatory reporting[10].

The DRR model follows 3 sequential steps:

1. **Translate:** This takes a firm's transaction event data and translates it into a CDM object representing that transaction.
2. **Report:** This takes the CDM transaction event object and applies the reporting logic (eligibility and field rules plus additional regulatory data guidelines) to produce a CDM report object.
3. **Project:** This takes a CDM report object and applies additional mapping and projection rules to produce a report file in the format required by trade repositories and/or regulators (e.g. XML, ISO 20022).

Coverage

The coverage of the CDM model includes CFTC (& CFTC re-write) regulations.

1.3
BIS Innovation Hub: Project Ellipse

Objectives

Project Ellipse is a Proof of Concept (PoC) launched by the Bank of International Settlements Innovation Hub Singapore Centre & Monetary Authority of Singapore (MAS) with support from the BoE, ISDA and Financial Network Analytics (FNA). This project was undertaken in two phases. Phase 1 focused on data-driven supervision using machine executable reporting in a cross- border context and Phase 2 looked at integrating unstructured data and advanced analytics to enhance supervision.

In this report we will focus on Phase 1 because not only is machine executable reporting a DRR initiative on its own, but it also looks at designing data models that could be used by multiple regulators across the globe. Additionally, Phase 1 also explored whether current DRR initiatives could be repurposed for different use cases, as such, the project team modelled the PoC's mortgage attributes using ISDA's CDM to ingest retail mortgage data and deployed for testing.

Technical Architecture

During Phase 1, the BISIH, MAS, and BoE explored the feasibility of identifying a common understanding of a particular regulatory data set collected across reporting frameworks. As such, the PoC was tested using retail mortgages reporting in the UK and Singapore.

The project team created dummy mortgage transactions to be ingested by the CDM. The executable code automatically generated from the model definitions enabled the project team to simulate the creation of retail mortgage regulatory reports for Singapore and the United Kingdom referencing the same model. As such, the conclusion is that Phase 1 was successful from a technical perspective.

Figure 1.3 MRER PoC end-to-end reporting process

1.4
European Commission (DG FISMA): MRER Proof of Concept - Assessing the feasibility of machine readable and executable reporting (MRER) for EMIR

Objectives

The aim of this project was to assess whether regulatory reporting could be digitalised by building a PoC. EMIR Transaction reporting requirements were used to test the PoC. The scope of the PoC covers Interest rate swaps, commodity options, and FX swaps.

Technical Architecture

Figure 1.3[11] below provides an overview of the end-to-end reporting process, and was developed in the following manner:

1. Transaction trade details are stored in a firm's trade system. Any life-cycle event of a trade will be reflected in the trade systems and trigger a reporting obligation.
2. The firm pushes the trade records to the MRER reporting system in a format dictated by the data model of choice.
3. The MRER reporting system contains regulatory reporting logic expressed in DAML. The reporting system will process the records by mapping the data to the fields required by the regulation and produces a CSV file, or in the case of this PoC, ISO 20022 Message model as a reporting output
4. The file is shared with Trade Repositories (TR) and validate the reports using their existing systems
5. As a final step, the Regulator extracts the required data set from the TRs.

The project team selected ISDA's CDM model and ISO20022 as data models and used Digital Asset Modelling Language (DAML) as a programming language for expressing reporting requirements. Additionally, a selection of EMIR Refit reporting requirements were translated into the machine readable and executable language for reporting derivative transactions.

The results of testing the PoC showed that it is not fit for purpose in its current state and further development is required. Please see Section 2.4 for more details

1.5 European Central Bank: Banks' Integrated Reporting Dictionary (BIRD)

Objectives

The ECB launched the BIRD project in 2015 with the aim of improving regulatory reporting in terms of quality and efficiency. This is achieved by developing a harmonised data dictionary and data models. This means that BIRD allows firms to accurately identify data sets from their internal systems that are required to be reported to regulators. Ultimately, this increases the quality and consistency of the data provided. This data model is very similar to AuRep's/OeNB approach as they are both based on Entity Relationship Model (ERM).

Technical Architecture

It should be noted that BIRD is not an IT tool, it is simply a data dictionary. BIRD is made up of two layers, the Logical level and the Technical Level. For the purposes of this paper, we will cover the technical layer that broadly describes the process from the regulated entity's perspective.

The premise is the input data comes from firms' internal bank system and goes through several Logical/Semantic Transformation Rules to ensure that those data sets meet the definition set by the dictionary and ultimately producing reporting the right data sets. Figure 1.4[12] provides a visual representation of the Technical Level.

Coverage

BIRD's regulatory coverage includes amongst others: ECB ANACredit, ECB Securities Holdings Statistics (SHS), ECB's Monetary Financial Institutions' Balance Sheet Items (BSI), EBA'S Implementing Technical Standards FINREP & COREP.

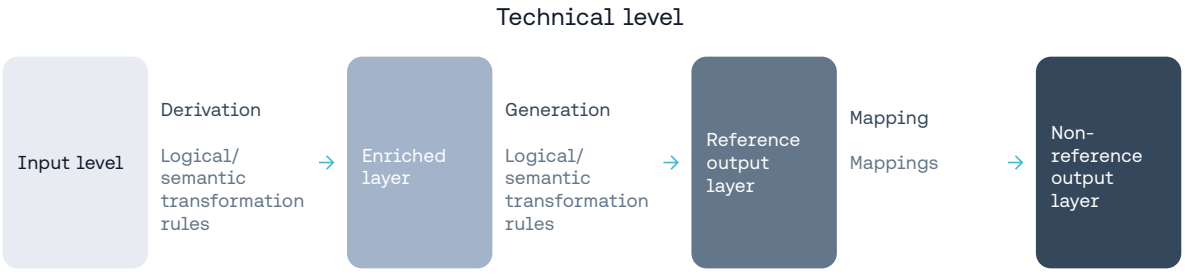

Figure 1.4 BIRD Components at the technical level

2 Development and Release of DRR

In this section, we explore the development and release approach of each DRR initiative. This includes ways of working, release approaches, and adoption of each of the DRR initiatives by industry.

Key Takeaways

Our analysis indicates that the long-term sustainability of any DRR initiative heavily relies on the following factors:

- **Close collaboration between regulators, regulated entities, and technical SME, working in an agile manner is key.** This is evident in the development approach of each initiative covered in this paper. This was echoed during our interview with a regulator where they made a clear distinction between supervision and reporting; reporting is a collaboration between a regulator and the regulated firm, whilst supervision is a monitoring function. This close collaboration can alleviate some of the initial challenges that may be faced when developing a DRR initiative which is resistance to change.
- **Ease of Integration and availability in open source.** For initiatives to be successfully adopted the technology needs to be easily integrated with and would not require drastic changes in regulated firms I.T systems. In the case of ISDA CDM and BIRD, both are available in the open source and freely available for all. In the case of AuRep, the data models set by the Austrian Central Bank are also made available in the public domain.
- **Navigating through common challenges:** Some of the common challenges faced by the initiatives range from agreeing harmonised definitions for regulatory reporting, resistance to change from industry, cost barriers, and increased complexity in data processing. Successful initiatives have been able to navigate through these challenges largely owing to close industry collaboration and an operating model that support this.
- **Measuring success by linking this to the initiative's objectives:** direct benefits can be a challenge to quantify due to a number of reasons such as phased market adoption and the limited availability of cost saving information in the public domain. Additionally, cost saving comparability cannot be easily obtained as accounting for reporting costs varies amongst market participants. However, most focus on assessing whether the objectives of the initiative have been met to determine success. These factors could be considered as qualitative measures or indirect benefits and can include, amongst others, quality of data, scalability of technology, and reduced reporting burden.
- **Market adoption should not be measured as an 'all-or-nothing' metric.** There tends to be a gradual or phased adoption of new technology by market participants. Additionally, it should be taken into consideration that 100% market adoption is unlikely if a DRR initiative is voluntary. Therefore, a fair metric would be an acceptable threshold rate of adoption set by the regulator.

2.1 Austrian Reporting Services GmbH (AuRep)

Design Approach

The aim was to define regulatory reporting as precisely as possible to ensure standardised and harmonised reporting by regulated firms. Additionally, the success of AuRep can be attributed to standardising the definition of data points that ultimately form the 'data cubes' gathered and submitted by regulated firms.

The reporting data model was developed in close cooperation between the OeNB and Austrian credit institutions with the aim of standardizing reporting requirements, documenting them clearly and comprehensibly, and reducing analysis and implementation efforts through a clear focus on granularity and redundancy free input (i.e. avoiding reporting the same data sets several times for under different reporting frameworks). AuRep's data model is voluntary, and the responsibility of the quality and correctness of the reported data remains with the reporting institutions.

Timeline

AuRep was officially formed in 2013 by the largest Austrian banking groups and took up to 3 years to develop the underlying technology with their first 'test run' taking place in 2015 and going live the same year.

Adoption

During an interview with a key stakeholder from OeNB, it was confirmed that 90% of Austrian Banks have integrated with AuRep. It has been noted that the relatively high number of participants could be attributed to two factors: the first being the lowered change and implementation costs for regulated firms; and the second is the ability to use standard IT solutions to integrate with AuRep[13]. These two factors can be seen as the most important considerations by regulated firms when adopting any DRR initiative.

The remaining 10% have adopted the following approach:

1. Use third-party software providers: OeNB's data model is published on the open source. Software providers can incorporate the data model and provide the technology-wrapper to support regulatory reporting.
2. Use their own data models: that may be similar to OeNB's data model with the appropriate reporting technology of choice.
3. Direct submission: Some banks have no data or software providers, so they submit regulatory reports to OeNB directly.

2.2 ISDA CDM

Design Approach

ISDA's CDM seeks to tackle the issue faced by the industry which is digitally representing trades, events, and processes in regulated firms' internal systems. This ensures that the information shared across market participants is consistent and standardised.

ISDA's development of the CDM model followed an Agile approach as it produced a rapid development of the model and focuses on two high level principles:

1. Focus on business value from the user's perspective, encapsulated in the concept of user stories.
2. Delivery of small, releasable changes that contribute to that business value (sometimes referred to as shippable increments).

It is further noted in ISDA's documentation[14] that wider industry community such as financial institutions and user community, and committees/ working groups can contribute to the continuous development of the CDM under a Contribution Framework:

1. A business use case is required for any change proposal.
2. Proposals are submitted to ISDA staff and Architecture & Review committee for approval
3. If the proposal is approved, the changes are incorporated into the CDM by CDM-Maintainers.

Testing

The CDM has adopted a test-driven development approach that maps model components to existing sample data. According to a stakeholder at ISDA, some of the biggest banks have volunteered to carry out the coding and testing. Firm Sponsors are assigned certain fields to test and validate. Feedback is then collected to refine and fine-tune the model as needed.

Timeline

The ISDA CDM/DRR initiative has progressed as follows:

- **2017:** ISDA published a conceptual version of its ISDA Common Domain Model (CDM), which sets out the required elements to achieve a single digital representation of trade events and actions[15]
- **2019:** ISDA published the full version of the ISDA Common Domain Model (CDM) for interest rate and credit derivatives and has opened access to all market participants, including non-ISDA members (CDM 2.0)[16]
- **2021:** ISDA, the International Capital Market Association (ICMA) and the International Securities Lending Association (ISLA) have signed a memorandum of understanding (MoU) to strengthen collaboration on the future development of the Common Domain Model (CDM)[17]
- **2022:** ISDA has launched the full open-source version of the Digital Regulatory Reporting (DRR) model and opened access to ISDA members and non-members to support compliance with the US Commodity Futures Trading Commission's (CFTC) amended swap data reporting rules[18].
- **2022:** BNP Paribas successfully implemented and tested the DRR model (which includes the CDM and the DRR extension, see section 1.2)[19]

Adoption

The International Securities Lending Association (ISLA) and The International Capital Market Association (ICMA) are developing ISDA's CDM to extend its coverage to other financial products. For instance, the ICMA has completed Phase 2 of the CDM model for repo and bonds in January 2023. During Phase 2, the CDM model was extended to cover open term and floating rate repurchase agreements, and the associated lifecycle events.

In a recent article published by ISLA CEO Andrew Dyson[20], it was noted that the adoption of CDM model would most likely be iterative rather than an 'all or nothing approach' as its benefits can range from enhancing communications between internal legacy systems to streamlining post trade life cycle events between market participants.

During our interview with key stakeholders at ISDA, they further echoed that firms do not need to use vendors or platforms to use the CDM model as it is a package that can be downloaded and incorporated into a firm's system. They further noted that firms can use the CDM model as a validation tool.

Nevertheless, the only known regulated firm to fully adopt ISDA's DRR initiative is BNP Paribas. In November 2022, BNP Paribas successfully implemented and tested the CDM & the DRR extension model making it the first initiative to be fully adopted and deployed and have been able to produce correct submissions of data to the regulators. Additionally, according to ISDA stakeholder there are a number of financial services firms that remodel ISDA CDM for internal data-centric projects.

However, given that the CDM model is fully available on open source and downloadable from Finos, ISDA have no means to track who is using the CDM model. This is based on our discussion with ISDA stakeholders.

2.3 BISIH Project Ellipse

Design Approach

Project Ellipse was a PoC rather than a productionised DRR solution. As part of Project Ellipse:

- One of the aims was to identify industry initiatives to see if data models and taxonomies used for specific product domains could be scalable and repurposed.
- The Project Team established a very narrow use case for phase 1, mortgage reporting, to identify common data attributes and agree their definitions.
- The Project Team explored ways in which the requirements for the reporting of those data sets can be published in programming languages.

Findings

As part of Phase 1 of Project Ellipse, the following findings[21] were reported by the project team:

- Regulatory reporting requirements can be expressed in unambiguous machine-readable logical reporting instructions underpinned by a consistent data model.
- Technical standardised programmatic specifications of the steps for generating regulatory reports can be published alongside regulation and ensure clear understanding at the most granular level of the expected data. By publishing these specifications, clear understanding can be ensured at the most granular level of the expected data. This helps firms identify what information they need to provide to meet regulatory requirements.
- Executable libraries can be automatically generated and published alongside regulations to assist accelerated implementation. These libraries typically contain functions and procedures that can be called by an application or program, allowing the program to perform certain tasks without having to write the code for those tasks itself. By using executable libraries, developers can save time and effort by reusing code, as well as reduce the size of the programs they develop.
- If a common data standard was agreed to and implemented, financial institutions may no longer need to interpret reporting instructions and submit aggregated data by use case; and
- With additional logical instruction based on the same data model, supervisors may also be able to automatically query the underlying transaction data and generate regulatory metrics referencing that standardised data.

Overall, Data standards, taxonomies and data models are integral for digital reporting and for enabling data-driven analytics. A move to machine-executable digital regulatory reporting is very closely linked with the need for data standards.

Challenges

According to stakeholders involved in Project Ellipse one of the challenges the project team faced was reaching a common understanding of the definitions relating to retail mortgages which required a great deal of collaboration to arrive at a standard definition of key terms. There were circa 120 data points relating to a retail mortgage transaction, of which, circa 32 data points' definition were mutually agreed upon.

Adoption

Not applicable as this was a PoC rather than a productionised initiative.

2.4
European Commission (DG FISMA): MRER Proof of Concept - Assessing the feasibility of machine readable and executable reporting for EMIR

Design Approach

MRER for EMIR proof of concept (PoC) was developed in close cooperation with ESMA. The project team comprised of members of DG FISMA and PwC.

The objectives of the project were:

- To develop a machine readable and executable representation of reporting requirements as a PoC
- To assess whether MRER systems can lead to efficient and effective reporting requirements
- To Identify regulatory challenges to MRER technology in the financial sector

Testing

The project team used internal testing procedures to ensure that MRER output is in line with expectations i.e. is the output aligned with regulatory requirements. Four in-built testing processes were used[22]:

1. **Mock-reporting system:** a stand-alone separate system that always returns the same report
2. **Golden-tested:** this test compares the report generated by MRER with the expected output in CSV format
3. **ISO20022 validator:** tests whether the XML message generated by MRER reporting system is a valid ISO20022 XML message.
4. **Test pack:** the project team maintains a test pack which is a set of test pairs. Each test pair consists of trade records and corresponding trade reports. The test packs consist of use cases.

Additionally, the project team tested the PoC with market participants which was not done with Project Ellipse. This was done to receive feedback from participants regarding the adoption of the MRER approach, gain insights on how participants can translate their trade records, and to verify the readability of the MRER code.

Findings

It should be noted that one of the recommendations of the project team was selecting an input data model that is supported by the majority of the industry. As such, there were no immediate fit for purpose data model for the PoC. Both data models (CDM & ISO20022) were considered suitable but had shortcomings that required them to be extended to fit MRER purposes. As mentioned in section 1.4, the conclusion reached by the project team is that the PoC is not fit for purpose in its current state. The findings, amongst others, are:

- The data model needs to define all the necessary fields to fully describe a trade
- For certain EMIR-reporting fields, no equivalent of a data element in the ISO20022 Business Model can be identified.
- Certain data requirements from EMIR Refit Level 2 regulations are not supported yet by the ISO20022 data model.
- Position level reporting (data relating to their open trades and positions to the TRs) is not supported by CDM yet.

Recommendations

The project teams put forward a recommendation, amongst others, for the European Securities and Markets Authority (ESMA) to take the lead in guiding the industry in developing the existing data models to become a fit for purpose data model for selected reporting frameworks.

Cost-benefit analysis

Overall, the paper[23] suggests that the long-term benefits of MRER technology across market participants (including trade repositories) such as:

- Harmonised reporting by all market participants in terms of data sets, the ability to respond quickly to changes in regulatory reporting
- Standardised reporting processes, and increased reporting quality outweigh the costs of implementation.

It is worth noting that one of the assumptions made by the project team when studying the cost-benefit relationship was mandatory use of MRER.

Adoption

The report provides varying degrees of adoption of MRER which would determine the optimal operating model for an MRER solution, including:

1. **Bottom-up local reporting**: a number of reporting entities collaborating to produce and maintain shared MRER implementations.
2. **Top-down local reporting:** the regulator publishes official MRER smart contracts alongside legal text and regulated firms execute them locally to comply with regulatory reporting.
3. **End-to-end reporting system:** all market participants (entities, regulators, trade repositories) are connected to a distributed ledger that enables end-to-end reporting.
4. **End-to-end trading system:** the system is used for trade reporting and execution.

However, there is no one right answer as the PoC is still in its infancy stage. Though there are additional factors that affect MRER adoption and those are:

1. The number of reporting regulations
2. Number of market participants that consider adopting MRER technology,
3. The state of regulatory reporting environment
4. The global applicability of MRER implementation which requires
cross border collaboration to achieve necessary harmonisation.

2.5 European Central Bank (ECB): Banks' Integrated Reporting Dictionary (BIRD)

Design Approach

The BIRD project started in 2014 and is a collaborative project between the ECB, European Banking Federation, national central banks, and several participating commercial banks with the objective of standardising data models and achieving a 'redundancy-free input' across the industry using a programming language that is easily understood by all market participants. BIRD is fully available on the open source and accessible by all market participants and the Working Group is looking to launch a dedicated website which contains different formats of BIRD.

Regulated firms played an important role in the development of BIRD as key Subject Matter Experts (SMEs) are involved in analysing regulatory requirements and devising a working plan on how to interpret and document those rules. This is co-ordinated by the ECB. Changes or updates to regulations are tackled in the same manner. SMEs are sourced and put into working groups to demystify the requirements. As the project and content of BIRD grew, it led to a fragmented approach to data modelling. As a result, in 2019, the project was reorganised by creating a dedicated group called Working Stream on Data Modelling, to ensure long term sustainability by defining a clear strategic roadmap, processes, and outcomes.

Adoption

The adoption of BIRD is completely voluntary, but it has been noted through our interview that there are 2 major European banking groups switching to the BIRD Data model.

3 Operating Model

In this section, we will explore the overall operating model and governance structure for the initiatives that are operational.

Key Takeaways

Our research indicates that there are commonalities in governance and operating models for some of the operational, or soon to be operational, initiatives. These include:

- Steering Groups: Every initiative is governed by a Steering Group which is comprised of representatives from the industry, regulator, and other authorities who set the strategic roadmap and are ultimately the decision makers.
- Working Groups: Additionally, there are working groups that are responsible for the technical development of the solution.
- Capabilities: The key capability required to progress DRR initiatives is in-depth technical understanding of regulatory reporting processes, technology and data. Most DRR initiatives have relied on industry collaboration to provide this input and expertise.
- Utility operating models: It is evident from our research that the DRR tool is operated and maintained by an independent party but ultimately, the responsibility of standardising data models resides with the regulator.

In PA's 2020 review of Phase 1 and 2 of the BoE and FCA's DRR Initiative[25], we listed five possible operating models for DRR implementation. These included:

Name	Managing Standards	Running Infrastructure	Description
Current State	N/A	Industry	The current regulatory reporting process, where regulation is issued in natural language by the regulator and firms manually interpret the regulatory requirements to generate their regulatory reports
Regulator-led	Regulator	Industry	This option is the closest to the current operating model for the regulatory reporting process with accountabilities for Managing Standards and Running Infrastructure staying the same. The key change to the current model is that regulatory rules and requirements will be issued simultaneously in natural language and machine executable code by the regulator and they will also issue and manage standards which support the execution of this code.
Standards Body	Central Platform	Industry	This option is similar to regulator-led. The key point of difference is that the data and technical standards will be managed by a new entity, separate from the regulator, rather than directly by the regulator. The regulator will issue regulation in machine executable code, while the industry will remain accountable for generating regulatory reports in-line with the standards by executing the MER on their data.
Utility	Central Platform	Central Platform	For this option, a new central entity will be set up to manage standards, like the Standards Body option. The key difference is that the new entity's capability would be enhanced to include an infrastructure platform in addition to standards governance capabilities. This infrastructure platform would be used to generate the regulatory reports on behalf of regulated firms. It does this by taking the MER produced by the regulator and executing this on industry provided data.
Future Regulator	Regulator	Regulator	For this option, the centralised infrastructure and standards governance capability held by the central utility in the Utility model are taken in-house to the regulator. This means the regulator is accountable for providing regulation in MER format, setting standards and running the infrastructure to generate the regulatory reports. In this model, firms would provide the regulator with access to their operational data and ensure that their data is in the correct format.

Table 4: Operating models for DRR implementation

Within the table below we have summarised our assessment of the operating models of 3 of the identified initiatives. Project Ellipse and EMIR were not assessed as they are PoCs and therefore do not have an operating model.

DRR initiative	Operating model
ISDA's CDM	Standards Body
AuRep	Utility
Project Ellipse	N/A- Proof of concept
EMIR PoC model	N/A- Proof of concept
BIRD/IReF	Regulator Led

Table 5: Identified operating model of DRR initiatives

3.1 Austrian Reporting Services GmbH (AuRep)

Governance

The Austrian Central Bank opted for a Utility operating model for AuRep. To support this operating model a new entity which manages both the data and technical standards was established called Austrian Reporting Services GmbH (AuRep).

AuRep is considered to be a 'bridging' company between regulated entities and the central bank. It is co-owned by 7 of the largest Austrian Banking Groups. It is noted that the Utility Model provides benefits to the market quicker than other models due to its cost efficiency as it relies on outsourcing regulatory reporting to a single centralised infrastructure provider. However, it can lead to vendor monopoly and concentration risk.

Co-operating with Austrian banks was key in transforming this initiative into a reality. As such, the following governance framework was created[26,27]:

1. **SCom Steering Group:** The committee is responsible for overall decision regarding the data model. Members include OeNB, Austrian Bankers' Association, Austrian Economic Chamber, Financial Market Authority (observer) and key representatives of key banking groups. This committee meets every two months.
2. **SCom Working/Expert Groups.** This committee is responsible for the development of the integrated data model and providing regulatory clarifications. Members include OeNB, Regulated Firms' staff and software developers tThe frequency at which they meet depends on development phase.
3. **Reporting Sponsors Committee:** Annual top management meeting

Suppliers

According to AuRep, some of their key stakeholders alongside OeNB, ECB, and EBA include:

1. Infrastructure Partner: Oracle
2. Data Centre Partners: Raiffeisen Computer Science
3. Software Partners: Regnology

Capabilities:

1. Software developers
2. Regulated firms SMEs to provide regulatory expertise
3. Regulator staff to provide data modelling expertise

3.2 ISDA CDM

Governance

ISDA's CDM Operating Model can be classified as a Standards operating model. In the sense that regulatory requirements are translated to machine readable and executable code by ISDA but the model itself is hosted by a third-party service provider, Finos[28].

The CDM is an open-source project and has a governance framework that oversees any changes or contributions to its development (please see section 2.2).

There are two governance structures in place, one to oversee the CDM and the other for DRR.

ISDA's DRR governance is structured as follows:

1. DRR Steering Committee: this committee is responsible for setting the roadmap for DRR. The members are firms who are providing resources to develop the DRR model and/or using DRR as part of their reporting solution. At the moment the focus is on EMIR Refit, but the coverage can (and will) expand as ISDA starts developing DRR for other jurisdictions.
2. The DRR Technical Execution Working Group: This working group consists of technologies from participating firms. This groups develops the code itself based on the technical standards and interpretations of the regulatory requirements coming from the wider ISDA membership. Firms that provide resources in this group would be on the Steering Committee.
3. ISDA Data and Reporting EMEA Working Group: This working group provides the input on the reporting interpretations. This is made up of any ISDA members with regulatory reporting interests and does not require any involvement with DRR. This group have traditionally agreed on any industry reporting interpretations / best practices and will continue to do so with the difference being this interpretation will now also feed into the DRR.
4. ISDA CFTC-EMIR DRR Peer Review Group: this working group consists of members with an interest in DRR and want to participate but cannot necessarily provide technology resources. All code developed during a sprint cycle is presented to the Peer Review before it is contributed to the model.

Additionally, an efficient technology governance framework would typically include full-board management, formal standing technology committees, and lastly, tech engagements on selected topics. As such the governance[29] structure for the CDM opted by ISDA is as follows.

1. The CDM Executive Committee: the committee is responsible for setting the strategy and promoting the adoption of the standard. The members are senior executives appointed by ISDA
2. The CDM Architecture and Review Committee: the committee is responsible for setting out the technical and modelling guidelines. The members are SMEs, senior technologist and professionals in business process, legal documentation, and technical modelling. This committee is made up primarily of ISDA members.
3. The CDM Working Groups: these working groups are created per subject matter or use cases to actively develop and implement targeted elements of the CDM. Members include ISDA members and non-members from the CDM user community.

During our interview with key stakeholder at ISDA, they have iterated that the ownership of this model should not reside with ISDA, rather it should sit with the local regulator.

Suppliers

According to ISDA stakeholders, some of their suppliers are:

1. Regnosys: provide the development platform and capabilities for CDM
2. TradeHeader: Provide CDM modelling support

Capabilities

1. Software developers
2. Professionals in business process
3. Professional in legal documentation
4. Professionals in technical modelling

3.3 European Central Bank: Banks' Integrated Reporting Dictionary (BIRD)

Governance

BIRD is a collaborative project between authorities and the banking industry; as such the governance framework consists of:

1. Steering Group: This committee guides the project's developments, sets priorities and objectives, assesses resources and workflow. Additionally, The Steering Group overseas the BIRD Expert Group. Members of this Steering Group are:

- Representatives of the banking industry
- National central banks
- European Authorities

The Steering Group meets every year.

2. BIRD Expert Group: The committee is an operational group of experts in data modelling and reporting frameworks. The responsibilities of this Expert Group are developing and maintaining the BIRD methodology, content, and documentation. Members include representatives of the banking industry and the ESCB who have expertise in reporting requirements and data modelling.

Suppliers

N/A- there are no suppliers for BIRD.

Capabilities

1. Software developers
2. Professionals in reporting frameworks
3. Regulatory Reporting requirements SMEs

4 Horizon Scanning

In this section we outline the future developments of some of the initiatives mentioned in the paper, along with other DRR initiatives implemented by Regulators, and the potential future landscape of DRR.

Future roadmaps of selected DRR initiatives

Of the five DRR initiatives explored through this report, the following developments are planned:

1. **Austrian Central Bank (OeNB)/AuRep:** the OeNB had begun shifting its data model documentation into a stand-alone IT Application called (MDI) that can be accessed via an API. One of the features included in this IT Application is a Data Lineage functionality. This functionality will be developed in a way that will allow firms to run a query that which will help them identify and understand changes that were made to the basic data cube. This will allow firms to assess the impact of the change on their existing data sets.
2. **ISDA CDM:** EMIR regulation is currently translated to fit into the CDM/DRR model and is expected to be completed in October 2023.
3. **BIRD- IREF:** The long-term vision is to align BIRD with the Integrated Reporting Framework (IRef). This is expected to go live in 2027.

Other global DRR initiatives

In additional to the above developments, we have identified the following DRR initiatives[30]. It should be noted that this is not an exhaustive list and other DRR initiatives may exist:

Country	DRR initiative	Description
Croatia	Granular data delivery	In this model, the Croatian National Bank (CNB) collects contract-granular data for legal entities and semi-aggregated data for households. Regulated firms submit their granular data to the CNB, where it gets processed, and the CNB generates the reports. The CNB created its own version of BIRD which was an integral deliverable to the project. The CNB maintains an open, common code repository that contains all transformation logic and allocation rules for reporting templates used by the CNB to process the data.
Switzerland/ Liechtenstein	Pull- Mechanism	In Switzerland and Liechtenstein, the market for core banking systems is highly consolidated, and most of the Swiss banks are using one of the popular six core banking systems. This facilitated the use of standardized data models by implementing six standard interfaces to each of the six core banking systems. These banking systems contain a ready-to-use interface that maps the banking system's operational data to the standardized data model used for regulatory reporting.
Philippines	Integrated data transfer & big data analytics	The central bank of the Republic of the Philippines, the Bangko Sentral ng Pilipinas (BSP), and the RegTech for Regulators Accelerator R²A together developed a prototype for an API-based Prudential Reporting System. In such a system, banks will individually prepare template-based reporting in a common data point model (DPM) to BSP in XML format that will automatically be extracted from the supervised financial institutions' databases via an Application Programming Interface (API)
Australia[31]	APRA Connect	API-powered solution that allows regulatory changes to be validated and consumed instantly. It delivers perfect return data using the same technology and rules engine as APRA. Powerful analytics dashboard includes full reports on performance, fund expenditures and insurance; enabling the use of submission data to create actionable insight
Federal Deposit Insurance Corporation (FDIC)- United States	Rapid Phased Prototyping (RPP)	The solution will explore new ways to receive, manage, and analyse data from individual institutions, particularly community banks, without increasing compliance burdens. The adoption of this technology would provide more timely and granular data to the FDIC. The project is in its Pilot Prototype phase.

Table 6: list of identified global DRR initiatives

Endnotes

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02 Addressing the complexities of the regulatory environment- Regnology https://www.regnology.net/en/knowledge-hub/case-studies/aurep-ukrep-addressing-complexities-regulatory-environment/
03 Katharina Kienecker, Günther Sedlacek, Johannes Turner: Managing the processing chain from banks' source data to statistical and regulatory reports in Austria
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10 Overview — Documentation documentation (rosetta-technology.io)
11 Final Report on MRER proof of concept: Assessing the feasibility of machine readable and executable reporting for EMIR https://finance.ec.europa.eu/publications/commission-publishes-final-report-mrer-proof-concept-assessing-feasibility-machine-readable-and_en
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20 Reflections of the ISLA, ICMA & ISDA CDM Showcase - ISLA Blog (islaemea.org)
21 Project Ellipse - An integrated regulatory data and analytics platform (bis.org)
22 Final Report on MRER proof of concept: Assessing the feasibility of machine readable and executable reporting for EMIR https://finance.ec.europa.eu/publications/commission-publishes-final-report-mrer-proof-concept-assessing-feasibility-machine-readable-and_en

23 Final Report on MRER proof of concept: Assessing the feasibility of machine readable and executable reporting for EMIR
https://finance.ec.europa.eu/publications/commission-publishes-final-report-mrer-proof-concept-assessing-feasibility-machine-readable-and_en

24 Representatives of the European banking industry BIRD organisational structures (europa.eu)

25 PA Consulting's Digital Regulatory Reporting: A Review of Phase 1 and 2 of the Digital Regulatory Reporting Initiative | FCA

26 European Reporting Framework (ERF) - a possible solution to reporting challenges for banks (bis.org)

27 Katharina Kienecker, Günther Sedlacek, Johannes Turner: Managing the processing chain from banks' source data to statistical and regulatory reports in Austria

28 FINOS Launches Common Domain Model Project in Partnership with ISDA, ISLA and ICMA for Standardizing Financial Products and Workflows

29 According to ISDA stakeholders, the CDM governance framework is in the process of reorganisation as a result of Finos hosting the CDM model. For more information of the proposed governance common-domain-model/finos-cdm-governance-structure.png at master · finos/common-domain-model · GitHub

30 RegOps- The future of data collection and data management: Agile RegOps for digitalizing the regulatory value chain- Regnology

31 APRA Connect Reporting Software | Regnology

Annex

We would like to thank representatives from the below organisations for their participation in the interviews with PA to inform our understanding and analysis:

- ISDA
- ECB
- OeNB
- Bank of England
- Bank for International Settlements Innovation Hub
- Regnology
- Monetary Authority of Singapore

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