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Topic (iv): Architecture

Business Architecture model within an official statistical context

Prepared by

Nadia Mignolli, Giulio Barcaroli, Piero Demetrio Falorsi, Alessandra Fasano
Italian National Institute of Statistics (Istat), Rome, Italy

I. Introduction

Several Official Statistical Institutions/Organisations are currently facing commitments towards modernisation and standardisation of their work processes, both from an organisational and a production-related point of view. In this context, this paper aims at illustrating a reference Business Architecture (BA) model that can be used to enhance this relevant evolution phase and represents a first step towards the development of a sharable common framework, so as to work in a more efficient and optimised way. In addition, this BA model results to be generic enough and, for this reason, also extensible to other different organisation both at a National or European/International Statistical System level.
This proposed BA model is characterised by three essential elements: (*i*) a formalisation of the production process; (*ii*) shared infrastructures; (*iii*) guiding principles.
This model is defined also on the basis of the recent deep involvement of the Italian National Institute of Statistics (Istat) at two different levels[1]:

(a) at the international level, Istat is actively participating in various groups (the UNECE High-Level Group for Modernisation of Statistical Production and Services[2], the Statistical Network[3], the Eurostat Sponsorship for Standardisation[4]), in particular in those projects dealing with standardisation and industrialisation (for instance, the Business Architecture Project Team of the Statistical Network[5], the Common Statistical Production Architecture – CSPA of the UNECE High-Level Group);

[1] The current version of the model was formalised, deliberated and approved by the ESSnet on standardisation members and represents one of the deliverables of phase 1 of the project, released on the end of March 2014. The Statistical Network BA Team Project is also contributing to the development of this model.
[2] http://www1.unece.org/stat/platform/display/hlgbas/High-Level+Group+for+the+Modernisation+of+Statistical+Production+and+Services.
[3] http://www1.unece.org/stat/platform/display/msis/Statistical+Network.
[4] http://www.cros-portal.eu/content/ess-standardisation-0.
[5] It includes a number of important Statistical Institutes (as Canada, Australia, Italy, New Zealand, Norway, Sweden) and works on the definition of a common model for the official statistical community.

(b) at internal level, since 2010 Istat has launched a long term Programme called *Stat2015*, that is focused on the modernisation of the whole statistical production process and is producing relevant and deep organisational changes (BA is considered an instrument of modernisation).

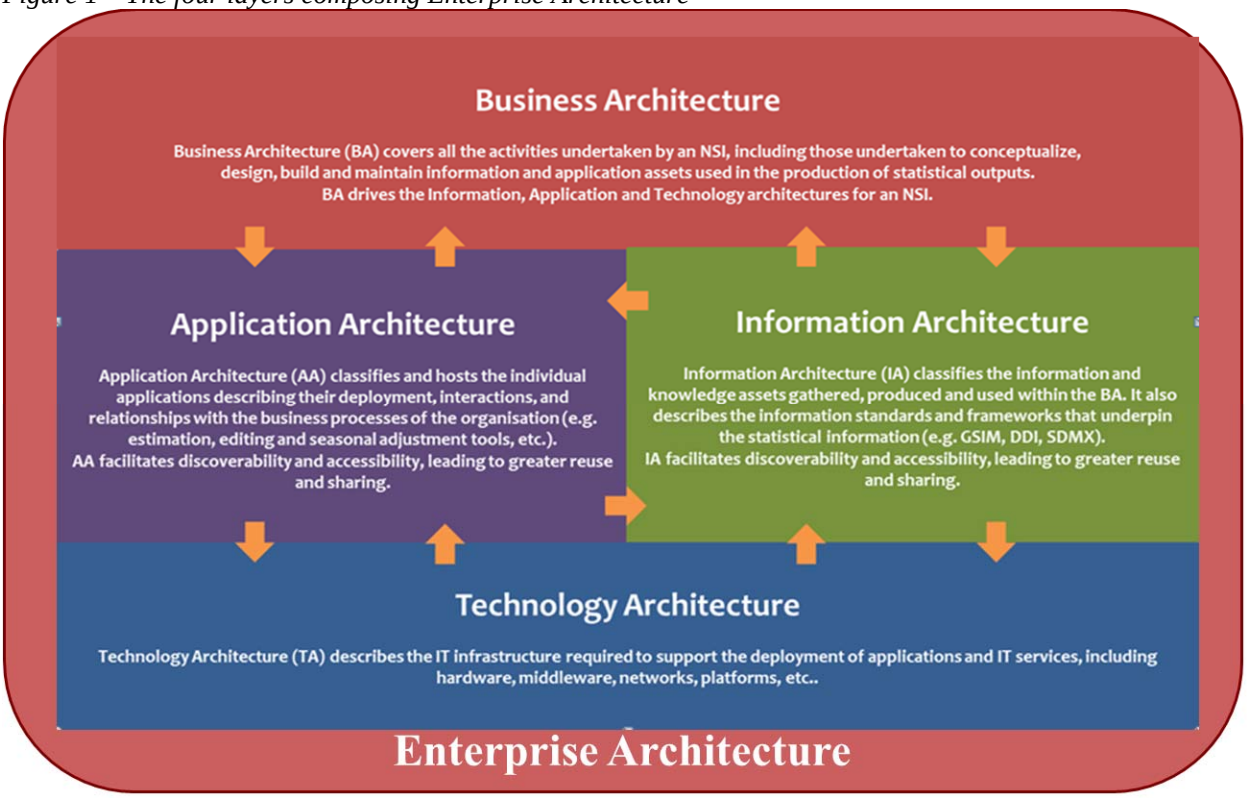
In this paper a particular attention is focused on:

(a) the activities defined within the different BA business lines that are organised in a general scheme and aligned with those set out in phases and sub-processes proper of the GSBPM (Generic Statistical Business Process Model), recognised as a real standard and adopted at international level;
(b) the infrastructures required to optimise the overall architecture (repositories of data and metadata, of methods and guidelines, of IT tools and applications);
(c) the decision and design principles that are general guiding rules to be followed to ensure optimality (Statistical Network Business Architecture Project Team, 2013).

II. Definition of a Business Architecture

Business Architecture is a reference model to optimise work processes within an Institution/Organisation and make them more efficient. It covers not only statistical activities but also strategic organisational tasks and capabilities.
The definition of a BA model is to be included in the general framework of Enterprise Architecture (EA).
EA is about understanding all the different elements that make up the enterprise and how those elements interrelate. It is an approach to enabling the vision and strategy of an organisation, by providing a clear, cohesive, and achievable picture of what is required to achieve this target (Statistical Network BA Team Project, 2013).
In more detail, EA can be split in four different architectural layers (Business, Applications, Information, Technology) each other interconnected by definitions, classifications, and concepts; data, metadata and paradata; functionalities, applications, services, interfaces and infrastructures (see Figures 1 and 2).

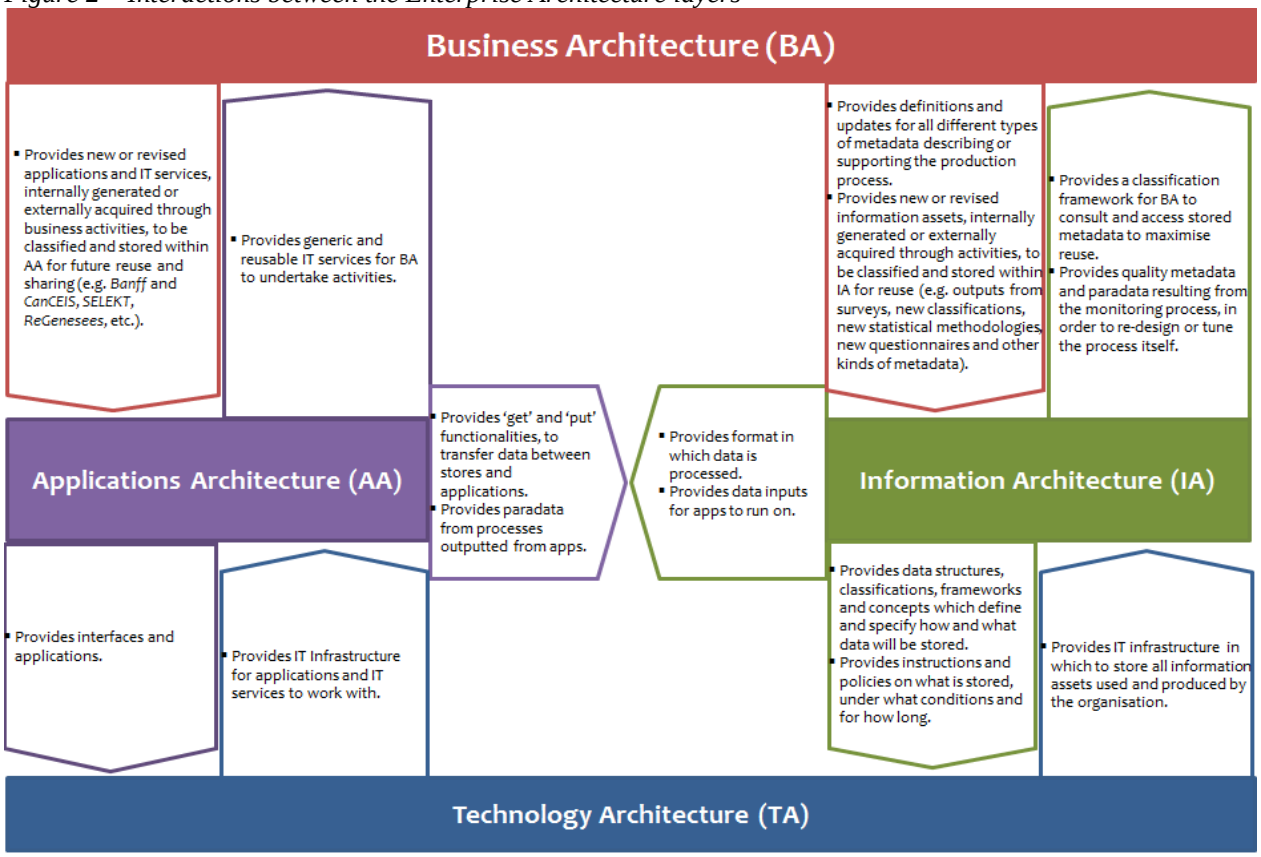
Figure 1 – The four layers composing Enterprise Architecture



Source: Statistical Network BA Project Team (shared also with CSPA), 2013.

From this framework it emerges that BA can be considered the real strategic part of EA and is called to play a central role in a programme as complex as that of industrialisation and standardisation of statistical information production as illustrated in vision of the European Statistical System (2009).

Figure 2 – Interactions between the Enterprise Architecture layers



Source: Statistical Network BA Project Team (shared also with CSPA), 2013

One of the most relevant obstacles to the success of such an ambitious modernisation process lies in the fact that Statistical Institutes/Organisations presently tend to be characterised by multiple organisational models (concerning financial, technological, regulatory sectors, etc.). The use of different vocabularies and terminologies sometimes can lead to conflicting descriptions of the same entities. Production processes in most cases are also organised following the logic of non-integrated stovepipe models.

For these reasons, it is therefore necessary that Institutes adopt a BA model ensuring a common language in order to enable all their components both to conceptualise the given situation ("as is") and the one to be reached at the end of the evolution process ("to be"). The description of the two states (present and future) also allows designing a path towards possible changes in a more rational and measurable way, defining specific actions involving different skills that need to interact within a shared view of a tangible progress. In such a complex situation, indeed, language and intent consistency can merely be achieved starting from the conceptual level that represents the only common point of the various specific languages. This is the real reason for a hierarchical logic that moves from the conceptual to the operational level (involving a specific technical knowledge), also taking into account the adoption of a Service Oriented Architecture (SOA) approach[6].

[6] The Service Oriented Architecture (SOA) is based on structured sets of modules, known as services, that collectively provide the functions required by complex applications. Each service is designed to provide a compactly defined group of functions. This makes it possible to reuse an application in different ways by changing only the way an individual service interoperates with the other services that compose the application, instead of making code changes to the service itself (Bieberstein et al. 2005).

III. BA business lines and activities

The main step in the definition of a BA model is to identify homogeneous areas with respect to the aim of the activities carried out and the nature of the information processed and/or services that insist on this information. Using a language typical of this organisational approach (Giachetti 2010), these areas are called *business lines* (Statistical Network BA Project Team, 2013) and are defined in order to guarantee independence from the Institutes current organisational structure, so as to ensure their stability with regard to any future institutional processes of reorganisation.

Presently, statistical Institutes often tend to replicate internally the same organisational model, instead of referring to a unique one at the enterprise level. This is a kind of stovepipe model characterised by strong heterogeneity (of procedural, methodological and technological approaches), lack of standards and redundancy of data and applications.

On the contrary, in order to achieve the target of harmonisation, it is advisable for the involved organisations to:

(a) define their strategic objectives and plan the activities that allow to achieve them (Strategy);
(b) support functions that develop work programmes (*Corporate support*);
(c) design the processes corresponding to the planned activities (*Design*);
(d) organise the designed processes taking into account the operational constraints (*Management*);
(e) implement the processes ensuring efficiency and quality (*Implementation*);
(f) provide capabilities to undertake all the above activities (*Capability*).

Consequently, six different *business lines* can be defined (*Strategy*, *Corporate support*, *Design*, *Management*, *Implementation*, *Capability*): each of them supplies the necessary products for carrying out the statistical processes. Each business line is characterised by specific activities that are fully aligned with GSBPM 5.0 phases and sub-processes. Each activity realises one aggregate service that transforms the input information into the planned output.

In more detail, *Strategy* consists of high level strategic, externally focused, functions and activities. Its products include: agreements with other bodies/agencies and communication initiatives, policy and strategic plans, budget planning, *portfolio* of projects definition and reports from the management line.

Activities carried out in this line correspond are:

(a) S1. Maintenance and consolidation of strategic relations;
(b) S2. Strategic planning;
(c) S3. Policy definition;
(d) S4. Project portfolio management and budget definition.

Corporate Support provides cross-cutting support functions and its products consist of: risk management reports, measurements of performance, audits and quality controls, regulations. Activities achieved in this line correspond to GSBPM over-arching processes (Ops) and are:

(a) CS1. Financial management;
(b) CS2. Internal and external data source management;
(c) CS3. Legal framework management;
(d) CS4. Human Resource management;
(e) CS5. Administrative management.

Design produces the meta-information essential for the functional organisation and for the statistical process control. Its products comprise: technical designs, action patterns, instructions, process indicators and their description. These are the activities:

(a) D1. Determine needs for statistical information;
(b) D2. (Re)Design statistical outputs;
(c) D3. Check data availability/(Re)Design data sources;
(d) D4. (Re)Design production system and rules.

Management utilises the control information in real time. Its products embrace: scheduling of activities, description of results, state implementation, reports on the achieved quality and plans for the improvement and adjustment of the procedures carried out. Management-related activities are:

(a) M1. Planning;
(b) M2. Monitoring;
(c) M3. Adjustment.

Implementation realises the value chain from the initial sources to the statistical information. Its products include: data and the metadata that describe them, as well as the applications developed to be used in the process. Implementation-related activities are:

(a) I1. Tool and application reuse/development and release for the production;
(b) I2. Collect: preparatory stage (sample selection; set up collection);
(c) I3. Collect: run and finalise data collection, administrative source acquisition, standardisations;
(d) I4. Process: integration, classification and coding, editing, imputation, new variables and statistical units derivation;
(e) I5. Process: calculate weights and aggregates;
(f) I6. Analyse: validate, apply disclosure control and finalise outputs;
(g) I7. Disseminate: produce and release dissemination products.

Capability deals with development and management of the required capabilities (related to methods, procedures, standards and frameworks, IT systems and people skills) underpinning the statistical production process. Its products are represented by the Repositories of Human resource Competencies (RHC), of Data and Metadata (RDM), of standard Methods and Guidelines (RMG), of Tools and Applications (RTA). Activities performed in this line are:

(a) C1. Development and management of Human Resource competencies;
(b) C2. Storage of data and metadata;
(c) C3. Management of the process for the development and evolution of standard methods and guidelines;
(d) C4. Management of the process for the development and evolution of IT tools and applications (aligned to GSBPM OP *Statistical framework management* and sub-processes from 3.1 to 3.3).

All the correspondences between the BA business line activities described above and the phases of the GSBPM 5.0 are illustrated in Figure 3. The activities described above can be organised into a logically ordered chain represented in Figure 4. This overall scheme is divided into layers identified by vertical rectangles indicating the different BA business lines. The three business lines corresponding to *Design*, *Management* and *Implementation* are those more directly related to the *Statistical production process*. Inside each layer, rhombuses are specific activities or business services (processes); the labels of each activity are indicated inside little white ovals, and refer to the labels of the activities described previously (see II and Figure 3). Cylinders symbolise information products (data and metadata) or applications; the grey ones within the *Capability* line are common shared repositories. Finally, large ovals indicate actors and external entities.

As illustrated in Figure 4 through all the interactions, the whole process is dynamic by nature and is realised through the iterative repetition of chain parts, which also depend on the possibility of reusing processes and/or information products. Changes to a node in the step sequence can impact on all subsequent ones but should have no direct impact on the previous stages.

The whole process starts with the analysis of the information needs expressed by stakeholders and common users. This generates a real business case that has to be evaluated by the Institute governance board (*Strategy*), in order to decide whether to include the related plan into the current *portfolio* of projects facilitated by the *Corporate support*. If the decision is positive, then the *Design* steps can be performed: firstly, the expressed needs are the basis for the design of the outputs required to meet them. Secondly, by considering these outputs, a recognition of the availability of the data sources necessary to produce them is carried out. In particular, great emphasis should be set on the reuse of existing data (especially from administrative and big data sources). Finally, the design of the production system can be executed, by primarily taking into account the available Repository of standard Methods and Guidelines (RMG), in order to define the process rules and the expected quality levels: this generates a set of metadata that will be considered in the management and implementation lines and will be stored into the Repository of Data and Metadata (RDM).

Management steps define all operational and practical aspects of the production process (*workflow* definition). Alongside these steps, quality and efficiency constraints are set, thus originating additional metadata (also to be stored in the RDM) that will affect the implementation of the process. In this business line, quality is controlled step by step and aligned with that defined in *Design*.

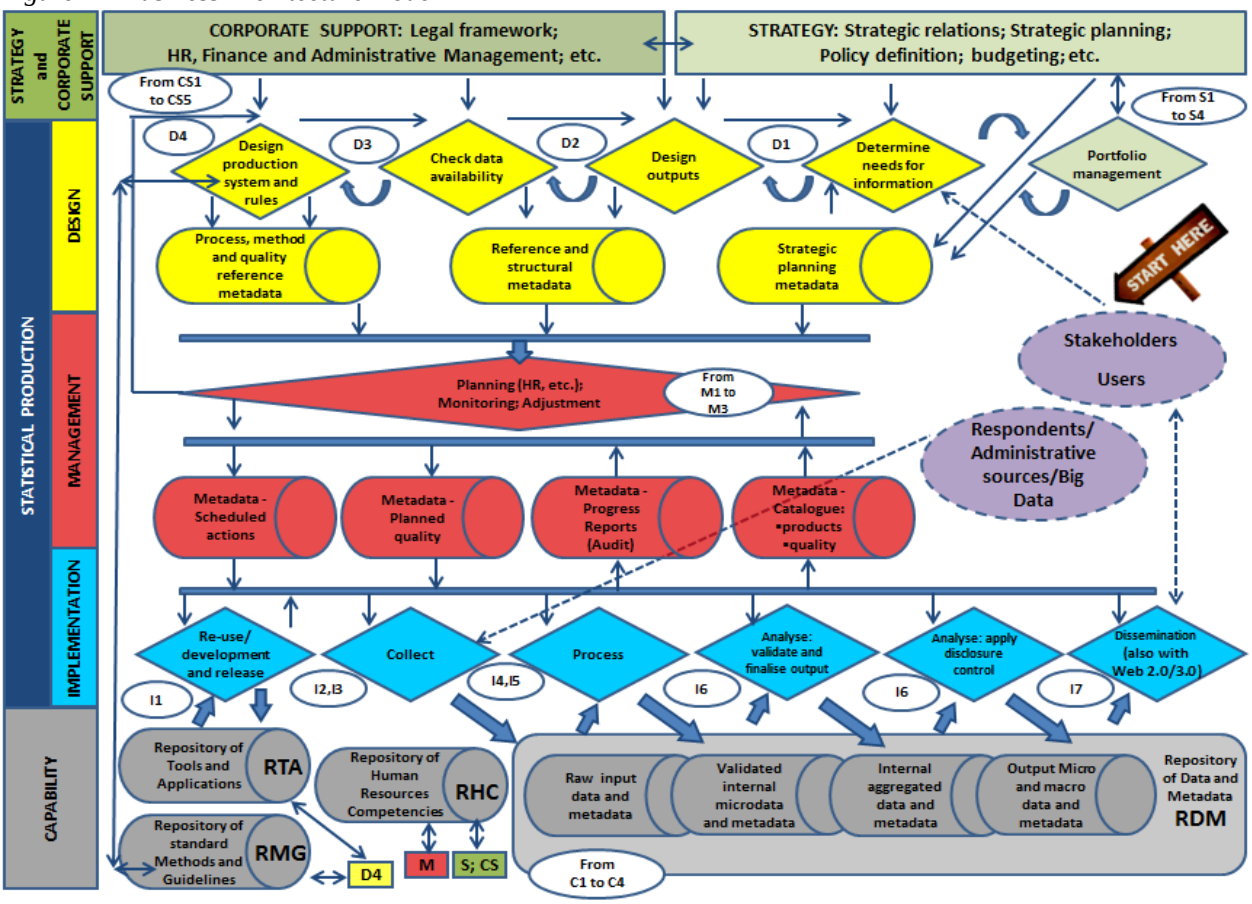
Figure 3 – Correspondences between BA business line activities and GSBPM 5.0

Business Lines		Activities	Generic Statistical Business Process Model (GSBPM version 5.0)								
			General over-arching processes	1. Specify needs	2. Design	3. Build	4. Collect	5. Process	6. Analyse	7. Disseminate	8. Evaluate
Strategy		**S1.** Maintenance and consolidation of strategic relations	Legal framework Management								
		S2. Strategic Planning	Strategic Planning Human Resource Management								
		S3. Policy definition	Quality Management								
		S4. Project portfolio management and budget definition	Strategic Planning Statistical Program Management Project Management Financial Management								
Corporate Support		**CS1.** Financial management	Financial Management								
		CS2. Internal and external data source management	Provider Management								
		CS3. Legal framework management	Legal framework Management								
		CS4. Human Resource management	Human Resource Management								
		CS5. Administrative management	Organisational framework Management Legal framework Management Financial Management								
STATISTICAL PRODUCTION	Design	**D1.** Determine needs for statistical information	Statistical Program Management Customer Management	1.1; 1.2; 1.3; 1.4; 1.6							
		D2. (Re)Design statistical outputs	Metadata Management		2.1						
		D3. Check data availability/(Re)Design data sources	Provider Management Metadata Management Quality Management	1.5							
		D4. (Re)Design production system and rules	Knowledge Management Statistical Framework Management Metadata Management Quality Management		2.3; 2.4; 2.5; 2.6						
	Management	**M1.** Planning	Metadata Management Quality Management			3.4					
		M2. Monitoring	Metadata Management Quality Management								8.1; 8.2
		M3. Adjustment	Metadata Management Quality Management								8.3
	Implementation	**I1.** Tool and application reuse/development and release for the production	Statistical Framework Management			3.1; 3.2; 3.3					
		I2. Collect: preparatory stage (sample selection; set up collection)	Metadata Management				4.1; 4.2				
		I3. Collect: run and finalise data collection, administrative source acquisition, standardisations	Metadata Management Quality Management				4.3; 4.4				
		I4. Process: integration, classification and coding, editing, imputation, derivation of new variables and statistical units	Metadata Management Quality Management					5.1; 5.2; 5.3; 5.4; 5.5			
		I5. Process: calculate weights and aggregates	Metadata Management Quality Management					5.6; 5.7			
		I6. Analyse: validate, apply disclosure control and finalise outputs	Metadata Management Quality Management						6.1; 6.2; 6.3; 6.4; 6.5		8.1; 8.2
		I7. Disseminate: produce and release dissemination products	Customer Management Metadata Management Quality Management							7.1; 7.2; 7.3; 7.4; 7.5	
Capability		**C1.** Development and management of Human Resource competencies (Repository of Human Resource Competencies - **RHC**)	Human Resource Management								
		C2. Storage of data and metadata (Repository of Data and Metadata - **RDM**)	Data Management Metadata Management Quality Management	1.	2.		4.3; 4.4	5.	6.5		
		C3. Management of the process for the development and evolution of standard methods and guidelines (Repository of standard Methods and Guidelines - **RMG**)	Statistical framework Management								
		C4. Management of the process for the development and evolution of IT tools and applications (Repository of Tools and Applications - **RTA**)	Statistical framework Management			3.1; 3.2; 3.3					

Source: Istat; ESSNet on Standardisation, 2014.

Implementation steps are those that realise the overall designed production process. Each step takes data and metadata as inputs and produces data and metadata as outputs. Each input is taken from the *Capability* line, through the RDM (with the exception of the data collection step), and each output is stored in the RDM (with the exception of the data dissemination step). In order to minimise costs and maximise quality, in this line the Repository of Tools and Applications (RTA), containing the certified tools and applications that implement standard methods, is used.

Figure 4 – Business Architecture model



Source: Istat; ESSNet on Standardisation, 2014.

To summarise, the described overall value chain can be divided in two main sub-chains: the first is given by *Strategy*, *Corporate support* and *Design* activities, the second by *Management* and *Implementation* activities. Once the production process is well underway, in the subsequent iterations of the same process the set of *Management* and *Implementation* activities may be fully automated and repeated on a regular basis for the release of specific statistical products. *Capability* line increases the general value of institutional assets and skills. The evaluation of the process is structurally included in all implemented steps in order to continuously improve efficiency together with product quality.

IV. BA infrastructures and principles

As illustrated in Figures 4, the most important infrastructures needed for the efficiency and efficacy of the overall process are:

(a) the *Repository of Human Resource Competencies* (RHC), that gathers information concerning employee skills;

(b) the *Repository of Data and Metadata (RDM)*, containing input data, intermediate data and output data ready for dissemination, with defined quality standards and metadata;
(c) the *Repository of standard Methods and Guidelines* (*RMG*), that contains the set of statistical methods, recognised as standards, to be applied to processes;
(d) the *Repository of Tools and Applications (RTA)*, including three distinct categories of software (generic IT tools, reusable applications and ad hoc applications).

Some activities carried out within *Strategy*, *Corporate support* and *Management* deal with human resources and make use of RHC. The information produced at the various stages of processing should be considered a reusable asset, to be stored in the available infrastructure of RDM. The definition of methods as standard, to be shared in RMG, has to follow a precise procedure that is to be adopted by the statistical organisation, also taking into account the international framework. In the same way, the set of production applications of the Institute, i.e. those necessary to ensure the realisation of statistical information to be disseminated to external users, should be also considered as an asset to be preserved and shared, maximising the use and reuse, through the infrastructure of RTA. In this context, shared services and standards should also be defined and implemented, with regards to Information Technology (IT) and the way to organise all the activities.
The whole BA model is led by *fundamental principles* that become real guidelines for the implementation of each business line activity, ensuring in this way the success of the standardisation process itself.
Being compliant with these principles represents a very important driver to foster and enhance standardisation, both inside each Statistical Institute and at ESS level. At the moment, the definition of these principles is still on-going within the Statistical Network BA Project Team. These principles are classified in two different groups: (*i*) Decision principles, that guide the activities of strategic planning (see Table 1); (*ii*) Design principles, that guide the design of production processes (see Table 2).

Table 1 - Business Architecture decision principles

DECISION PRINCIPLES		
1	Capitalise on and influence national and international developments	Collaborate nationally and internationally to leverage and influence statistical and technological developments which support the development of shared statistical services.
2	Deliver enterprise-wide benefits	Design and implement new or improved statistical business processes in a way that maximises their value at an enterprise level.
3	Increase the value of statistical assets	Add value to the organisation statistical assets (either directly or indirectly) through improved accessibility and clarity, relevance, coherence and comparability, timeliness and punctuality, accuracy and reliability, and interpretability.
4	Maintain community trust and information security	Conduct all levels of business in a manner which builds the community trust. This includes the community trust and confidence in the statistical organisation decision making and practices and in their ability to preserve the integrity, quality, security and confidentiality of information provided.
5	Maximise the use of existing data/ Minimise respondent burden	Leverage existing data from all sources (e.g. statistical surveys or administrative records) before collecting it again. Statistical organisations are to choose the source considering quality, timeliness, cost and the burden on respondents. Statistical authorities monitor the respondent burden, and aim to reduce this over time.
6	Sustain and grow the business	Focus investment and planning on long term sustainability and growth, both in terms of the organisational role and position within its own community, as well as internationally.
7	Take a holistic and integrated view	Ensure data, skills, knowledge, methods, processes, standards, frameworks, systems and other resources are consistent, reusable and interoperable across multiple business lines within a statistical organisation.

Source: Statistical Network BA Project Team (shared also with CSPA), 2013.

Considering both decision and design principles, some general suggestions emerge clearly and it is possible to highlight some key messages. To begin with, the whole statistical process is output and metadata-driven: the statistical process chain starts from the output desired (from required products) and goes backwards, defining the various aspects of the process.

Table 2 - Business Architecture design principles

DESIGN PRINCIPLES		
1	Consider all capability elements	Consider all capability elements (e.g. methods, standards, processes, skills, and IT) to ensure the end result is well-integrated, measurable, and operationally effective.
2	Re-use existing before designing new	Re-use and leverage existing data, metadata, products and capability elements wherever possible before designing new.
3	Design new for re-use and easy assembly	Design, harmonise and standardise all new data, metadata, products and capability elements for re-use, so they can be easily assembled and modified to accommodate changing user demands.
4	Processes are metadata driven	Ensure that design, composition, operation and management of business processes, including all input and output interactions, are driven via standard metadata and automated wherever possible.
5	Adopt available standards	Adopt open, industry recognised, and international standards where relevant and available. Statistical industry standards such as the Generic Statistics Business Process Model (GSBPM) and the Generic Statistical Information Model (GSIM) are examples.
6	Designs are output driven	Ensure the whole statistical process is output-driven. Output is the reference starting point; the statistical production process starts from the output desired, that is from required products, and goes backwards, defining the various aspects of the process.
7	Enable discoverability and accessibility	Ensure data, metadata, products and capability elements are discoverable and accessible to achieve the benefits from sharing and reuse.
8	Ensure continuous quality improvement	Evaluate and document quality at all stages of the statistical production process. This is to be defined and planned during design or redesign, monitored and assessed in each phase of GSBPM and in connection with intermediate and final data releases.
9	Foster industrialisation of statistical processes	Ensure the independence between design and implementation, thus promoting the industrialisation of statistical processes. The assumption of an industrialised process is that it can be realised by agents other than those who have designed it.

Source: Statistical Network BA Project Team (shared also with CSPA), 2013.

Metadata resulting from the design are the reference for the implementation of the production process. As a requirement, metadata have to be generally accessible and, as far as possible, standardised with regard to the types of units, the definition of concepts, classifications, quality characteristics, process, etc..
Another strategic indication regards the concept of re-use that is related to data, metadata, methods, tools and applications. It focuses on both what is produced within each organisation and what is issued outside, with particular attention to the standards defined at European and international level. It is referred to existing and available data, whose use is generally to be preferred over the decision to conduct a new survey: data should be collected only once. Re-use is fostered by the adoption of modular services that can be shared in different contexts and statistical areas (Service Oriented Architecture). Developments from scratch should be considered real exceptions.

V. Concluding remarks

The Business Architecture model can provide an important support to an integrated and well-organised implementation of all the useful necessary innovations, since it is to be intended as a common language, sharable and adoptable by NSIs.
For this reason, it represents the foundation, fostering and intensifying the creation of a Business Architecture also at international level.
In the medium term, the BA model can be made fully operational through a road map properly designed and scheduled, focusing particularly on the implementation of some of the basic infrastructures provided, both in terms of procedures (such as the management of the *portfolio*, the compliance assessment of the several statistical production processes with the BA and EA principles, with their subsequent validation, etc.) and in terms of shared services (the Repository of Human Resource Competencies, the Repository of Data and Metadata, the Repository of standard Methods and Guidelines, the Repository of Tools and Applications).
In this road map planning phase, a particular attention is to be focused on:

(a) the *governance*, to provide the strategic directions, to coordinate, to validate and to monitor all the necessary activities, also involving some institutional reference Committees (e.g., "Methodology", "Quality", "Innovation and Research");
(b) the *organisational structure*, for the different operational phases and to advise the governance arrangements for the basic infrastructure implementation;
(c) the *communication process*, to share BA principles within Organisations and to disseminate their knowledge.

This involves necessarily an active participation and the sharing of broader initiatives aiming at increasing integration at national, European and international level, so that this conceptual model may become a best practice to be widely disseminated.

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