

The information model at *Banco de Portugal*: innovative and flexible data solutions¹

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1. Introduction

Efficient management of information is of the foremost importance to central banks. To cope with the tasks for which it is incumbent, the *Banco de Portugal*, as indeed most national central banks, need to manage huge amounts of data and other information. Therefore, to reap the benefits of ongoing advancements in IT systems it is critical to set up capable and flexible information models, while guaranteeing and improving the integrity, control, transparency and sharing of data.

With this in mind, *Banco de Portugal* (hereinafter referred as “the Bank”) is revamping its information model, including a streamlined governance structure, a revisited relationships management model and a continually improving information architecture based on micro-data and a Data Warehouse (DW).

2. Integrated Management of Information

The new integrated management of information model is intended to contribute to the:

- Elimination of unjustified redundancies.
- Definition of efficient mechanisms for compiling information.
- Improvement of the quality and integrity of data.
- Dissemination and agile consultation of the information.

Attaining these goals presupposes an effective cooperation between different functions of the Bank, based on sharing of knowledge and the identification of the information needs of both users and producers. The starting point is the conduction of a systematic and rigorous survey on the information requirements that are essential to pursuing the different tasks of the Bank.

¹ I would to thank Luís D’Aguiar, António Silva and Alexandra Miguel, from the Statistics Department, for their valuable contributions to this paper.

Three dimensions constitute the cornerstones of the integrated information model: the governance structure, a relationships management model and information architecture based on micro-data and a DW.

2.1. Governance Structure

The definition of an Information Governance Structure aims to ensure proper alignment between the strategic and operational levels of decision, which are mediated by the information management level of decision.

The **Statistics Department** is in charge of the **operational management**, including:

- a. Coordinating and monitoring the process of collecting quantitative information from external entities.
- b. Ensuring the central point of contact of the Bank with external entities on the reporting of quantitative information.
- c. Promoting, in conjunction with the IT Department and the user departments, the:
 - Organization of information architectures, namely by identifying objects, features and respective relationships and configuring the domains of integration to manage.
 - Definition of concepts and creation of metadata associated with different information objects in order to avoid duplication and facilitate the understanding/utilization of information.
 - Creation of catalogues/dictionaries/repositories of information available on particular operating systems.
- d. Monitoring the interaction and timely reporting of information to and from external entities.
- e. Analyzing the changing needs of quantitative information identified by other departments.
- f. Guaranteeing the quality of information, defining indicators of their use and ensuring its relevance and auditability.

In this context, the **various departments that are originators/users of information have the decentralized responsibility**, in collaboration with the department responsible for the centralized management of information, of analyzing in a critical manner the information and metadata that is most important for them and ensure its quality. They also collaborate on the identification of the functional requirements, having in mind the integrated and shared management of information – the identification of functional requirements is the basis for the consolidation of logical and technological architecture.

The several departments involved including the department responsible for the operational management of information – the Statistic Department – must create structures that guarantee the coordination of the projects that are implemented.

2.2. Relationships Management

The relationships' management between the various actors seeks to introduce greater efficiency in the communication process, normalizing and formatting it in the perspective of the customer. It is based in two principles:

- i. Information is a key asset of the Bank so it must be managed in an integrated way.
- ii. The exploration and analysis of information are distributed activities, typically related with the needs and tasks of each department.

An efficient management of information should be based on shared management, which requires a separation of responsibility between the “originator/user of information” and the “manager of information”. The first is best done in a decentralized way by each department, while the latter should be concentrated in a single department. In fact, given that information is a common good it should be managed by specialists – these specialists are better placed to collect, classify, manipulate, store, recover and disseminate information.

Moreover, to the users departments and the department that manages the information the relationship model includes two other players: the suppliers of information and the external clients.

2.3. Information Architecture: Micro-databases and a Data Warehouse

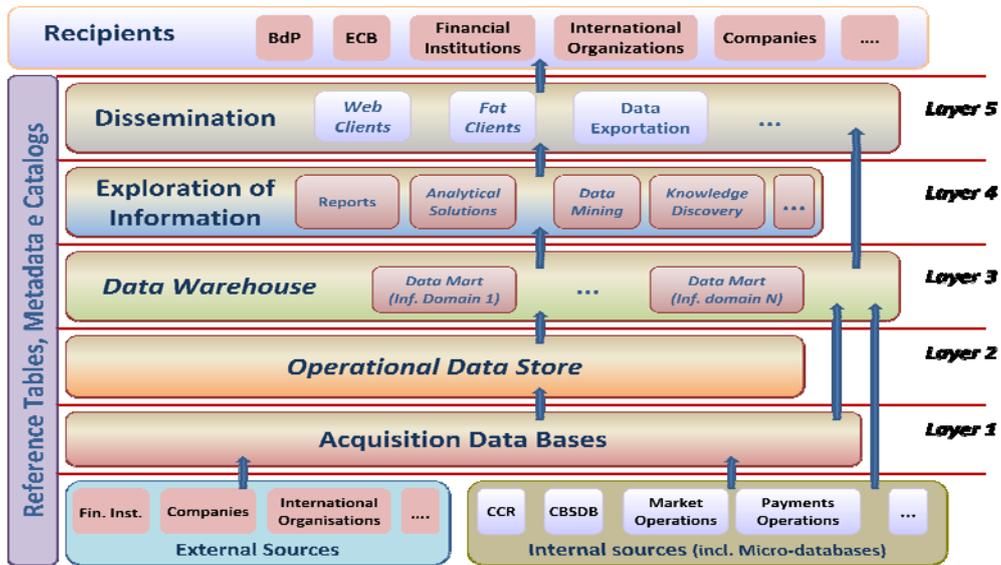
The Information Architecture is the infrastructural base of the information management and its aim consists of ensuring the quality, auditability and manageability of the data. It also serves to establish levels of responsibility in the management of information, separating the activities related to the organization and processing of information from the analysis and exploration activities.

It is based in five layers where the division between the information management and the exploration and analytics activities occurs from the 3rd to the 4th layer (Figure 1).

To facilitate the integration of the different domains and reduce the production burden and eliminate redundancies it is important to develop high quality reference tables and to maintain up-to-date metadata and catalogs.

We will turn our focus on two key aspects of the Information model – the predominant use of micro-data as input and the DW. These two aspects are related to the organization and processing of information activities but have a strong influence on the analytical and exploration capabilities of the information model.

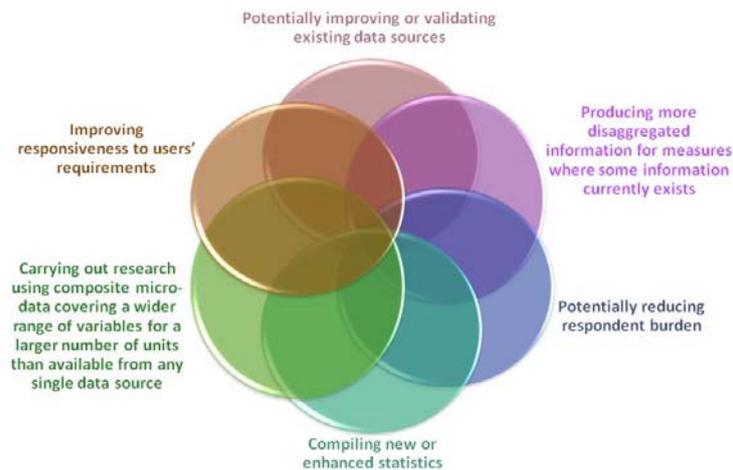
Figure 1 – The Information Model



2.3.1. Micro-data

The increasing demand for comprehensive, detailed and high-quality information has led the Bank to opt to increase its statistical exploration of available micro-databases. In fact, conventional data collecting systems cannot keep on expanding indefinitely to keep up with the ever-increasing need to fill information gaps or future data requirements² (Figure 2). In this respect, several advantages can be observed in micro-data such as, good population coverage, increased flexibility, relatively low reporting costs and more rapid response to ad-hoc data requirements.

Figure 2 - Micro-data – Strengths and Opportunities



² Please refer to Menezes, P. & D’Aguiar, L. (2013a) for a list of motives for not pursuing recurrently this approach.

At the Statistics Department our micro-databases already provide a good coverage of the economies' financial assets and liabilities, by sector and financial instrument (Figure 3). The Securities Statistics Integrated System (SSIS) gives us granular information on all kinds of securities; the Central Credit Register (CCR) has micro-data regarding loans to all sectors; the Central Balance Sheet Database (CBSD) gives us a complete view on the non-financial sector assets and liabilities; the Balance Sheet Information (BSI) on Financial Corporations has granular information on the assets and liabilities of the sector; the BoP/IIP system supplies micro-data on the assets and liabilities of the Rest-of-the-World sector. To complete the picture, it would be feasible to get information on "Insurance and Technical Reserves" and also more granular information regarding the "General Government" sector. However, our most immediate goal is to get granular data on "Currency and Deposits", which would allow us, in the shortest possible time, to have very reasonable micro-data coverage of the economies' total financial assets and liabilities.

Figure 3 - National financial accounts: financial assets and liabilities, by sector and financial instrument

	Non-Financial Corporations		Financial Corporations		General Government		Households + NPISH		Rest of the World	
	A	L	A	L	A	L	A	L	A	L
GOAL → CURRENCY AND DEPOSITS	38.908	0	44.499	317.955	19.160	13.566	153.183	0	144.725	68.953
SSIS → SECURITIES OTHER THAN SHARES	2.619	44.450	133.594	42.019	9.038	106.601	26.072	-4	105.294	83.551
CCR → LOANS	32.014	176.347	295.939	18.618	5.805	85.317	28.530	150.946	121.608	52.669
SSIS → SHARES AND OTHER EQUITY	49.528	173.806	41.210	96.342	37.955	0	102.762	0	104.546	66.882
FEASIBLE → INSURANCE TECHNICAL RESERVES	2.741	3.966	462	60.232	19	0	61.235	0	203	462
OTHER ACCOUNTS RECEIVABLE AND PAYABLE	30.241	37.082	23.185	18.203	11.173	6.713	14.958	13.865	13.632	17.327
	↑ CBSD		↑ BSI		↑ FEASIBLE				↑ BOP / IIP	

An example that can attest to the advantages of micro-data has very recently been observed in Portugal. From 2011 to 2014 the country has been under a Financial Assistance Programme led by the International Monetary Fund (IMF), the European Commission and the European Central Bank (ECB) – the so-called "Troika". Considering that one of Portugal's woes is related to high non-financial sector private (and public) indebtedness, the Troika specifically asked the Bank to produce a comprehensive range of statistics related to non-financial indebtedness.

Using the available micro-databases, namely the Central Balance-Sheet Database (CBSD), the Securities Statistics Integrated System (SSIS) and the Central Credit Register (CCR), and taking advantage of the reference tables and related administrative sources, the Bank was able to go beyond what was requested and started to publish, in the beginning of 2012³, very detailed statistics on non-financial sector indebtedness, including break downs by sector, companies size, exporting vs non-exporting companies, financing sector, types of loans, loans maturities, etc. Figures 4 and 5 are a good example of the kind of information that we have started to publish.

Figure 4 – Non-financial sector indebtedness

	Dec-11	Dec-12	Sep-13	Dec-13	Sep-13	Dec-13
	(10 ⁶ euros)				(y. r. - in %)	
	1	2	3	4	5	6
Total debt						
1 General government	214 378	241 413	251 179	252 914	6.9	4.8
2 Public corporations	49 039	44 371	45 482	44 886	0.7	1.2
3 Public corporations included in general government ⁽¹⁾	23 290	25 374	27 161	26 717	7.5	5.3
4 Public corporations not included in general government	25 749	18 997	18 321	18 169	-7.9	-4.4
5 Non-financial public sector (1 + 4)	240 126	260 410	269 501	271 083	5.8	4.1
6 Private corporations	310 630	311 731	309 631	306 973	-1.0	-1.5
7 Micro, small and medium corporations ⁽¹⁾	179 524	170 969	166 994	165 251	-4.1	-3.3
8 Micro corporations (321 thousand)	78 436	77 058	75 642	75 062	-2.8	-2.6
9 Small corporations (39 thousand)	50 845	46 155	44 608	43 807	-5.4	-5.1
10 Medium corporations (6 thousand)	50 243	47 756	46 744	46 381	-5.0	-2.9
11 Large corporations ⁽¹⁾ (1 thousand)	83 513	88 055	89 473	89 021	3.8	1.1
12 Non-financial holdings (3 thousand)	47 593	52 708	53 165	52 701	1.3	0.0
13 Private individuals ⁽¹⁾	173 892	167 115	161 688	159 918	-4.4	-4.3
14 of which: housing	122 928	118 392	114 965	113 869	-3.9	-3.8
15 Non-financial private sector (6 + 13)	484 521	478 846	471 319	466 891	-2.2	-2.5
16 Total - non-financial sector indebtedness (5 + 15)	724 648	739 255	740 820	737 974	0.6	-0.2

Figure 5 – Loans to non-financial corporations, yearly rate



³ Please see the [press release on the new chapter on non-financial indebtedness](#).

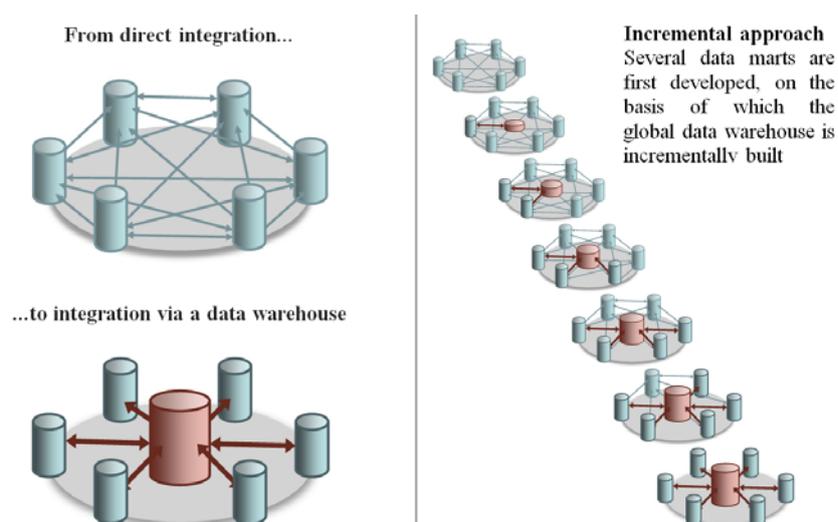
2.3.2. Data warehouse

Clearly, the use of micro-data could allow us to develop innovative statistical products faster and in a more cost-efficient manner in case a DW is available. Such a structure is currently being set up and the Bank foresees great advantages in the future from its exploration. A DW guarantees a central access point to every statistical data, independently of the input source or the production process – a common technological infrastructure across multiple information systems makes it easier to integrate and reuse components and promotes data access efficiency and transparency to final users.

A DW strategy typically falls in one of the following cases:

- A top down approach, whereby a central DW is first constructed, from which are then extracted specific data marts for each business process. It allows the integration of multiple information domains, achieved through a global development effort. However, its intrinsic difficulty, together with the time and cost required to obtain the first results, explain its high failure rate.
- A bottom up approach, whereby several data marts are first developed, on the basis of which the global DW is incrementally built. This allows for reducing the risk of the projects and speeds up the achievement of the first results. The problem with this approach is that it often results in new information silos, when successive isolated projects fail to promote the integration of data from different sources.

Figure 6 – Data Warehouse – Incremental approach



The Bank opted for the second approach, on the grounds that in our case there is an intermediate area – the so-called “working data store” –, where production processes take place, accessing data from different domains already stored in the DW – unlike the more common situations, in which

data flows from source systems only in one direction and the construction of the DW has no upstream impacts.

In fact, the additional complexity arising from this dual dependency, in which information providing processes are at the same time clients of the DW, suggests following an incremental approach (Figure 6).

3. Quality management and audit operations

Quality is an essential element to secure confidence in the production and dissemination of statistics. In the field of statistical quality management, the Statistics Department has established a Statistics Audit Unit (hereinafter referred as “the Unit”) which deals with transversal subjects such as, statistical audit operations and also the production of Quality Reports and Quality Manuals. This work goes beyond the quality control procedures and working arrangements implemented in each specific domain of statistical compilation, and helps ensure an effective statistical quality control.

Concerning statistical audit operations the Unit: (i) analyses and evaluates the different phases of statistical production procedures in place; (ii) analyses the organizational and functioning aspects; (iii) evaluates the efficiency of the procedures; (iv) contributes to enhance methods and applied techniques by issuing suggestions and/or recommendations; and (v) encourages and promotes the sharing and comparing of best practices and procedures among the different areas of the Statistics Department. The operations concluded so far have produced a significant number of recommendations and suggestions that either have already been implemented by the units under audit or are in a process of being implemented.

Once a year, Quality Reports (compiler oriented) are produced to assess the quality of the current statistical compilation. These reports focus on statistical results, basing the analysis on a series of quality indicators for the various statistics, taking into account their specific nature and critical points in their compilation process. To this end, the Data Quality Assessment Framework’s basic structure (the IMF’s benchmark to assess statistical quality) is used as the key reference for this analysis.

Another area of current work relates to the preparation of Quality Manuals (user oriented) on the statistics in charge of the Bank. This activity aims at improving the knowledge and increasing the transparency of both the production processes and the quality control procedures in place, with the purpose of enhancing the users’ confidence in the statistics compiled. Up to now, two documents (published as Supplements to the Monthly Statistical Bulletin) have been produced in the field of statistical quality control: “*Quality management in Banco de Portugal’s statistics*”, January 2012, and “*Quality management in monetary financial institutions’ balance sheet statistics*”, September 2013.

4. Concluding remarks

The integrated information model is an ongoing project of continual improvement and its final aim is to guarantee flexible and efficient data solutions that contribute effectively to the different and evolving tasks of the Bank.

To that end, good definitions of the governance structure and relationships model are essential. However, it is the multi-dominium information architecture, with a strong emphasis on the use of micro-data and the development of a DW that, ultimately, constitute the extra added value and the innovative solution of *Banco de Portugal's* information model by allowing greater flexibility to adapt to changing needs and respond to *ad hoc* requests in a cost-efficient manner both to the compiler and the respondents while guaranteeing very high standards of quality

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