Managing the processing chain from banks' source data to statistical and regulatory reports in Austria

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Data reporting and user requirements have become increasingly granular and demanding, which also applies to central bank and banking supervision statistics. Traditionally, every authority devised its own approach to collecting data and defining requirements, and every reporting agent implemented these requirements separately. This isolated approach frequently resulted in redundant and non-harmonized data collection schemes and inconsistent implementation by different banks, making reporting processes inefficient and data analysis complicated. Austrian banks and the Oesterreichische Nationalbank (OeNB) decided to develop and implement new approaches to data reporting to address this unsatisfactory reporting situation and to minimize the risk of exploding costs.

This paper starts with a description of the important initial phase of the Austrian paradigm change in banks' reporting. The main features of this new reporting approach are (1) collaboration between the OeNB and banks and among banks, (2) the realization of synergies between banks using a shared reporting platform, and (3) the reporting data model developed jointly by banks and the OeNB. The involved OeNB experts have been invited to speak at numerous international conferences and bilateral meetings as well as to hold important positions in comparable projects of the European System of Central Banks (ESCB), bearing witness to the OeNB's leading role in modernizing reporting.

The number of reports that banks have to provide to meet monetary policy, financial stability and supervision requirements has grown substantially in recent years and continues to do so. At the same time, reporting data need to be increasingly granular and complex. Most recently, EU efforts to impose uniform supervisory reporting requirements as published by the European Banking Authority (EBA) in 2014[1] as well as the adoption of European Central Bank's (ECB) statistics regulation on the collection of granular credit and credit risk data[2] (for the ECB's AnaCredit dataset) in 2016 have placed greater demand on institutions to provide more and higher-quality data.

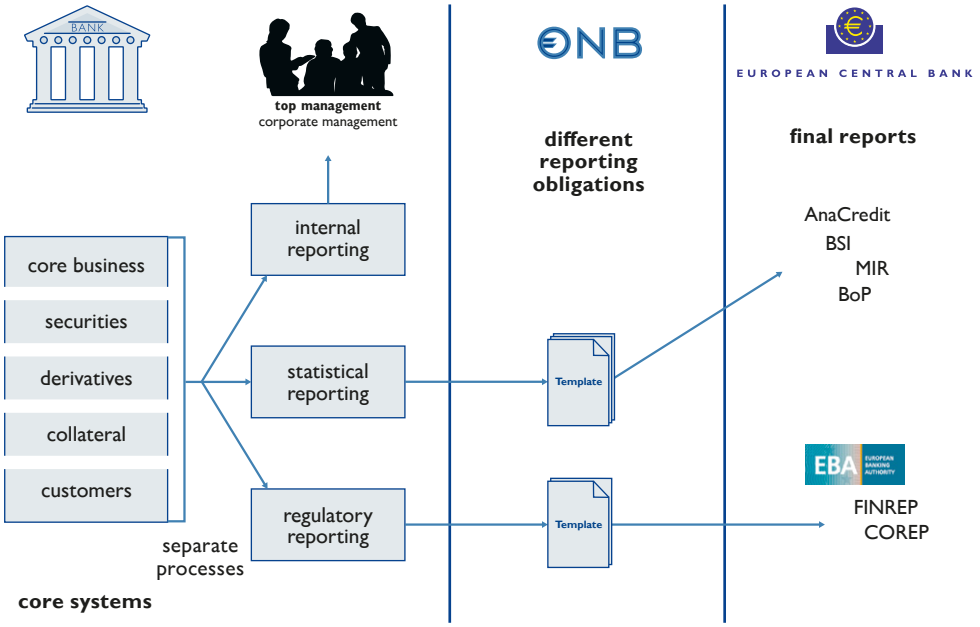
Traditionally, every authority devised its own approach to collecting data and defining requirements. This system not only increased the reporting burden but also frequently resulted in redundant and non-harmonized data collection schemes and thus in a lack of data consistency. Many different approaches also make it difficult to keep track of the overall reporting and compilation process. Additionally, the competent authorities often describe complex data requirements in verbal form, thus leaving room for interpretation. The lack of harmonized and precise specifications and data dictionaries may result in inconsistent implementations among banks and therefore, for instance, to different classifications of the same business case. Furthermore, without harmonization, data analysis becomes complicated, and establishing links between different reports is difficult. The more data are needed and the more granular they have to be, the more obvious the

[1] *"Implementing Technical Standards on Supervisory Reporting" (the EBA's ITS on reporting), see https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:JOL_2014_191_R_0001.*

[2] *https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32016R0867.*

Chart 1

Traditional silo reporting processes



Source: OeNB.

Note: AnaCredit = analytical credit datasets, BSI = balance sheet items, MIR = monetary financial institution interest rates, BoP = balance of payments, FINREP = financial reporting framework, COREP = common reporting framework.

inefficiency of such data collection and compilation processes becomes (see chart 1 for a simplified representation of traditional silo reporting processes). This unsatisfactory situation combined with the risk of exploding costs prompted Austrian banks and the OeNB to launch new approaches to data reporting.

Turner and Sedlacek (2015) lists the existing balance sheet-related reporting requirements that significant Austrian credit institutions (at an unconsolidated level) must meet for secured loans to nonfinancial corporations as an example (subject to different frequencies, different reporting deadlines and different aggregation levels). This example demonstrates how often the authorities collect redundant or similar information.

The OeNB has a long-term tradition of data collection and has acquired great experience in this area. Its statistics department has long been responsible for collecting and compiling all standardized statistical as well as regulatory data to be sent to the OeNB. Furthermore, the OeNB was one of the pioneers in collecting security-by-security data and using them for different purposes (see Sedlacek, 2008). The OeNB also has a long tradition of cooperating with banks to solve reporting issues. Against this background, the OeNB launched a discussion with banks about new and innovative ways in reporting already in 2011 (see also Hille, 2013).

The first section gives some background information about the important initial development phase of the new Austrian reporting landscape for banks. Section 2 reviews collaboration with banks, one of the key features of the OeNB's new approach to reporting. Section 3 describes the OeNB's reporting data model, its current use and an outlook for further development in depth. International aspects

are discussed in section 4. The final section provides an outlook for the future potential of the data model, such as its use for banks' internal reporting processes.

1 Launching a paradigm change in reporting

Some resistance has to be expected when a paradigm change is introduced. Therefore, it is crucial to bring the key players of all stakeholders on board. After several brainstorming sessions with banks' experts, the largest Austrian banks and the OeNB started a discussion about a new innovative reporting system at the top management level. It was also important not only to convince the banks of the idea, but to discuss different scenarios developed jointly by the OeNB and banks. When the discussion phase was wrapped up in 2012, the top management of the OeNB and the largest Austrian banks concluded a cooperation agreement featuring the following two pillars of the new reporting landscape:

1 establishment of a Standing Committee on Reporting (SCom) chaired by the OeNB;
2 joint specification of a precise integrated data model for statistical and regulatory reporting.

Legal requirements oblige banks only to send the reporting forms that the OeNB or international institutions like the EBA specify but not to implement the data model. However, the OeNB expects banks to do so. It was agreed that this integrated data model should be not only the basis for external reporting to the OeNB, but also for banks' internal financial and risk reporting in the long term.

In parallel, banks and the OeNB started a discussion on the most efficient way to implement the joint data model. They assessed three scenarios:

1 joint hardware (e.g. in the form of a joint data processing center), but separate software development;
2 joint software development to be run separately in each bank;
3 establishment of a joint reporting company responsible for hardware and the maintenance of the joint software.

After an intensive discussion process, the largest Austrian banks decided on scenario 3 in 2014 and founded the joint company Austrian Reporting Services GmbH (AuRep). The OeNB does not participate in AuRep.

2 Collaboration with banks

2.1 Standing Committee on Reporting (SCom)

As a follow-up of the collaboration agreement, the Standing Committee on Reporting (SCom) was founded at the beginning of 2013 and held its first meeting in June 2013. SCom is the central communication platform on reporting for the OeNB and Austrian banks. It consists of a steering body and expert groups, and is chaired and organized by the OeNB.

The steering committee meets every two months. Its members are line managers responsible for regulatory and statistical reporting at the largest Austrian banks[3] and the OeNB. Representatives of the Financial Market Authority, the

[3] *Erste Group Bank, UniCredit Bank Austria, Raiffeisen Bank International, Raiffeisen Landesbank Oberösterreich, Sberbank Europe, BAWAG, Volksbank Wien, Hypo-Verband, Austrian Bankers' Association.*

Austrian Economic Chambers and AuRep act as observers. The main tasks of this body are:

- holding strategic discussions and taking decisions on (1) the development of the reporting data model (e.g. what contents are to be integrated, what timelines for data model releases are to follow, and what specific modeling aspects are to be included), and (2) necessary amendments to national legal acts;
- giving advice on specific methodological issues;
- providing information about national and international developments in statistical and regulatory reporting.

The OeNB organizes and chairs several expert group meetings a year in addition to the steering committee meetings. The frequency of the meetings depends on the intensity of the development phase. The banks' experts who attend those meetings are mostly from reporting divisions, but sometimes also from specific divisions like risk or accounting, depending on what is being discussed. Additionally, experts from software development companies as well as from consulting firms are invited following the recommendation of banks' experts. Reporting developments are presented and specific data model issues are discussed and developed at expert group meetings. The expert groups are authorized to take minor decisions on data modeling issues and to prepare strategic topics for the SCom steering body for decision.

Participants of both groups may submit topics for discussion.

In addition, the top management meets once a year to review recent developments in reporting and to decide about strategic aspects going forward.

Altogether, our experience shows that intensive discussions and joint decisions are a win-win situation and very much appreciated by both the OeNB and Austrian banks. Practice has shown that open communication fosters mutual understanding and facilitates the drafting of national legislation. The presentations and minutes of all the meetings are documented transparently in the OeNB's reporting wiki, which is accessible to banks, software developers, consultants and all parties that have a justified interest in reporting issues on request.[4]

2.2 AuRep

Seven banks founded AuRep in 2014 as a shared reporting platform. In 2015, the Raiffeisen banking sector also joined AuRep, which means that now more than 90% of the Austrian banking sector (in terms of the number of banks and the balance sheet total) uses this platform. AuRep acts as a central manager and tester of the joint reporting software and constitutes the interface between software developers and the banks that use the software. Additionally, AuRep organizes training courses on the reporting software and organizes expert group meetings to discuss specific data model issues for banks' staff. AuRep is a central point of contact to the OeNB on technical issues and cooperates closely with OeNB on the development of the integrated data model.

However, banks are still responsible for managing their internal data warehouses such that they are able to fill the input layer of the integrated data model (see section 3.1), which is implemented and operated by AuRep. Furthermore, banks are

[4] *http://www.myoenb.com/. To request access, users must fill in the contact form at https://www.oenb.at/Kontakt/Kontaktformular.html?id=11823bac83654f26b0078a4e8ea016a8.*

liable for the data quality of their reports as well as for calculating own funds, risk weighted assets, consolidated values and other key figures. For confidentiality reasons, AuRep's staff has no access to the physical data included in the data model. However, AuRep tests the model and software with real data that banks provide in an anonymized form.

Banks' main reason for establishing this reporting company was to benefit from as many synergies as possible. AuRep's structure and tasks indicate the key synergy potentials:

- AuRep is a central technical platform for generating reporting data.
- While developing a uniform software would have been possible without establishing AuRep, it is more convenient to have AuRep maintain and (to some extent) test the unique reporting software that is based on the joint reporting data model rather than to have separate reporting activities in every bank.
- AuRep provides for a shared IT Infrastructure and operations.
- AuRep facilitates communication between banks on
  - discussing and agreeing a common strategy on data model development;
  - sharing the data quality management methodology;
  - establishing AuRep as banks' competence center for reporting and thus enabling a common interpretation of the reporting data model and reporting rules.
- AuRep is the central technical interface to the OeNB. It concentrates technical issues in a single company and thus eliminates banks' need to address separate, mostly similar, requests to the OeNB.

Realization of these synergies is expected to lead to (1) higher data quality, (2) a reduced reporting burden (and thus reduced costs), and (3) better knowledge transfer between banks.

Although such a project implies substantial challenges and a large initial effort, AuRep is on a good way to achieving these synergies and has established itself as a successful intermediary between banks, the software developer and the OeNB. However, AuRep still faces many permanent technological challenges, such as (1) the high number of (dependent) processes, (2) a high data volume, (3) banks' different interests, (4) necessary regression testing of the software, and (5) limited test cases. The first two issues could lead to massive performance problems, while the last three form constraints on the successful delivery of a new software release. Data security is also a critical and important topic. For instance, it must be ensured that each staff member of a certain bank has only access to the data of that bank.

Apart from the synergy potentials for the banking industry, the OeNB itself had high expectations of the establishment of a central reporting platform. The (expected) advantages include the following:

- A central platform would improve the quality of reports by
  - providing for consistent implementation of the data model;
  - centralizing enrichment, aggregation, quality assessment and correction procedures.
- A central platform acts as a central contact for technical reporting issues.
- A central platform provides support for data modeling.

AuRep has become a key player in reporting and has gained great acceptance in the reporting market.

3 The OeNB's reporting data model

3.1 Features

3.1.1 Overview

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. To this end, the data model features a granular entity-relationship model (ER model) as a central element that captures all information needed to fulfill reporting requirements. This model, which is referred to as the basic cube, was developed jointly by the OeNB and Austrian banks. The OeNB's reporting data model also comprises algorithms in a formal pseudo code that enrich the basic cube and generate the following primary reporting frameworks:

1 integrated reporting frameworks (smart cubes): Smart cubes are multi-dimensional reporting frameworks that use data collected by the OeNB to generate various secondary statistics. The description of these reporting frameworks forms a part of the OeNB's reporting data model.
2 supervisory reporting requirements such as those of the EBA: The OeNB collects these data in the form of data templates.

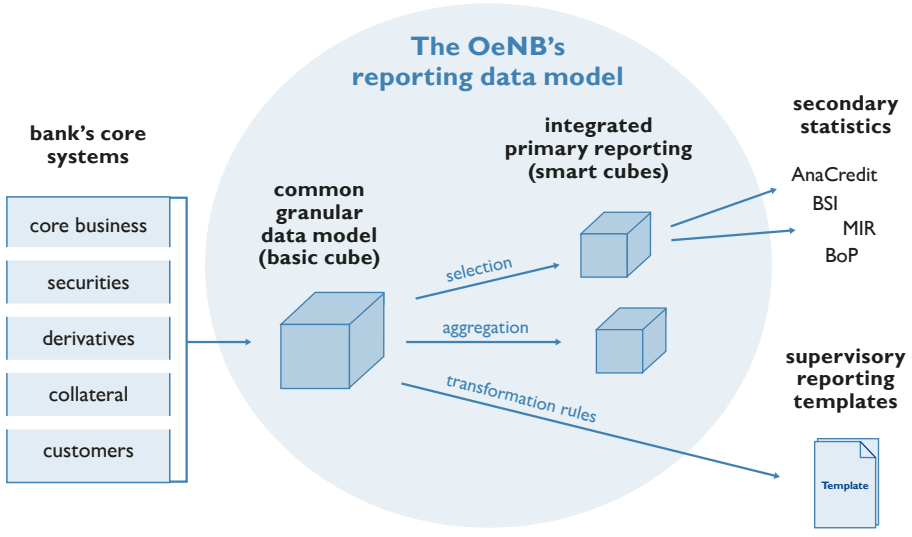
It is important to note that the OeNB cannot access the granular input data, just the (mostly aggregated) primary reporting data.

Chart 2 shows the data flow within the context of the OeNB's reporting data model. Granular data are sourced from banks' core systems into the basic cube, which is used to meet reporting requirements in smart cubes or supervisory reporting templates by applying harmonized enrichment algorithms and transformation rules.

The OeNB's reporting data model aims at giving a complete, single description of the contents of the reporting data and in this way at minimizing the room for interpretation. Therefore, the basic cube was designed to be a normalized, logical

Chart 2

Data flow in the OeNB's reporting data model



Source: OeNB.

Note: AnaCredit = analytical credit datasets, BSI = balance sheet items, MIR = monetary financial institution interest rates, BoP = balance of payments.

data model; also, the transformation rules that describe the derivation of reporting requirements from the basic cube were specified in a formal language. In addition, descriptions in verbal form are available to make the algorithms easier to understand. Traditional text-only descriptions always include some ambiguities or are not necessarily suited to covering all special cases. The OeNB's reporting data model thus constitutes a precise reporting manual for all reporting frameworks covered and replaces all national reporting instructions.

3.1.2 The basic cube

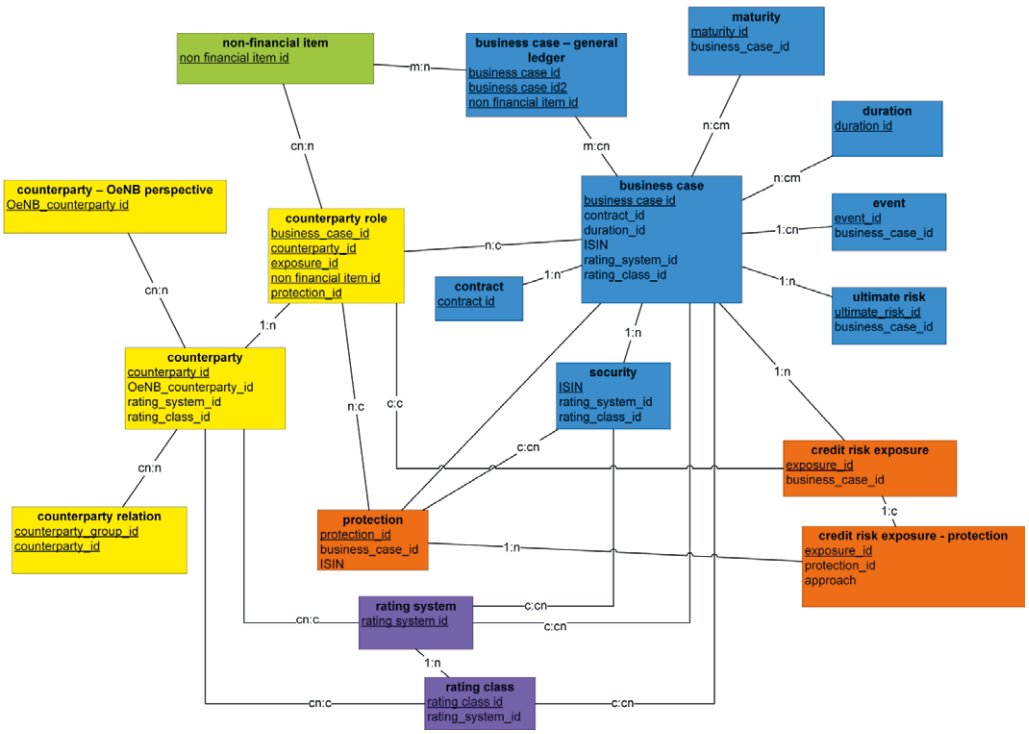
The basic cube is a single, standardized input entity-relationship model (ER model) for different reporting frameworks. This form of representation implies a redundancy-free depiction of the basic cube's contents ("third normal form"). Moreover, it implies consistency of the reporting data of a particular bank, as all required data are derived from a single, granular database.

For example, in AnaCredit, the carrying amount of a loan that is used internally for accounting purposes has to be reported on a loan-by-loan basis. The same value is used to aggregate data points for the reporting of supervisory financial information (FINREP)[5].

Furthermore, the joint reporting model implies consistency of reporting data between different reporting agents, as the data are structured and processed in the same manner in each case. Data are modeled from the perspective of the reporting agent in the basic cube, and thus as closely as possible to the core banking systems. Chart 3 shows the ER model of the basic cube.

Chart 3

Entity-relationship model of the basic cube



Source: OeNB.

[5] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32015R0534.

The basic cube has different entities – each represented by a box in the ER model – for different types of information. Every instrument of the reporting agent – such as a loan, deposit, security or derivative – is represented in the business case entity the basic cube model (see chart 3). Many attributes are available at the instrument level to describe all relevant characteristics of a business case needed to meet different reporting requirements, e.g. type of instrument, issue and maturity date, purpose of a loan, accounting classification.

Chart 4

Part of the code set for the attribute "purpose of a loan"

Source: OeNB.

Most attributes feature a predefined code set that is granular enough to serve all reporting requirements integrated in the OeNB's reporting data model. Chart 4 shows the code set for the attribute "purpose of a loan" as an example. Loans with the purpose "construction investment – real estate" and loans with the purpose "construction investment – other" are both reported as "construction investment" in AnaCredit. However, the distinction between the two categories is necessary, as loans with purpose "construction investment – real estate" are reported as "real estate financing" according to national requirements whereas loans classified as "construction investment – other" are not.

Another central entity in the basic cube is the counterparty entity (see chart 3). It contains information on counterparties that have a business relationship with the reporting bank. For example, all debtors of loans that are disbursed by the reporting bank as well as issuers of securities that the reporting bank holds are represented in the counterparty entity. Furthermore, if a third party services a loan disbursed by the reporting bank, that third party has to be registered in the counterparty entity.

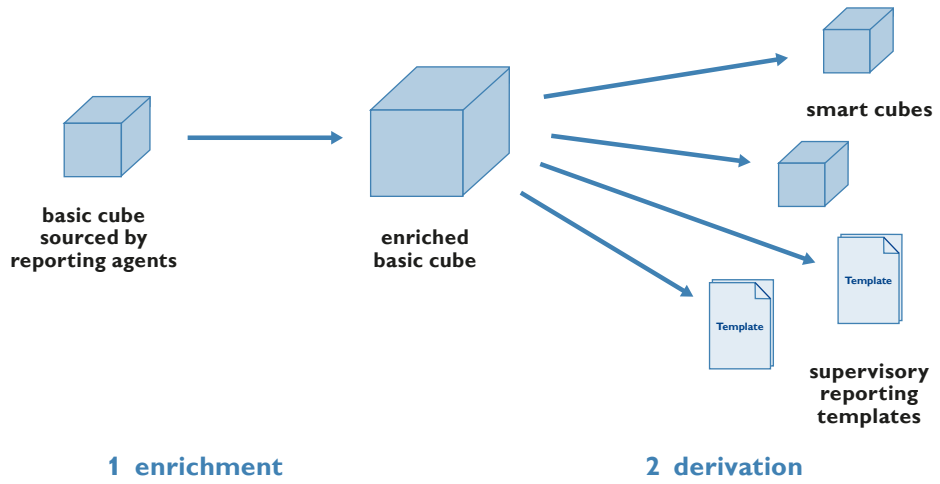
The ER model structure of the basic cube implies that its contents are redundancy-free and consistent, as different entities for all relevant levels of information are available. As a case in point, the economic sector is obviously a characteristic of the counterparty and thus is modeled at the counterparty level. If the economic sector were modeled at the instrument level, it would have to be shown for each instrument in a redundant way. In this fashion, inconsistent economic sectors would be possible on two different loans to the same debtor.

The basic cube model also contains entities for rating systems and ratings, reference data of securities, collateral, (credit risk) exposures, events per instrument such as renegotiations as well as non-financial balance sheet information (e.g. tangible assets).

A particular feature of the integrated data model is an entity containing the reference data of counterparties maintained by the OeNB. The OeNB provides

Chart 5

Data processing steps in the OeNB's reporting data model



Source: OeNB.

the reporting agents with a standardized set of counterparty reference data as a service to guarantee that the classification of counterparties is harmonized within aggregated reports. For example, whenever the country of origin of a counterparty is required for reporting purposes, the reporting agent selects the country code from the OeNB's counterparty reference data rather than from the reporting agents' internal data, provided the standardized set contains the respective counterparty.

3.1.3 Data processing

Data sourced into the basic cube must be transformed and aggregated to generate reporting data. The transformation and aggregation rules are expressed in a formal language as algorithms or select statements.

The first step of processing is called enrichment (see chart 5). During this phase, the detailed input information is used to deduct characteristics that are relevant for multiple reporting purposes, and these characteristics are then represented in the basic cube as "enriched information."

For example, many aggregated reporting frameworks require loans, deposits and securities to be broken down by original and/or residual maturity. The basic cube meets this requirement by including different dates as attributes per instrument, such as the inception date, the date of the first settlement and the final maturity date. Both the original and residual maturity are attributes in the basic cube that are calculated in the enrichment step. For example, the original maturity of loans is roughly the difference in days between the final maturity date and the inception date. Additionally, if there is no fixed final maturity date, the creditor's rights to claim the repayment of the exposure have to be taken into account. The calculation result is stored in the form of maturity buckets that are granular enough to fulfill all relevant reporting requirements.

Chart 6

Enrichment algorithm for the attribute "90 days past due"

```
FUNCTION 90_DAYS_PAST_DUE(business_case_ID id, Observed_Agent_ID oa, Reporting
_Date repDate)
    //Selection of the instrument's past due date from the Basic-Cube's entity
    containing all business cases
    past_due_date = SELECT past_due_date FROM business_case
    //By default, the instrument is not considered past due
    90_days_past_due = FALSE
    //In case the instrument is not past due, the past due date is set to the
    value "999912312". Further conditions have to be considered only for past
    due instruments.
    IF (past_due_date  IS NOT "99991231")  THEN
        //The term (repDate - past_due_date) computes the difference between
        the two dates in days.
        IF ((repDate - past_due_date) > 90) THEN
            //In case the difference between the reporting date and the date of
            past due is more than 90 days, the variable 90_days_past_due is set
            to TRUE.
            90_days_past_due  = TRUE
        END IF
    END IF
    //The attribute 90_days_past_due is returned.
    RETURN 90_days_past_due
END OF FUNCTION
```

Source: OeNB.

The transformation rules are drafted as algorithms in a pseudo code language based on SQL (Structured Query Language) syntax. Chart 6 below shows the enrichment algorithm for calculating the attribute "90 days past due" for loans as an example.

In the second step, the contents of the reporting templates are derived based on the information in the basic cube from sourced and enriched data (see chart 5). 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. Thus, the granular information in the basic cube has to contain all information per instrument needed to cover different business aspects, e.g. financial information, risk figures and accounting values.

With the implementation of the AnaCredit reporting framework, the full synergy effects of the standardized input layer came into effect, as the basic cube already contains two-thirds of all attributes required by the AnaCredit regulation at the loan-by-loan level. Thus, only the remaining AnaCredit information not yet not covered had to be added to the basic cube.

The OeNB's reporting data model has to distinguish between two different types of reporting frameworks: (1) smart cubes, which are integrated reporting

frameworks that serve multiple, mostly statistical, purposes and are designed as multidimensional data cubes; (2) traditional reporting templates for supervisory data. Due to the diverging formats, the derivation rules look different but are essentially of the same nature.

3.1.4 Smart cubes

The concept behind smart cubes is to collect data at a sufficiently granular level only once and to generate multiple statistics from them. Every business case is reported only once in the smart cube reporting framework.

The multi-use of data concept makes sense because many statistical requirements use overlapping attributes or criteria for breakdowns. In particular, the ECB's statistics on the balance sheets of monetary financial institutions[6] (BSI) as well as those on interest rates applied by monetary financial institutions[7] (MIR) require breakdowns similar to those used for the balance of payments. For example, most statistics distinguish between certain loan types. The classifications differ slightly between reporting frameworks, but can be described by a common, possibly more granular list that is reported in the loan smart cube. This cube contains sufficient information to meet multiple statistical requirements (see details in section 3.3), but the information is less granular than at the single-loan level.

Smart cubes also have the great benefit that they contain more granular data, thus allowing the OeNB's analysts to explain developments without further inquiries to reporting agents, whereas more aggregated data often require requests. For example, analysts can explain an increase in interest rates as having been caused by loans that have become past due because the loan smart cube includes past due information.

At the initial stage of the project, the smart cube framework included three basic types of cubes containing financial information (see also Turner et al., 2014) of securities, loans and deposits and an additional cube containing anchor values, i.e. aggregates designed mainly for data quality checks. These cubes have up to 36 dimensions, such as instrument type, purpose of the loan and country of ultimate risk. Furthermore, for each data record, multiple values are reported, including the outstanding nominal amount, the new business amount and the average interest rate. By default, each value is broken down by all dimensions of the cube; however, for some values and attributes, the extent of granularity is restricted to enable only the combinations of attributes relevant for secondary statistics. For example, the effective interest rate is reported only for credit for consumption and lending for house purchase extended to households.

The reporting data from these cubes are used to generate BSI and MIR statistics as well as the locational and consolidated banking statistics of the Bank for International Settlements (BIS).[8] Furthermore, banks' portfolio and other investment data for the balance of payments and other external statistics[9] are generated

[6] *See https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32013R1071.*

[7] *See https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32013R1072.*

[8] *https://www.bis.org/statistics/bankstatsguide.htm.*

[9] *https://www.ecb.europa.eu/stats/balance_of_payments_and_external/balance_of_payments/html/index.en.html.*

from these reporting data. Moreover, the data serve to make detailed analyses of maturities, country risks and foreign currencies.

On adoption of the AnaCredit regulation and amendment of the securities holdings statistics regulation[10] including group data (Securities Holdings Statistics Group, SHSG) in 2016, two additional smart cubes were developed.

The first additional smart cube is a granular reporting framework on individual credit data. It includes all information necessary for AnaCredit reporting purposes and all complementary data that are relevant for the OeNB's Central Credit Register (CCR), i.e. information not only on loans but also on securities, off-balance sheet items and derivatives. For operational reasons, it was decided to integrate the AnaCredit/CCR requirements with the existing loan smart cube only in a later second step.

The second smart cube is a granular reporting framework of securities at the group level to collect SHSG data, which was implemented as a complementary framework to the securities smart cube and the CCR.

All dimensions and values contained in smart cube frameworks are generated as the result of derivation rules whose syntax is identical to that of enrichments of the basic cube (see section 3.1.3).

3.1.5 Integration of supervisory reporting requirements

Most supervisory data are collected as data templates rather than integrated reporting frameworks. Because of the nature of the template structure, other rules of transformation from the basic cube apply than to the smart cubes: each applicable cell of a template contains a mapping rule that serves as a filter on the basic cube to select all instruments relevant for the respective cell. All conditions that have to be fulfilled are connected by a logical AND ("&&"). Additionally, each mapping rule refers to the kind of value that has to be reported in the cell via "VALUE(…)." The sum of the respective values of all relevant instruments has to be reported in the cell.

Chart 7 shows the derivation of a data point in FINREP, 08.02, subordinated financial liabilities: the carrying amount including accrued interest is the selected value.

Chart 7

Derivation of a data point in FINREP, 08.02. subordinated financial liabilities

	Carrying amount
	Cost-based method
Deposits	VALUE("Carrying amount including accrued interest") && GF00_Instrument_Type_Code == "Deposits" && GFA126_Accounting_classification_FinRep_NGAAP_Code == "Non-trading non-derivative financial liabilities measured at a cost-based method[1]" && GF05_Subordinated_Code != "Not subordinated"

Source: OeNB, EBA.

[1] EBA ITS, Annex IV.

[10] *https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32012R1011.*

Furthermore, all deposits from the accounting classification "Non-trading non-derivative financial liabilities measured at a cost-based method" that are subordinated are selected as relevant instruments in the cell.

3.1.6 Drilldowns of aggregated reporting data

Most reporting templates require aggregated data. To ensure data consistency and to improve the analytical possibilities, it is crucial to link aggregated data points with micro data.

The OeNB's harmonized reporting data model allows all stakeholders to understand at a glance how aggregated data points are generated from granular data. Consequently, interrelations between reporting data of different reporting frameworks become visible in the form of transformation rules. With this information, data users can drill down aggregated data points to the underlying micro data.

For example, the OeNB already collects data on securities at the ISIN level in the securities smart cube. Thus, it is possible to drill down from the carrying amount of trading debt securities in the FINREP framework to the single underlying ISINs in the securities smart cube.

In the near future, the drilldown possibilities will increase considerably on integration of the national CCR and AnaCredit in the reporting model. An abundance of harmonized information on financial instruments on the asset side as well as on derivatives and off-balance sheet exposures will be available. In particular, risk data on an exposure-by-exposure basis are reported for each instrument in the CCR alongside ratings and, if available, the PDs of the debtors. Once the drilldown options have been fully utilized, the number of inquiries from the OeNB should decrease significantly while the analytical options will grow substantially.

3.2 Advantages and challenges

- One of the main advantages of the OeNB's reporting data model is the implicit consistency of reported data in and across reporting frameworks resulting from the use of a single, granular database for all reporting frameworks. Obviously, data users and compilers benefit from higher data quality, as do reporting agents. In particular, having achieved stability of the new system, reporting agents benefit from having to field fewer queries from authorities and submitting fewer revisions to correct inconsistent data.
- The integrated approach reduces the number of reporting frameworks significantly and thus lowers expenses for reporting agents and data compilers. Moreover, as smart cubes are more granular than the resulting secondary statistics, the OeNB rather than the reporting agent performs the aggregation.
- Integration makes content more complex. In particular, quality checks and the process of reporting and generating secondary statistics become more complex, as the data are highly interrelated. This complexity has to be managed at the technical level, which is why the OeNB introduced a new, highly modern system landscape for data processing and analysis. Additionally, the complexity at the reporting data content level is managed by the common, transparent definitions in the basic cube.
- More complex requirements and processes imply changed job qualifications in the reporting divisions of reporting agents as well as of data compilers and users: Whereas it remains crucial for them to understand the methodological aspects

of reporting requirements, they also need to master the more technical aspects of data processing. In particular, they have to understand the functionality of entity-relationship models and to tackle formal transformation languages.
- Also, data volumes rise exponentially as the degree of integration grows. However, the OeNB's experience has shown that the number of processes rather than the number of data points matters.
- The analytical possibilities grow at the same rate as the data volume: Integrated reporting frameworks allow more flexibility in performing quality checks than the traditional template format, as the data are much more granular. In particular, an integrated dataset allows for an analysis of the interrelation between different attributes.

3.3 State of play

All contents of the OeNB's reporting data model are documented in a wiki that is accessible to banks; additionally, main contents of the wiki are published (in German) on the OeNB's website at regular intervals.[11]

Reporting requirements for the following statistics, which are collected in the form of smart cubes, have already been specified within the OeNB's reporting data model:
- the ECB's BSI and MIR statistics
- BIS locational and consolidated banking statistics
- banks' related components of the balance of payments and other external statistics as well as the financial accounts
- national financial market stability statistics
- the ECB's AnaCredit dataset
- the national CCR (including specific requirements on securitization, credit risk exposures and rating systems)
- the ECB's Securities Holdings Statistics Group (SHSG) statistics

Additionally, reporting templates for the following supervisory frameworks are currently integrated into the OeNB's reporting data model:
- the ECB's (simplified) FINREP under National Generally Accepted Accounting Principles
- sovereign exposures as part of COREP under the EBA's Implementing Technical Standards (ITS) on supervisory reporting
- FINREP (IFRS) under the EBA's ITS on supervisory reporting (under development)
- asset encumbrance under the EBA's ITS for supervisory reporting (under development)
- resolution planning[12] under the European Banking Authority's ITS on procedures, forms and templates for resolution planning (under development)
- national requirements on balance sheet information
- national requirements on covered deposits

To meet all these reporting requirements, the basic cube currently features 245 attributes available for sourcing on 31 entities and additionally 45 attributes that are generated by enrichments. Altogether, 122 different kinds of values are available for instruments, exposures and protection items.

[11] *https://www.oenb.at/Statistik/Meldewesen/gemeinsames-meldewesen-datenmodell.html.*

[12] *https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32016R1066.*

3.4 Next steps

The OeNB's reporting data model aims at covering all reporting requirements addressed to banks that cover information on business aspects available in core banking systems on a granular level where meaningful.

The OeNB has adopted a stepwise approach to reach this goal: all newly developed reporting frameworks such as AnaCredit or resolution planning under the EBA's ITS are implemented in the OeNB's reporting data model immediately while existing reporting frameworks are being integrated gradually.

At the data model documentation level, automatization options are being improved constantly. In particular, the OeNB is considering creating a database containing all contents of its reporting data model and transferring the transformation rules into a fully standardized, machine-readable formal language such as the Validation and Transformation Language (VTL) developed by the Statistical Data and Metadata eXchange (SDMX)[13] community.

Furthermore, in the long run, quality measures are to be shifted from the reporting data to the basic cube input data. At this point, it is worth considering new methods in big data analysis, such as data mining and machine learning.

4 International aspects

4.1 Groupe de Réflexion on the integration of statistical and supervisory data (GRISS)

Given increasing data requirements, non-harmonised definitions and data collection schemes alongside soaring costs, the ESCB Statistics Committee (STC) established a Groupe de Réflexion on the integration of statistical and supervisory data (GRISS) in 2013. As identified in the GRISS mandate, "an integrated approach consists of managing the data needs of specific domains (monetary policy, supervision) as parts of a comprehensive system, rather than independently from each other in separate 'stovepipes', paying attention to the overall process ranging from the possible data sources to the final use" (Turner and Sedlacek, 2015). In other words, the idea is to facilitate the use of existing data wherever possible ("multi-use of data") rather than creating new reports for each new data requirement.

The group agreed on several recommendations, such as (1) starting the work toward the ultimate goal of a comprehensive and harmonized common reporting framework for regular data transmission by banks to European national central banks (NCBs), and (2) developing a European input approach in close collaboration with the banking industry to possibly organize the banks' internal processes for reporting to the authorities in an integrated fashion. Regarding the GRISS recommendation to establish a high-level forum that includes the European Commission, the EBA and the ECB that would be tasked with enhancing the cooperation at strategic level among the relevant stakeholders involved in building up an integrated reporting system for banks, it could be mentioned that the ECB recently started a "dialogue with the industry" at a first meeting in March 2018.[14]

[13] *https://sdmx.org/?page_id=5096.*

[14] *https://www.ecb.europa.eu/stats/ecb_statistics/co-operation_and_standards/html/index.en.html.*

4.2 Banks' Integrated Reporting Dictionary (BIRD)

As a follow-up of the GRISS recommendation to develop a European input approach, the STC created the Expert Group on Statistical and Banking Data Dictionary (EG SBDD) in 2014 to establish a reporting dictionary for banks, among other things. In three work streams, the expert group (1) analyzed reporting requirements and their implementation in a formal language, (2) developed the methodology for the dictionary, and (3) elaborated the governance structure.

In 2016, a pilot project on the development of the Banks' Integrated Reporting Dictionary (BIRD) for the new requirements on AnaCredit and SHSG was launched at the suggestion of the EG SBDD and as the basis for the preparatory work of this group. The objective of the BIRD initiative is to develop a European input data model aiming at harmonizing and integrating banks' internal processes for reporting to the authorities in a way comparable to that for the basic cube and the transformation rules of the OeNB's reporting data model.

Contributions by the representatives of the ECB, several NCBs and participating commercial banks helped bring the pilot project to a successful close in April 2017. Due to positive feedback provided by commercial banks, the BIRD initiative was continued in 2017 with the development of a BIRD for FINREP requirements, which was completed in June 2018. Subsequently, (the main components of) the EBA's COREP, asset encumbrance and resolution planning are to be implemented in the BIRD, as the primary reporting within the EBA's ITS has already been harmonized compared to statistical reporting. Ultimately, the BIRD aims at covering all reporting frameworks for banks, including BSI, MIR and securities holdings statistics sector data.

The main deliverable of the BIRD is a data dictionary realized as an Access database containing a logical description of the data and transformation rules that a bank may find useful to fulfill the requirements of European authorities. The BIRD is not mandatory but rather a service to European banks and all interested parties. It is available as a public good on the BIRD website.[15]

The BIRD activities, including the creation and maintenance of the BIRD content, are carried out by a group of experts from NCBs and commercial banks whose work is coordinated by the ECB. The organizational set-up of the BIRD is similar to the OeNB's collaboration framework with banks (SCom, see section 2.1): the BIRD Steering Group is composed of managers from the ECB, several NCBs and the commercial banks that participate in the BIRD initiative. The Steering Group decides on the BIRD priorities and multiannual work program and oversees the work of the BIRD Expert Group.[16]

4.3 Integrated Reporting Framework (IReF)

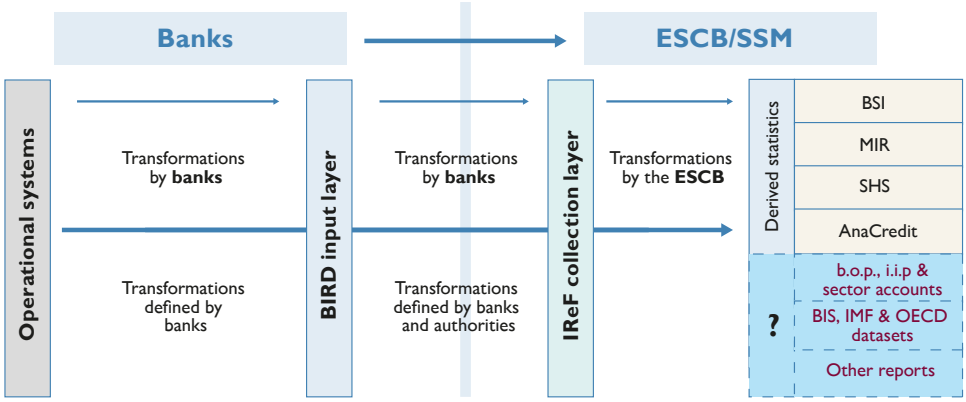
In 2014, as a follow-up of the GRISS recommendation to establish a common reporting framework, the STC established the Task Force on the European Reporting Framework (TF ERF), which was chaired by the OeNB. This task force was mandated to develop a European Reporting Framework (ERF) covering the existing ECB reporting requirements for banks for (1) balance sheet items, (2) MFI

[15] *http://banks-integrated-reporting-dictionary.eu/.*

[16] *http://www.public-test.banks-integrated-reporting-dictionary.eu/wp-content/uploads/2018/06/BIRD_Steering_Group_-_Charter.pdf.*

Chart 8

Reporting process with BIRD and IReF



Source: https://www.ecb.europa.eu/pub/pdf/other/ecb.escb_integrated_reporting_framework201804.en.pdf, figure 2, p. 5.

(monetary financial institution) interest rates and (3) securities holdings statistics targeting mainly deposit-taking corporations. Moreover, the task force was founded to support ongoing work on establishing a common granular analytical credit dataset (AnaCredit) and to investigate possible ways for further integrating existing reporting schemes and new requirements developed, in particular, by the Single Supervisory Mechanism (SSM) and the EBA. This task force finished its work in 2016 with a final report that included a first proposal for a phase 1 European Reporting Framework.

Following the recommendations in the final report, the STC established an Expert Group on the European Reporting Framework (EG ERF) in 2016, which was to (1) prepare a cost-benefit analysis (CBA) on the one hand and (2) continue work on the framework itself on the other hand. In 2018, the European Reporting Framework was renamed Integrated Reporting Framework (IReF). The quantitative CBA planned for the first half of 2019 will be a follow-up of the qualitative stock-taking questionnaire (QST) for compilers, reporting agents and users to be conducted in the second half of 2018. This QST is aimed at assessing all stakeholders' opinions on different approaches to achieving the IReF objectives to standardize and integrate existing reporting frameworks across domains and countries. The findings of the QST will be used to more precisely define applicable IReF solutions that will form the basis for the CBA.

The expected synergy effects of a parallel development of the IReF and the BIRD (see chart 8) are very high, as the more harmonized the primary reporting of banks is, the more impact the BIRD will have. Conversely, the IReF would benefit from the BIRD as a common, transparent set of definitions for reporting requirements.

More details on the current status of the IReF and the BIRD are available on ECB's website under "ESCB long-term strategy for banks' data reporting."[17]

5 Outlook and conclusions

The integrated data model will provide optimum benefits if banks use it for internal reporting in addition to external reporting.

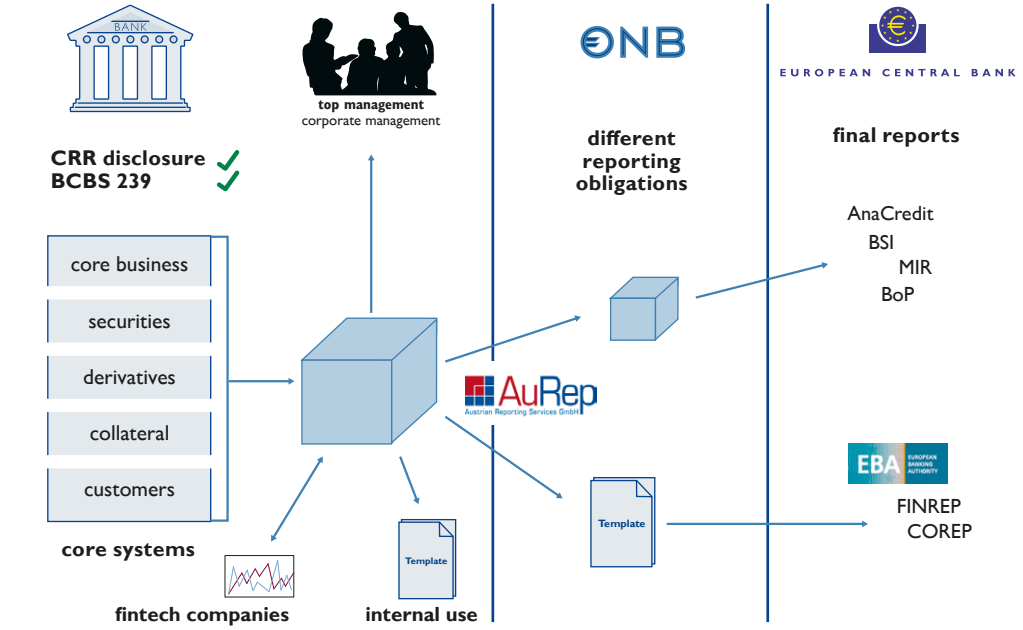
[17] *https://www.ecb.europa.eu/stats/ecb_statistics/co-operation_and_standards/reporting/html/index.en.html.*

Certainly, some partially integrated reporting processes in banks are already in place, but many banks process internal financial and risk reporting separately from external statistical and regulatory reporting. The processes follow separate data quality management and enrichment procedures, and data are mostly corrected in the data warehouses (at an aggregated level) rather than at the business-case level. This gives rise to inconsistencies between the different reports sent to authorities as well as between external and internal reports (see chart 1 for a simplified representation of banks' traditional silo reporting processes).

Banks will need to integrate their reporting processes more strongly because transparency requirements will increase, e.g. disclosure requirements under pillar 3 of the CRR[18] are envisaged to be subsets of EBA's FINREP and COREP. Also, consistency between granular data and aggregates has to be stepped up to meet the Basel Committee on Banking Supervision's standard 239 (Principles for effective risk data aggregation and risk reporting) and AnaCredit requirements. The data model approach entails a stronger focus of data governance activities on data supply than on reporting, which has an impact on organization, technology and processes. This, however, may deliver big advantages for internal reporting and confidence in decision making. The basic cube could be established as a central data warehouse that can be used as standardized interface for different purposes. Besides the OeNB, banks themselves could in the long run use an extended basic cube for internal reporting purposes as well as a standardized interface for other market participants, like fintech companies, as shown in chart 9 below.

Chart 9

Integrated reporting processes



Source: OeNB.

Note: AnaCredit = analytical credit datasets, BSI = balance sheet items, MIR = monetary financial institution interest rates, BoP = balance of payments, FINREP = financial reporting framework, COREP = common reporting framework.

[18] *https://www.eba.europa.eu/regulation-and-policy/transparency-and-pillar-3.*

Digitalization pressure and growing regulatory needs require all parties – the ESCB and banks alike – to rethink reporting processes. The new reporting data model represents a paradigm shift in regulatory and statistical data remittance. It fosters two-way understanding and transparency and is a driver to align internal and external reporting. The new reporting data model is expected to lead to higher consistency and data quality in general, less redundant data deliveries, higher flexibility and to lower reporting costs in the long run.

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