Impact of Legislation on Database Design and Maintenance in Public Administration and Utilities

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Abstract: Analogously to what occurs in other European Countries, the current policy of the European Union concerning the economic and monetary union is having a dramatic impact on Public Administration and utilities in Italy. As for Public Administrations, efficient services have to be provided, and even distributed via the Internet, to citizens and enterprises. On the other hand, the deregulation of the market is aimed at promoting a higher level of competitiveness: today also "natural" monopolies (like energy, gas, water, and telecommunications) are forced to competition. This new paradigm requires an organizational change which has a significant impact on information systems and on their most valuable component: the database. In this paper, the authors present the impact of the European policy on databases in two case studies: Regione Lombardia, an Italian Local Public Administration located in Milan, and ACEA, an Italian Energy Undertaking located in Rome. The authors show common issues related to the impact of the new legislation on database design and maintenance. In particular, the authors discuss issues related to the re-design of databases to be federated or split, as a consequence of the new legal context.

Key words: database; information system; re-design; case study

In order to pursue its institutional goal, that is, an increasing level of economic and social integration among the peoples of Europe, the European Union (EU) is promoting policies intended to facilitate integration. Over the time, these policies passed through several stages: from a weak initial co-operation to the present economic and monetary union. In the process of promoting a single market, and providing correct information to its citizens, Europe carries out the objective of the removal of technical barriers to trade. Competition policy is reputed to be essential to the achievement and maintenance of the single market. Moreover, no real economic progress can permanently be ensured without the modernization of both Local and Central Public Administration (that we refer to as PAL and PAC, respectively) aimed at gaining transparency, accessibility, and efficiency of services provided in favor of citizens and of small and medium enterprises (SMEs). In the meanwhile, traditional "natural" monopolies in energy, such as gas, water, and telecommunications are challenged by a new legislation that fosters competition and has a significant impact on their information systems.

In each EU Member State there is a hierarchy of laws where the European law takes precedence over the national laws. The EU acts can be classified as follows[9]:

· Regulation: an act with a general scope, directly applicable in each Member State.

· Directive, an act that links any Member State to the results, leaving to the national authorities the jurisdiction regarding the forms and methods to be used.

· Decision, an act that binds on the addressees, one or more natural or legal persons (even one, several or all the Member States), it indicates. A decision has a variety of potential addresses and a variety in the scope.

The directives on competition adopted in the last decade are redesigning the internal market. On one hand, Public Administrations (PA) have to offer new services to citizens and enterprises; on the other hand utilities (energy, water, gas, and telecommunications) are challenged in their traditional businesses. As a consequence, business processes and systems are analyzed, valued, downsized, and eventually given in outsourcing. In any case, both PA and utilities have to deal with a change of paradigm which has a significant organizational and technical impact on their information systems and on the core thereof, that is, its database.

Several strategies can be adopted – i.e., splitting vs merging data repositories – in order to be compliant with the requirement of publishing a substantial part of the data repositories and to comply with rules regarding efficient database management and data privacy. These issues impact on the design and management of distributed databases and of datawarehouse systems, management of distributed data, and management of data security and privacy[3].

Most PAL, PAC, and utilities, have two main goals with respect to this new legislative context:

· A user friendly access to their services (e.g., HealthCare services reservation or register office services, invoice or product information delivery) to citizens, as well as to SMEs, and to local administrations through the Internet.

· A complete offer of information (that is, a Corporate Portal) based on a standardized model of the federated information system.

Common problems deriving from the above issues regard the design and maintenance of a Federated Information System (FIS) out of existing systems and out of heterogeneous databases. A FIS is constructed by federating existing component systems managing data that are distributed either on a thematic or on a geographic basis, for example, because of their location in different Companies or Organization Units[6].

Regarding data, the need arises to share different data sources, to preserve the autonomy of existing sites for data maintenance and publishing and, at the same time, to provide homogeneous, consistent and non contradictory information in the FIS. For applications, the FIS component systems aim at:

· Preserving their application wealth possibly updated from a technological viewpoint and/or re-engineered.

· Sharing applications between Companies and Organization Units thus reaching a level of interoperability between applications.

In this paper, we present the issues related to the management of a FIS in two case stories: a PAL (Regione Lombardia, the local government of the area around Milan) and an energy utility, ACEA an Energy Supply Undertaking (ESU) located in Rome. We present common problems, issues, and solutions undertaken by the two considered organizations.

1 Impact of the Public Resources Deregulation on PA and ESU Databases

In this section we summarize the main issues in PA and ESUs, intended to ensure the full compliance to the EU Directives on liberalization and deregulation, with respect to the Directive on data privacy (95/46/EC), which dictates “minimal measures” concerning data integrity and access control. As mentioned in the introduction, a “directive” is one of the possible forms of legal acts provided by the legal system of the European Community. Therefore “Directive 95/46/EC” stands for a legal act (Directive) No. 46 adopted by the European Union (EU) in year 1995.

1.1 Issues in local public administration

To be compliant with the EU (as well as Italian law regarding the re-organization of the Public Functions) guidelines for the development of the Public Administration Information Systems, Regione Lombardia has produced a development plan aimed at federating component systems in a Client/Server FIS architecture. The basic policy is

to maintain the autonomy of the Divisions in the management of their own databases and applications, but also to enforce standard software and data exchange protocols and to let information circulating in the Regional FIS coherently and in a shared way.

Currently, the Regional Information System is characterized by the presence of procedural application for traditional areas, such as personnel management. It is also characterized by the heterogeneity of the application areas, and the proliferation of solutions, particularly in individual productivity tools. The requirement is to frame the Regional Information System in the unitary structure of a FIS according to the following guidelines:

a) To outline the general strategies and to develop the regional role of coordination of services to agencies on the territory, to the citizens, and to SMEs.

b) To plan and control the development of the Information Communications Technology (ICT) applications through development projects.

The methodology for the Regional Information System development is as follows:

· Acquisition of the strategic requirements for the regional system.

· Survey of the current situation of the regional system starting from the results of a previous requirement collection phase.

· Definition of the restructuring work necessary to the Region to its meet the strategic targets.

· Definition of a distributed architecture for the Regional Information System.

· New applications, databases, and Web services.

· Re-organization of human resources in charge of FIS development and management.

In order to meet these objectives, the proposed architecture is based on standards for heterogeneous distributed systems[7,10], recommending the use of multiple, standardized layer architectures and of a common database model. For example, an object-oriented model is recommended in that it is able to support the integration of the cooperating component databases belonging to the different Organization Units. In fact, the controlled sharing of data is a key issue in the FIS considering the need to open the FIS towards other Administrations and enterprises on the territory to provide services and to exchange information. For example, data are exchanged between Regione Lombardia and the Municipality Administration of Milan, or with the HealthCare Regional Organizations.

In Fig.1 we show the overall view of the project from the goals (institutional dimensions, top) to the available infrastructure(bottom) and its main intervention areas: territory and environment, strategic competition of the regional system, infrastructure for mobility, and services to citizens.

1.2 Issues in ESUs: from federated to split databases

Since the early 90s, several EU Directives have been adopted to foster the completion of the internal market and to limit the exploitation of market dominant positions. Among the others, we mention the following:

· Directive 96/92/EC, promoting the internal market of the electricity.

· Directive 98/30/EC, promoting the internal market of gas.

The more complex world of telecommunications (TLC) is regulated by at least 12 Directives. Among them, the most relevant are:

· Directive 90/387/EC, dealing with the internal market for TLC services.

· Directive 96/19/EC aimed at promoting full competition.

· Directive 99/64/EC, on competing markets.

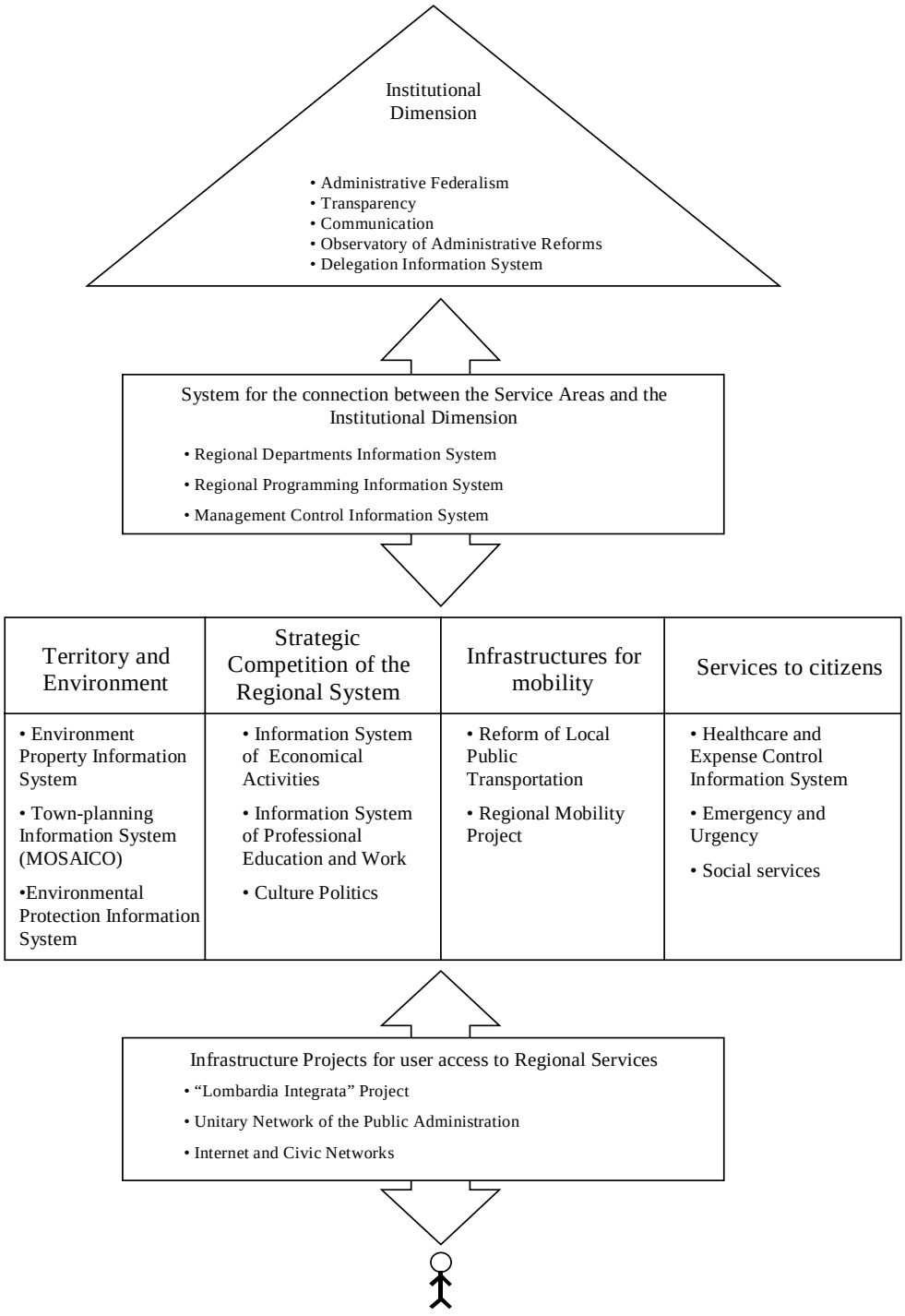

Fig.1 Overall view of the ICT project

ACEA's case history deals with practical experiences on database management and application in the electric business. As a consequence of the EU policy on competition, most ESUs, in search for an efficient and optimal

resource allocation, are migrating to new organizational models, namely:

· The holding model, in compliance to the EU directive (96/92/EC) on the unbundling of the energy sector which splits generation, transmission, and distribution of energy among different companies.

· The multi-utility and multi-service model (energy, water, sewage, solid waste, gas, and telecommunications) to gain competitive advantage from diversification and from the synergies produced by assembling similar lines of business (network-based services).

The technology of FIS was object of intense applied research, until the adoption of Directive 96/92/EC. A FIS for an ESU can be described in terms of a Reference Information Model, i.e., the one developed by the UNIPEDE's (International Union of Producers and Distributors of Electrical Energy) working group INFORPROG in 1992[12,13]. Table 1 shows the attribution of specific responsibilities on the main component systems (and their relative databases) of a FIS among the different companies after the corporate "unbundling" dictated by Directive 96/92/EC.

Table 1 Impact of deregulation on FIS in electrical undertakings

MAIN SUBSYSTEMS of a Federated Information System for electrical undertakings		**HOLDING (MULTI-UTILITY) data set allocation**				
		Energy Companies				CSA
		Generation Ltd.	Transmission Ltd.	Distribution Ltd.	Trading Ltd.	
Customer information					X	
Logistics						X
Human resources						X
Accounting						X
Network information	Asset maintenance	X	X	X		
	Geographic information		X	X		
	SCADA	X	X	X		
Help-Desk and end user computing						X
ICT Infrastructure						X

Directive 96/92/EC introduces several technical and legal problems, for instance a data responsibility issue: how to split the data ownership on the interrelated elements of the existing FIS among the new subjects introduced by the unbundling.

The successful strategy is to maintain centralized the database design, eventually migrating accounting, logistics, human resources, and asset maintenance components into an Enterprise Resource Planning (ERP) platform, managed by a Center for Administrative Services. Such Center is an organizational unit that provides administrative services (accounting, human resources management) in an organizational model that follows the Profit Center Accounting approach. Nowadays, competence on ERP systems is a commodity[5] and, therefore, also companies with a limited ICT expertise can benefit from ERP applications choosing between maintaining an internal ICT staff or exploiting different forms of outsourcing.

Other applications, peculiar to the energy industry, and with no real markets (remote reading with electronic meters via power line carrier, electric customer care, and billing), are still developed and supported in-house and require an ICT staff. Moreover, the ICT infrastructure, difficult to justify in terms of cost/benefit analysis, is still demanded to the holding. In the past, the main sources of complexity for the customer database, which can be regarded as the hub of an ESU Management Information System, were:

· The energy-related fiscal policy.

· The binomial tariff (contractual power and energy consumption).

· The granularity in the supply of the contractual power (3kW, 4.5 kW, 6kW for domestic customers) and the relative "tolerance" intervals (+10%).

· Complex fiscal rules (VAT, contributions to energy saving policies and several local authorities).

· Different classes of users: domestic, commercial, industrial (MV supply), temporary.

Today, the new challenges are:

· Time dependence: pick and off-pick hours also for domestic customers.

· Energy trading liberalization and possibility of buying energy from a different supplier.

· Rules of the game in progress (EU, National Authorities, PAL and PAC).

All these requirements, and the new legislative context, introduce a dimension of complexity in the database design and management.

2 A Common Methodology for Database Federation in Public Administrations and the Electric Business

In this section, we outline the steps of a methodology that can be followed to restructure an Information System belonging to the company and regional Divisions to be re-organized according to the policies described so far. Such methodology has been applied to the two cases presented in this paper (we will call Divisions the Organization Units of both PA and ESUs indifferently).

The key of any restructuring is the concept of business process. A business process can be defined as "a bundle of activities for which one or more inputs are needed and this creates a result value for the customer" [8] or, more operationally, as "part of the net value added chain which can cross organizational boundaries such as department or external boundaries" [4].

The aim of the methodology, also described in Ref.[1], is to construct a FIS based on business processes viewed as cooperating component systems, which are integrated via a virtual connection. Such virtual connection in Italy is called RUPA (Network of Public Organizations) and is being implemented by the Italian Information Systems Authority for Public Administrations.

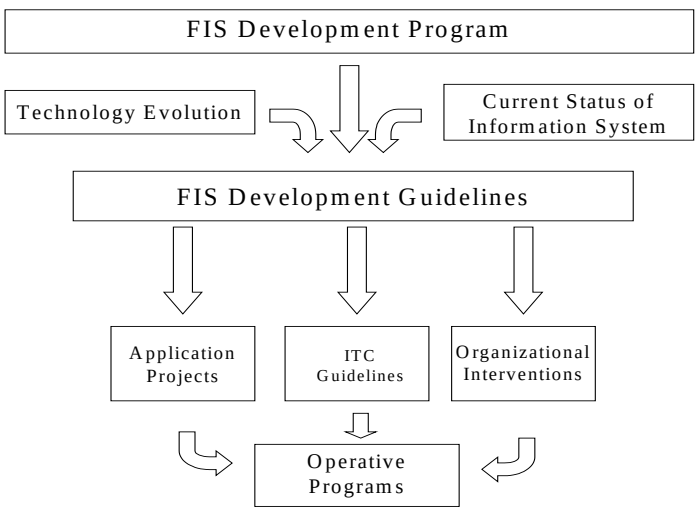

Fig.2 Planning process for FIS development

As an example, in Fig.2, we see the intervention plan stated in Regione Lombardia to start up a FIS projects.

Figure 3 shows the high level architecture of a FIS for an ESU. Through access rules, a desktop can access a metadatabase of global concepts (a semantic dictionary). The metadatabase activates agents (drilling and mining

tools) that access the various Division databases.

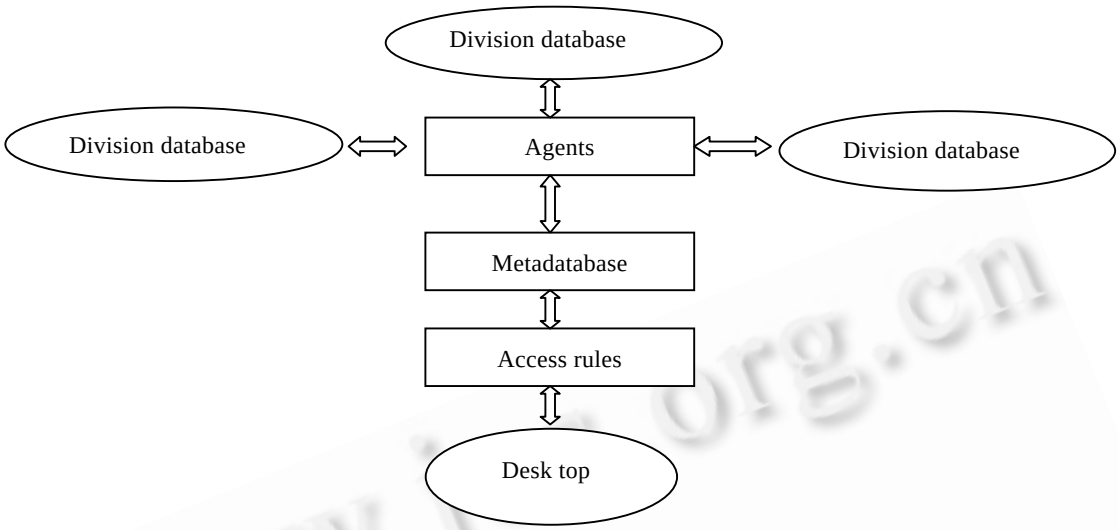

Fig.3 FIS architecture for an electrical supply undertalking (ESU)

2.1 Requirements

A fundamental requirement for the component systems is to maintain them autonomous. In the FIS, the component systems operate by:

· Exchanging data, i.e., through the RUPA Network.

· Using the applications in Client/Server mode.

The component systems are kept autonomous and independent for the functions regarding the generation and management of their local data. They are integrated within the FIS system in the following aspects:

· The architectural and software choices involving the interaction of the component systems with the FIS are negotiated between the Divisions and the FIS designers. Usually, it is necessary to adapt the application and technological requirements of the Divisions to the overall requirements and standards of the FIS.

· The organization choices regarding the implementation of new functions and the management of existing applications of the component systems are pursued with the aim of coping with the general organization and strategic choices of the FIS.

One key requirement in the management of component database systems involves the modalities of their feeding and maintenance across the RUPA network. In fact, the information sources of Divisions are heterogeneous: some are file structures, others are managed via a DBMS under heterogeneous models, others are geographical databases. Moreover, data are loaded from various sources for which it is possible to employ automatic tools for object classification, customized to the data sources. For example, an encapsulated file in e-mail message is a text or an image. Software modules called classificators/extractors[2] are currently available to support integration; the information so built can be exported towards the FIS.

2.2 The enterprise information system

The connection modalities between the component systems and the FIS make the FIS a whole-distributed system, which can be viewed as an “Enterprise Information System”. Its functions are a synthesis of the activities of the Divisions. This system can be identified and accessed via “drilling” and “mining” tools. Hence some

applications of the FIS become Client applications, that is, they access the Division Server, while a Client Division can access other FIS applications through the Regional Intranet.

In such view, most of the applications of the new FIS will be data management and administration applications. Each Regional Department is in charge of data publishing and certification over the network, but the definition and management operations of the federated integrated schema (or integration schema) of the FIS data are under the responsibility of the FIS management staff.

In the Enterprise Information System, a FIS Service function is created which will be the FIS Database Administrator and the reference for common data and for requirements and standards regarding new applications to be developed and installed in the FIS and in the component systems. The FIS Service is in charge of the definition of reference process and data architectures at the global level.

In particular, the definition of the reference data architecture for the FIS requires dealing with data spread in multiple databases that are distributed and heterogeneous. To come up with a reference representation of data, it is necessary to perform data schema analysis by taking into account specific heterogeneity and interoperability requirements. Starting from multiple source schemas, the construction of the reference data architecture process has to provide a unified description of schema elements that are semantically similar indifferent schemas, to mediate among their different representations due to different kinds of conflicts (i.e., name, type, structure). The goal is to define global concepts of data, where conflicts are solved. Global concepts are structured by defining a semantic dictionary, providing a uniform interface against the distributed and heterogeneous databases, to be exploited for querying and browsing activities at the global level in the FIS. A semantic dictionary provides a flexible architecture, while representing all data of interest for process cooperation and execution in a unified way, to facilitate interoperability at the FIS level.

Global concepts and links in the FIS dictionary provide a unified view of the databases of different Divisions in the system. An example of the semantic dictionary for the FIS is shown in Fig. 4, derived by analyzing and unifying schemas of three databases, namely, Municipality, Insurance, and HealthCare. This dictionary portion provides information about individuals and medical centers, together with associated information, such as residence, identity information, retirement information, and medical doctor. Concepts are related by means of association links. The '*' symbol denotes that the "Individual" concept groups three semantically related elements: Municipality Individual Insurance from the Municipality database schema, Regional Individual Insurance from the Regional schema, and National Assisted Individual from the HealthCare database schema.

The construction of the semantic dictionary focuses on the solution of conflicts/ambiguities among data representations in different schemas. For example, if we discover that the Municipality Individual Insurance and Regional Individual Insurance relations in the Municipality and regional databases have the following schemas:

Municipality Individual Insurance (Fiscal Code, First Name, Last Name, Sex, Birth date, Citizenship, Nationality, Municipality Code)

Regional Individual Insurance (Fiscal Code, Name, Surname, Sex, Birth date, Regional healthcare code, Retirement code, MedicalDistrictCode)

We can conclude that they are semantically similar, in that they describe individuals from two different perspectives. Then, data should be unified and related by semantic links.

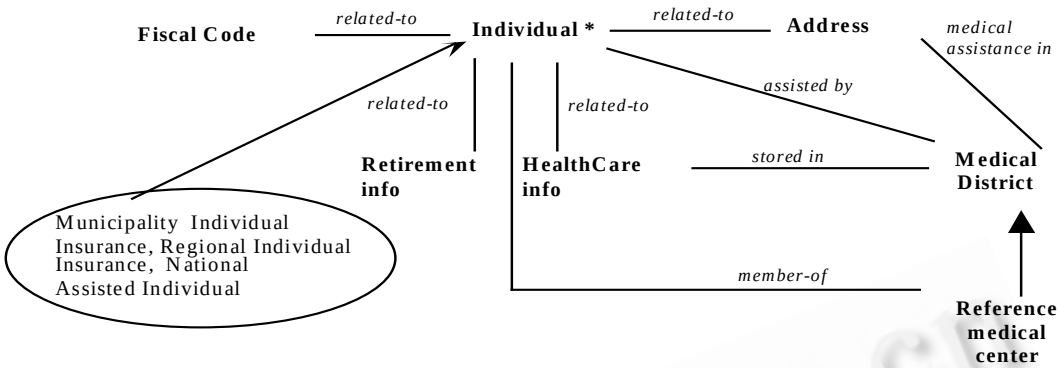

Fig.4 Example of dictionary in a FIS system

For example, the global concept Individual obtained by unifying the concepts of Fig.4 is shown in Fig.5. Individual has five featuring properties denoted by (f) in Fig.5, derived from the unification of attributes common to all elements of the cluster. Moreover, Individual has other 6 properties, which have a correspondent property only in some component schemas

Individual

(Fiscal Code: char[11] (f),
Surname: char[30] (f),
Name: char[30] (f),
Sex: m/f (f),
Birth date: date (f),
Citizenship: char[30],
Nationality: char[30],
Municipality Code: char[15],
HealtCare position: char[5],
Regional code: integer,
Medical District code: integer,
)

Fig.5 Example of global concept in the FIS semantic dictionary

An important issue in the database integration process regards the identifier to be associated with a global concept derived from a cluster of schema elements, for query purposes. With reference to our example, a global identifier Fiscal Code: char[11] can be defined for global concept Individual, starting from identifiers of all individual elements in the associated cluster. In our case, being in the Italian PA domain, Fiscal Code verifies also the primary key constraint by definition. Another issue is related to the identification of equivalent instances, that is, instances belonging to different local databases that denote the same real world entity. The problem of determining equivalent instances have been recently studied in the literature on object bases, and some solutions for object matching have been proposed[11].

We adopt the key-based approach due to the semantics of the global identifier Fiscal Code. In fact, if two individuals have the same value of Fiscal Code in different databases, we can conclude that they are the same individuals.

Global concepts are exploited for query purposes, and for browsing, based on relationships established in the

semantic dictionary. After selecting a global concept C of interest, the FIS user can explore the dictionary space and get a link to connected databases.

2.3 Architecture of the enterprise information system

Figure 6 gives a general view of the FIS reference architecture. It shows the RUPA Network, acting as a national backbone for data interchange. The different Divisions operate through the Wrappers and the Mediator. Outsourcing providers are endowed with the same dialog tools used within the FIS. The FIS Integration System module stores the data schema of the FIS and the Access Control Module.

Other Organizations (such as PAL, PAC, Ministries, SMEs or HealthCare Organizations) can dialogue with the FIS through the interface called “Lombardia Integrata” in Fig.6. The suite of network services provided by this interface supports home computer and phone based services and is the core of the Extranet connections of the FIS.

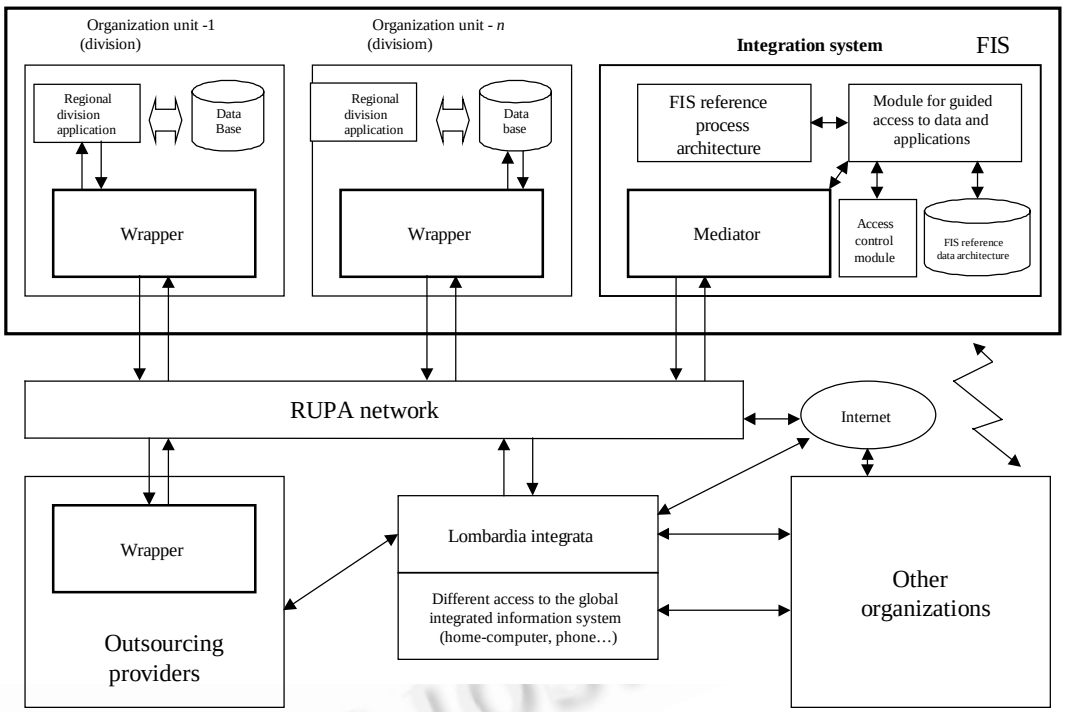

Fig.6 FIS reference architecture

In this architecture, it is worth noting the role of the FIS reference data architecture, describing shared data, as usually happens in heterogeneous FIS[10] and the role of the FIS reference process architecture, describing processes and their interactions. The FIS module contains also an access control unit (firewall) ensuring the privacy of shared data.

In the figures and tables that follow, we show some parameters that have guided the implementation of the FIS in Regione Lombardia. In Table 2 we give an idea of the budget regarding the FIS implementation.

Table 2 Data from "ITC Expense of Regione Lombardia" SDA Bocconi research (in EURO)

	1995	1996	1997
ITC Expense (Excepted Healthcare)	25 347 000	31 879 000	32 094 000
ITC Expense for Healthcare	16 876 000	20 866 000	21 174 000
Total	42 223 000	52 745 000	53 268 000
Variation (%)		17.29	0.97

	1995 (%)	1996 (%)	1997 (%)
Expense for management	96.2	83	81.8
Expense for development	3.8	17	18.2

In Fig.7, we see the distribution aspects of the FIS with respect to the central administration institutions of Regione Lombardia.

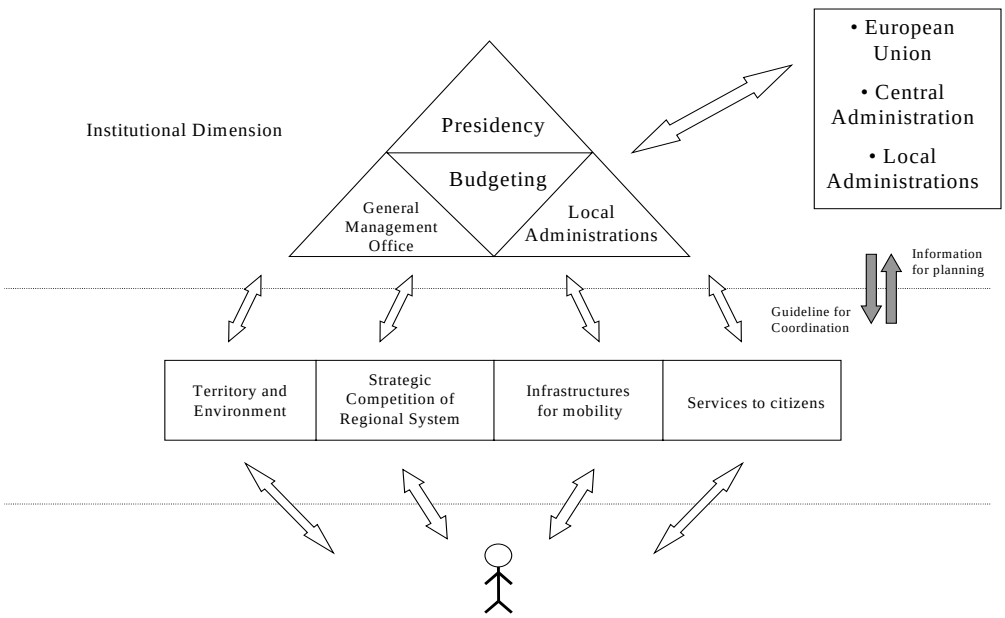

Fig.7 Intervention areas of the regional FIS

In Table 3 we list the criteria that have guided the data distribution in the FIS. Finally, in Fig.8 we depict the architecture that has been selected for the FIS of Regione Lombardia on the basis of existing hardware configurations.

Table 3 Criteria for the data and application dislocations

Data layer	Application layer
Data Bases for the totality of the Regional Administration	General Applications for the Regional Administration (Integration, Coordination and Consolidation Applications)
Data Bases for the single Organization Units	Operative Applications for the single Organization Units
Individual Data Bases	Individual Applications
Downloadable Data for third parties	Third Parties Applications

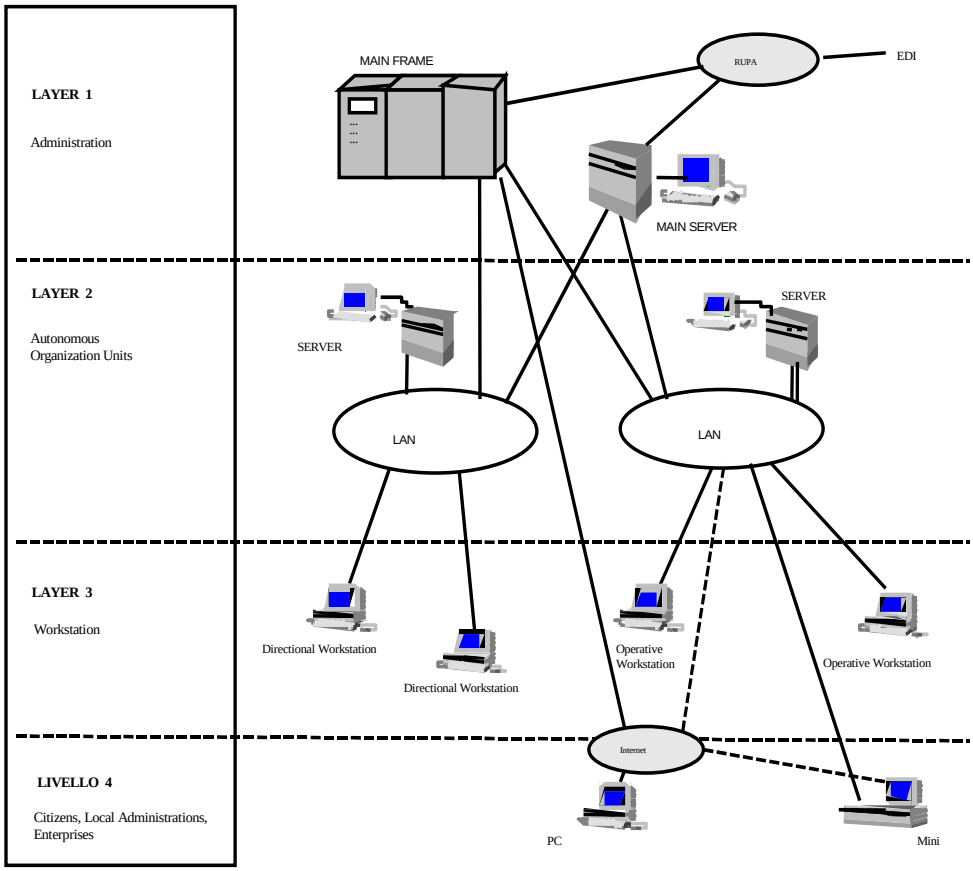

Fig.8 Logical architecture of the FIS information system

3 Concluding Remarks

The paper proposes two “case stories” of database integration, one in a Local Public Administration and one in a public utility, under the pressure of a new legislative context.

On one hand, the quest for synergy pushes into the direction of maintaining a unified design of the citizens’ or customers’ databases augmented by information related to other services offered. On the other hand, the new organizational design requires a redistribution of responsibilities, access policies, and access rights. In such a framework, data privacy introduces further constraints and additional complexity as discussed in Ref.[3], where the security framework for PA data designed in the framework of the Italian National Project Demostene (Security in Public Administration Information Systems) is described.

A common methodology for database integration, from both the technical and organization viewpoints, has been proposed and implemented. The methodology seems to be a powerful tool to cope with a framework in progress.

Further studies and implementations are in the pipeline. The widespread success of the Internet technologies pushes organizations to develop Corporate Portals. In this process, FIS offer one of the basic technologies.

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新立法对公共设施经营机构的数据库设计和维护的影响

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摘要: 正如在其它欧洲国家所发生的一样,目前欧共体关于经济和货币一体化的政策对意大利的公共设施运营机构产生了戏剧性的影响.一方面,这些机构必须提供有效的服务,甚至通过互联网来提供给公民和企业,另一方面,市场的不合常规目的是促进更强的竞争:如今那些垄断的行业,如能源、汽油、水和电信,不得不进行竞争.这个新的范型需要组织方式的变化,它对信息系统以及其中最为重要的部分——数据库将产生重大的影响.通过两个案例研究来说明欧洲的政策对数据库所产生的影响.这两个案例分别是,一个坐落在意大利米兰的地方性的公共设施经营机构 Regione Lombardia,另一个是在意大利罗马的能源企业 ACEA.关于新立法对数据库设计和维护的影响,将介绍一些基本的观点.还将特别讨论,作为新法律环境下的一个产物,数据库重新设计所进行联合和分裂的一些问题.

关键词: 数据库;信息系统;重新设计;案例研究

中图法分类号: TP311 文献标识码: A