Gianluigi Viscusi
Carlo Batini
Massimo Mecella

Information Systems for eGovernment

A Quality-of-Service Perspective

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Gianluigi Viscusi
University of Milano-Bicocca
Department DISCo
Viale Sarca 336/14
20126 Milano
Italy
viscusi@disco.unimib.it

Prof. Carlo Batini
University of Milano-Bicocca
Department DISCo
Viale Sarca 336/14
20126 Milano
Italy
carlo.batini@unimib.it

Dr. Massimo Mecella
University of Rome, La Sapienza
Department of Systems and Computer Science
and Engineering “Antonio Ruberti”
Via Salaria 113
00198 Roma
Italy
mecella@dis.uniroma1.it

ISBN 978-3-642-13570-5 e-ISBN 978-3-642-13571-2
DOI 10.1007/978-3-642-13571-2
Springer Heidelberg Dordrecht London New York

Library of Congress Control Number: 2010932189

ACM Computing Classification (1998): J.1, H.3.5, H.4.1, K.6, D.2

Cover design: KuenkelLopka GmbH, Heidelberg

Printed on acid-free paper.

Springer is part of Springer Science+Business Media (www.springer.com)

To my wife, Barbara, to my brother Beppe, to my sister Mariella, and to all who believe that writing books contributes to reduce the disorder of the universe

Carlo

To my "stella" and our Giulio and Valerio

Massimo

To Chiara, for her support, to Nella, Roberto and Giancarlo

Gigi

Preface

Motivation for the Book

This book aims to describe a comprehensive methodology for service-oriented information systems planning, considered in particular, in eGovernment initiatives. The methodology is based on the research results produced by the Italian project "eGovernment for Mediterranean Countries (eG4M)," granted by the Italian Ministry of University and Research from 2005 to 2008.

The concept of service is at the center of the book. The methodology is focused on quality of services as a key factor for eGovernment initiatives. Since its grounding is in a project whose goal has been to develop a methodology for eGovernment in Mediterranean countries it is called *eG4M*. Furthermore, eG4M aims at encompassing the relationships existing between ICT technologies and social contexts of service provision, organizational issues, and juridical framework, looking at ICT technologies more as a means than an end. eG4M satisfies a real need of constituencies and stakeholders involved in eGovernment projects, confirmed in the eG4M experimentations and in previous preliminary experiences in the Italian Public Administrations. A structured process is needed that provides a clear perspective on the different facets that eGovernment initiatives usually have to challenge and disciplines the complex set of decisions to be taken.

The available approaches to eGovernment usually provide only one perspective to public managers and local authorities on the domain of intervention, either technological, organizational, legal, economic, or social. Our aim is to provide a methodology which structurally supports the choice of the optimal eGovernment plans, considering all the above-mentioned perspectives. The quality-driven construction of the eGovernment plan is initially influenced by the social, legal, and organizational perspective, while it subsequently achieves its final shape when considering the economic and technological perspectives. As a consequence of the above vision, the most innovative contribution of the eG4M approach is that the planning activity is orchestrated by a team of social, legal framework, public administration organization, economy, and ICT experts. As such, the service-oriented information system approach of eG4M is the leverage for the exploitation of contributions from public managers and eGovernment authorities.

Another contribution of the book is in the data-centric approach to eGovernment. Data, information, and knowledge are the typical strategic resources used by public administrations in eGovernment processes and services delivered. As a consequence, the methodology pays specific attention to data and to the quality of data managed in administrative processes and services, whose inner quality is strictly related to the quality of the data they use.

Intended Audience

The book aims to be of interest for public administrators, decision makers, practitioners, ICT professionals, and Ph.D. students, providing a comprehensive perspective of the challenges, opportunities, and decisions involved in the effective strategic and operational planning of service-oriented information systems in eGovernment. Usually, the culture of public administrators is a mix of legal and administrative knowledge, while lacking an important organizational and technological background, namely information systems-oriented culture. Our aim is to bridge this gap, providing the necessary (and sufficient) background to allow administrators to play an active role in eGovernment strategic and operational decisions.

Organization

We provide a high-level description of the book organization in parts.

Part I. eGovernment: A Complex Challenge – We introduce the general issues of eGovernment, discussing the different disciplinary perspectives and state-of-the-art contributions. A detailed analysis is dedicated to methodologies for the life cycle process of eGovernment initiatives and to the quality-related aspects. Finally, we briefly describe the eG4M methodology.

Part II. Strategic Planning – This part describes the strategic planning phase, during which, starting from general macro-objectives and the general vision of governmental institutions, the state of the actual social, organizational, and technological systems is reconstructed and analyzed to identify the domain of intervention and the critical areas. At this point, an assessment is performed that measures the set of eReadiness and quality dimensions related to all the systems above. Starting from macro-objectives and stakeholder needs, evolutionary requirements are elucidated and target quality dimensions to be achieved for services are fixed.

Part III. Operational Planning – In this part we describe the operational planning phase, during which projects that allow achieving desired service qualities in the time span of the plan are identified. Data governance, business process management, and IT architectures are considered at this stage as the leading issues to be considered; these issues represent challenges for the different facets of an eGovernment initiative; on the other hand, they are relevant for the definition of the constraints and the requirements that bind project selection. At this stage, the

method for project selection is described that allows to choose on a qualitative basis the portfolio of projects that, among others, allow to meet in the time span of the plan desired quality targets for services within the given budget. At this point, we fix the resulting structure of the eGovernment plan, optimizing the development of front-office and back-office software and middleware components on the basis of common needs by selected projects. We conclude the operational planning phase providing a specification of administrative processes on the assumption of using a service-oriented architecture and related engineering approaches.

Part IV. eGovernment in Mediterranean Countries Public Administrations: Case Studies – Former versions of the eG4M methodology have been conceived and applied in Italy on the basis of the experiences carried out in a 10-year planning activity by the authority for the information technology in public administration. During the years 2007–2009, eG4M was adapted to and experimented in the Mediterranean countries such as Morocco and Tunisia. It resulted in an improvement of the eModel, developed by the G8 Group in 2001 for developing countries. Taking this into account, in Part IV we describe experiences, analyses, and real case studies, from the Italian, Tunisian, and Moroccan experiences.

Final part. Appendixes: Techniques used in eG4M – In the two appendixes we describe technologies considered and design languages adopted in eG4M. More specifically, Appendix A describes data integration technologies that may be used to reconcile the heterogeneous representations of data typically present in large information systems. Appendix B focuses on business process management, and BPMN (business process modeling notation) a language widely adopted to provide specifications of administrative or business processes as an input to the software production phase.

Reading Paths

There are at least two different reading paths of the book. The first path, made of Part I, Part II, Part IV, and Appendix A, is for public administration managers, that in a first reading are not necessarily interested in technological issues. The second path for ICT professionals includes Part II, Part III, Part IV, and Appendix B. The whole book is of interest for students of master and Ph.D. programs on eGovernment, service science, information systems management, information systems engineering, and informatics.

Authors

The book is the final systematization of a 3-year research activity granted by the Italian Ministry of Research. The research has been carried out by researchers of the Department of Informatics, Communication and Systems and the Department of Sociology of the University of Milano-Bicocca, the Department of Economic

Sciences, and the Department of Computer and Systems Science and Engineering "Antonio Ruberti" of SAPIENZA University of Rome and the University Luiss in Rome. The head of the project was Professor Carlo Batini, one of the authors of the book.

The experience gained by Professor Batini is due to his experiences from 1993 to 2003, during which he was on leave of absence from the university, being a member of the executive board of the Italian Authority for information technology in Public Administration, where he led significant projects related to the Italian eGovernment initiatives. Projects concerned services to businesses, portals for access to public data, re-engineering of flows of documents and processes in public administrations, back-office services among administrations based on the publish–subscribe paradigm, human resources management in public administration, data quality as a means of improving the quality of administrative processes, accessibility and usability of web sites and services by disabled persons. In this period he contributed to produce several norms and technical rules on document management, structure, and access to norms and laws using XML markup language and accessibility of web sites by disabled persons. He also contributed to produce guidelines for feasibility studies, IT plans, quality of service, access to public data. In 2009 Carlo Batini obtained a University award from IBM for a research project on service science. Carlo Batini has published more than 80 papers in journals and conferences; furthermore he has also published 18 books, among them 2 for the international market (see [23] and [26]).

The book has two other main authors, Gianluigi Viscusi and Massimo Mecella.

Dr. Gianluigi Viscusi received a master's degree in philosophy from the Università Statale di Milano in 2001. In November 2007 he received a Ph.D. from QUA_SI, a doctoral and advanced research program in information and communication technology applied to the knowledge society and to learning processes, University of Milano-Bicocca. He has published 28 papers in international journals, edited books, and attended conferences and workshops. He has experimented the eG4M methodology in Morocco and Tunisia. The above-mentioned award on service science is strictly grounded on Viscusi's post doc program.

Dr. Massimo Mecella (Ph.D. in computer science and engineering) is an assistant professor at SAPIENZA University of Rome, Department of Systems and Computer Science and Engineering "Antonio Ruberti." His research interests include cooperative, distributed, and web-based information systems, service composition and orchestration, mobile computing, process management, domotics, emergency management, cooperative architectures, and software engineering for eGovernment and eBusiness. He has authored about 70 papers and participated in various European and national projects (SM4All, WORKPAD, SemanticGOV, EU-PUBLI.com, MAIS, VISPO, DaQuinCIS). In 2005 he also collaborated with Italian authorities in the definition of the Italian SOA for eGovernment.

One of the chapters of Part II, the chapter on eReadiness, has been written with the contribution of other researchers involved in the eG4M project; their names appear at the beginning of the chapters together with their affiliation.

Finally, one of the chapters of Part IV, dedicated to the Italian experience, has been written by Guido M. Rey in collaboration with Sandro Clementi. Guido M. Rey has been the president of the above-mentioned authority for 8 years, after having been formerly the president of the Italian National Bureau of Census.

Acknowledgment

We acknowledge all the relevant researchers and scholars of the eG4M project. A special mention to Gianluca Misuraca for his role in the management of the relationships with the Moroccan and Tunisian public administrations, Prof. Roberto Baldoni, Prof. Tiziana Catarci, Prof. Guido Martinotti, Prof. Giorgio De Michelis, Prof. Marcella Corsi for their scientific contribution to the eG4M supervision, Daniela Cherubini for her contribution in developing early stages of the social aspects of the state reconstruction and eReadiness, Milos Carloni and Michele Lembo for their work on the field, respectively, in Tunisia and Morocco and Simone Grega for his precious work as project management officer of the eG4M project, Ruggero Russo and Damiano Pozzi for their precious work on the technological issues of the project, and Giuseppe Cammarota for his contribution on legal issues. We also thank Julia Weekes for English proofreading. Furthermore, we acknowledge the Tunisian and Moroccan public administrations which participated in the eG4M experimentations. Concerning the Tunisian Public Administration, a special mention to the eGovernment Unit and the Tunisian Prime Ministry, the Tunisian Ministry of Public Function, the Tunisian Ministry of Agriculture, and the Tunisian Ministry of Higher Education. In particular, we wish to thank Madame Khedija Zammouri and her staff (in particular Rim Garnoui), Monsieur Zaabi, and Madame Henda Ben Ghezala for their support. Concerning the Moroccan Public Administration, a special mention to the University Mohammed V – Souissi – and the Ecole Nationale Supérieure d'Informatique et d'Analyse des Systèmes (ENSIAS). Finally, we acknowledge the Italian Embassies in Tunisia and Morocco, and in particular to Caterina Veglione for her support in the different steps of the organization of the final seminar in Tunis. For what concerns Morocco, a special thank goes to Prof. Bouchaib Bounabat for developing a state of the art on the Moroccan e-Readiness. Finally, Carlo Batini wishes to thank GuidoRey, Gaetano Santucci for the unbelievable help they provided during the period on leave from University, Gianluigi Benedetti of Italian Ministry of Foreign Affairs, and Alessandro Palanza of the Italian Chamber of Deputies for having involved himself in relevant international projects in eGovernment.

Contents

Acronyms

BMO	Business model ontology
BPM	Business process management
BPR	Business process re-engineering
DBMS	Database management system
EGEL	eGovernment vision elicitation step
eG4M	eGovernment for Mediterranean countries
ER	Entity–relationship model
EREA	eReadiness assessment step
ERP	Enterprise resource planning
G2B	Government to business
G2C	Government to citizen
G2G	Government to government
ICT	Information and communication technology
ISTAT	Italian National Statistics Institute
MeRM	Micro eReadiness model
NPM	New public management
OECD	Organization for Economic Co-operation and Developement
OPER	Operational planning phase
QUAL	Quality assessment step
PA	Public administration
PEC	Italian-certified electronic post
PROC	Specification of new administrative processes
PROJ	Government architecture and choice of projects
RGS	Italian general accounting agency
RIA	Regulatory impact analysis
SECI	Social and economic context indicators
SERV	Definition of priority services and value targets
SOC	Service-oriented computing
SREC	State reconstruction step
STRA	Strategic planning phase

Part I
eGovernment: A Complex Challenge

Chapter 1
The Different Facets of eGovernment Initiatives: Paradigms and Approaches

In recent years research on eGovernment has grown rapidly at both the quantitative and qualitative levels [104]. Besides this rapid development both practitioners and scholars have considered the results of solutions and initiatives deployed in the last 10 years in the different countries involved in eGovernment programs, showing that these latter initiatives focused mainly on front-office processes, while actual project efforts aim to re-design and manage back-office processes.

At the state of the art, this new trend opens a new phase in eGovernment called *transformational government*, more focused toward the reuse of available solutions and systems [61] or in migration toward information systems of new generation more sustainable in terms of costs, when possible. The focus on back-office improvement is considered as the strategic way to create more efficient and customer-centric public services, where the challenge for public administrations is to align IT and organization in order to ensure that their teams can exploit systems to deliver value-added services.

The change of focus toward back-office processes claims (i) to improve the modeling activity in order to represent the actual alignment between the technological infrastructure, the organization, the economic and juridical facets of the domain of intervention and (ii) flexible and modular methodologies allowing to adapt the planning activity to different social and juridical contexts [10]. These issues ask scientific research for theories of reference, to provide the basis for the planning and design of eGovernment transformational systems [104]. Furthermore, theories and methodologies must be able to instantiate case studies confirming or falsifying their effectiveness.

Section 1.1 discusses the main issues related to the development of eGovernment initiatives, motivating the need for methodologies and introducing the main theoretical perspectives inspiring eG4M. Section 1.2 analyzes the central role of the concept of service in the context of eGovernment planning. Due to the different facets involved in public service provision and the organizational complexity of the public administrations, Sect. 1.3 points out the specificity of eGovernment strategy and the needs for more effective ways of representing alignment between strategy and

This chapter is authored by Gianluigi Viscusi.

G. Viscusi et al., *Information Systems for eGovernment*,
DOI 10.1007/978-3-642-13571-2_1, © Springer-Verlag Berlin Heidelberg 2010

operational levels. Among the different factors which impact on planning, Sect. 1.4 investigates the role of rules in eGovernment initiatives. Finally, Sect. 1.5 discusses the eG4M multidisciplinary approach by deepening relevant concepts and issues.

1.1 Background and Motivations for a Methodology

The success of public sector investments in eGovernment initiatives strongly depends on exploiting effective governmental ICT systems and infrastructures [67]. In particular, planning activities are both a major challenge and the most relevant instruments to carry out sustainable and valuable eGovernment. Recently, for example, IT discussions of cost savings have evolved to concerns over energy efficiency. Faced with the issue of an energy-efficient data center, public sector organizations are looking for ways to optimize their computing environments to do more with less and improve service delivery for citizens in a sustainable way. These objectives are hardly reachable without methodological frameworks providing a holistic perspective and knowledge on the different facets of the contexts where eGovernment initiatives take place, due to the critical relationships between information systems and global diversity [10].

Furthermore, we have assisted in the change of focus in the management of the public sector, from the disaggregation, competition, and performance characteristics typical of the *new public management (NPM)*[1] to new models of governance, aiming to reintegrate services with a new perspective on bureaucracy [54, 66], which aims to exploit the extensive digitalization of administrative operations [67] without reducing the public administration at a minimal state.

In the literature, this shift is related to the growing awareness that models and techniques of information systems evaluation exploited in the private sector cannot be adapted to the public sector domain and to eGovernment initiatives, where information systems evaluation encompasses subjective judgement, grounded in opinion and world views [109].

Besides individual and group perspectives, Fountain [80] pointed out among other factors how technological determinism contribute to "misinform decision making and the clarity of discussion." The lack of clarity in decision making is often tied to a scarce awareness by public managers and public decision makers of the potential of the ICTs, leading to deploy information systems for eGovernment where individuals and organizations use only a limited set of the available function and features provided. This perspective is motivated by the need to provide a tool

[1] NPM is a complex concept referring to a perspective on public management change, deeply rooted in business practices and market orientation. According to Dunleavy et al. [68] NPM can be seen both (i) as a theory of managerial change based on three themes, namely *disaggregation*, *competition*, and *incentivization* and (ii) as a way of intervention in the public sector which exploits policy technologies driven by economic and business ideas. For further details on NPM and on public management as the main research topic, we remind among others to the work of Pollitt and Bouckaert [173].

supporting the definition of the characteristics of eGovernment projects which are suitable to have a positive impact on the contest of intervention.

Due to these issues, we claim *strategic planning* as the most relevant phase of the eGovernment information system life cycle to achieve a clear understanding of the alignment between the political vision and the target either and/or both internal, external social worlds, the actual ICT goals, architectures and infrastructures.

The aims of strategic planning are to provide a detailed representation of the strategy adopted in the eGovernment initiative. In general terms, an eGovernment strategy is

> a plan for eGovernment systems and their supporting infrastructure which maximizes the ability of management to achieve organizational objectives [103]

Furthermore, the eGovernment strategy can be seen from an institutional perspective as a rule-based action [138–140] aiming to provide services appropriate for the institutional context [217]. The appropriateness of rules organized into institutions includes both cognitive and normative components [137, 140]. As pointed out by Fountain "the embeddedness of government actors in cognitive, cultural, social, and institutional structures influences the design, perceptions and uses of ICT [80]."

Taking these issues into account, we consider *appropriateness* as the capability of detecting and enhancing the potential of the context [35], and the degree the eGovernment services fit the context characteristics, both at the macro- (scenery) and micro (user's context)-levels [217]. Furthermore, we consider appropriateness as tied to theoretical perspectives that evaluate the *capability* of a system to achieve valuable goods [200] or activities and states that allow people's well-being, namely *functionings* [155], and to convert them into utilities.

Besides appropriateness, the multidisciplinary facets involved in the planning of an eGovernment strategy ask for a systemic perspective on eGovernment planning [133]. Due to these issues we adopt a methodological principle described by the concept of homology of the system or structure [33, 34]. *Homology* establishes a structural correspondence between two phenomena or between two coherent systems of meaning and action.

In our work the concept of homology contributes to explain the level and degree of diffusion of a certain technology within a social context (or between different contexts), assuring the coherence between technologies and social systems. For example, homology allows to ascertain the correspondence between the behavior of a population toward a new technological application (e.g., adoption, rejection) and its cultural capital. We further discuss appropriateness and homology of systems in Sect. 1.4.

It is worth noting that the adoption of appropriateness and homology aims to support a systemic perspective on the technology *enactment* resulting from the embeddedness of government actors. Enactment is "the subjective representation of a problem that reflects an actor's perception and boundedly rational reasoning rather than the situation itself [80]" and the process of enacting technology refers to "the tendency of some organizational actors to implement new IT in ways that reproduce, indeed strengthen institutionalized sociostructural mechanisms [80]" (namely routines, script and patterns of the organization).

Taking these issues into account, we have produced a multidisciplinary methodology for strategic planning of eGovernment initiatives called *eG4M* (eGovernment for Mediterranean countries). The aim of eG4M is to provide guidelines for the choice of projects that on the basis of the actual social context and of the actual rules and available resources fulfill planned objectives; these latter are expressed in terms of target quality levels for services, administrative processes, and ICTs involved. The choice to introduce "Mediterranean Countries" in the name of the methodology aims to put in evidence the specific domain where the methodology has been conceived and developed and the specific cultural, social, economic, and juridical facets.

Earlier versions of eG4M have been applied in Italy on the basis of the experiences carried out in a 10-year planning activity by the authority for information technologies in public administration, an agency devoted to supporting the Italian Public Administration in the adoption and use of ICTs for improving services to citizens and businesses. It has been enriched and adapted to other countries, in particular Morocco and Tunisia, giving rise to an improvement of the *eModel* produced by the G8 Group in 2002 for developing countries [114].

A first version of the methodology focused on social and organizational aspects was produced in 2007 [24], whereas in the current version the eG4M deals with the complexity of different aspects of the context of intervention for eGovernment or public administration innovation initiatives.

Indeed, the application of the eG4M methodology points out the relevance of legal issues in the planning phase, due to the difference between local rules and legal frameworks and misalignments between the technological solutions proposed in the early versions of the local eGovernment plans and the requirements emerging from the eG4M-mediated analysis of the context of intervention. In particular, the undervaluation of legal issues confirms that when decision makers aim to carry out a certain initiative in order to improve public services, the actual legal framework governing services is poorly investigated. Most of the time, a technological solution is a priori supposed to be suitable for the aims of the initiative, but usually no evaluation of its coherence within the legal framework is performed.

The adopted theoretical perspective is influenced both by institutional conceptions of political change and by *structuration theory*, both in the original formulation of Giddens [86, 87] and the main adaptations in the information systems literature [117, 160, 161]. To provide an exhaustive discussion of structuration theory is out of the scope of this book and we refer to the above cited literature; whereas we are interested in how it considers structure as "non-temporal and non-spatial, as a virtual order of differences produced and reproduced in social interaction as its medium and outcome" [86, p. 3].

Another relevant issue in structuration theory is the overcoming of dualisms such as subject/object and individual/society by considering the *duality of structure* as "the essential recursiveness of social life, as constituted in social practices: structure is both the medium and outcome of reproduction of practices" [86, p. 5]. In structuration theory terms, structures as resources and rules mediate social action through three modalities, i.e., facilities, norms, and interpretative schemes

[86, 87, 117, 160]; these latter, through their instantiation by social actor, enact a reconstitution of the resources and rules that structure the social action.

For what concerns rules (see also Sect. 1.4), as the eGovernment focus is evolving from the national government level to local public administrations [88], juridical issues play a relevant role in the governance of eGovernment initiatives, influencing the feasibility of the interventions and their outcomes. In particular, focusing on the context where the experimentations of the methodology take place, state-of-the-art studies [109] have confirmed that countries in Africa with more effective legal frameworks have higher scores on the network readiness index [221].

eG4M driving factors are the qualities of the social, organizational, information, and technological systems involved in eGovernment development. In this context, the literature on information systems methodologies has pointed out the relevance of the different issues involved in the design and planning of information systems, and solutions from different perspectives have been proposed [12, 79]. In the following we discuss all these issues, comparing our approach with the related work.

Planning methodologies in the eGovernment domain are considered as a specific case of methodologies in the information systems area. Avison and Fitzgerald [13] define the present state of research in the area as a "post-methodology era," and claim that the success or failure of development efforts cannot be attributed exclusively to "the use, misuse, or non-use of methodologies." Our point of view is that methodologies in the eGovernment area present original research aspects, due to the complexity in the alignment of the different disciplinary facets involved. As pointed out in [46], these facets cross the boundaries of procedural methodologies and point out an integrated approach involving social and organizational perspectives.

Furthermore, the theoretical framework of eG4M is based on the experience gained in information systems development, as described in [28, 144]. This experience locates eG4M on the boundary among methodologies developed from theory and methodologies developed from practices [12]. eG4M driving factors are the qualities of the social, organizational, information, and technological systems involved in eGovernment development. In this context, the literature on information systems methodologies has pointed out the relevance of different issues involved in the design and planning of information systems, and solutions from different perspectives have been proposed [12, 79].

In the following we discuss the service-oriented nature of eGovernment planning (Sect. 1.2), the role of rules and laws in eGovernment initiatives (Sect. 1.4), and the multidisciplinary approach of eG4M for planning of appropriate and quality-based initiatives (Sect. 1.5).

1.2 Planning eGovernment Initiatives as Services

Service science is an emerging effort to build a scientific discipline based on the concept of service [48, 107]. Despite the fact that the service sector has widely grown over the last 50 years in the most advanced industrial economies, scientific understanding of modern services is rudimentary [48]. Services apply in a broad

range of different domains, such as business, government, health care, education, finance, transportation, and communication. Besides these domain issues, the different facets of the concept of service have been investigated by different disciplines such as economics, sociology, organizational science, and at present computer science; the resulting diversity of perspectives and approaches implies a growing complexity in providing a common theoretical framework. A service can be defined as follows:

> . . .an activity or series of activity, of more or less intangible nature, that they have place in an exchange between a supplier and a customer, where the object of the transaction is an intangible good [95].

This definition is general enough to encompass the specific characteristics of services involving both intangible services and products as services, where ". . .almost any product can be turned in a services to a customer" [94]; for example, a machine becomes a service if we consider the machine not only under the physical perspective of product, but together with the way to treat the customer with an appropriate designed machine [94]. Furthermore, focusing on services as activities, we can also consider as valuable services to customers the administrative services, such as billing and handling claims or, in the context of government that we consider in this book, all the back-office procedures that enable, e.g., a certificate provision. These latter are *hidden services* [94] or *support services* that contribute to provide the necessary infrastructure which enable the effectiveness of the core services. In fact, the service package [94] is usually composed of both *core services* and *support services*.

In the following we adapt the definition of the service package to eGovernment and public information systems, by adopting the concepts proposed in [164], where the service package is composed of *administrative services* (the basic functionalities and resources offered) and *value-added services* (the functionalities and resources having value for the user). Indeed, administrative services (as hidden/support services) are often handled in a passive way by customers who consider them not as services but as nuisances. Nevertheless, their improvement and innovation can create competitive advantage for organizations characterized by an intensive use of these hidden services [94, 95], because of the bureaucratic nature of their transactions [66, 227].

Due to the different facets of the concept of service, the diversities between these domains imply a growing complexity in providing a common theoretical framework. In particular, these efforts are directed toward providing a framework that aims to integrate ICTs with traditional paradigms of service management, such as customer relationship management. Moreover, the evolution of information systems to network-based systems, competition and globalization of markets [129], and the fast growing economic relevance of services led businesses to conceive and adopt new strategic models. Among them, the *value constellation* model considers the competitive advantage for businesses coming from the dynamic creation of value by the different stakeholders involved, e.g., businesses, public administration [154].

In this scenario, ICT represents a critical enabler in service interactions, in particular, within the service-oriented computing (SOC) paradigm [165], which points out the relevance of business modeling for service design and development. The idea at the basis of SOC is that the concept of service as Web service can be exploited to enhance the interaction among applications and systems in order to achieve interoperability, integration, and collaboration between different actors and platforms. In fact, a Web service is a software component providing an external interface accessible via web so that once the service is invoked, it is able to perform a certain number of operations.

Taking into account these issues, besides the general definition of service in order to cover the actual spectrum of the concept and the new kind of services enabled by technological evolution, we provide a definition also for the concept of e-service and Web service. An e-service can be defined as

> . . .the provision of service over electronic networks. This notion includes services provided by a typical service organization as well as the services provided by goods manufacturers where the quality of customer care plays an important role. The notion of electronic networks includes the Internet and wireless networks as well as electronic environments such as ATMs, smart card networks, kiosks, among others [192].

The concept of e-service has been used in the last few years to describe "revenue-generating, efficiency-increasing assets in the Net" [192]. Nevertheless, the concept of e-service is much broader than the concepts of IT service and Web service including all these services, and encompassing the service product, the service environment, and the service delivery that comprise any business model, whether it belongs to a goods manufacturer or a pure service provider. In this context, Web services are mainly software components that is the functional basis of e-services [192]. Web services can be defined as follows:

> self-describing, open components that support rapid, low-cost composition of distributed applications. Services are offered by service providers-organizations that procure the service implementations, supply their service descriptions, and provide related technical and business support. Since services may be offered by different enterprises and communicate over the Internet, they provide a distributed computing infrastructure for both intra and cross-enterprise application integration and collaboration. Service descriptions are used to advertise the service capabilities, interface, behavior, and quality [166].

A unified way to look at services is nowadays far to be achieved, in particular in the planning phase where the different stakeholders hardly cross the boundaries of their own perspectives. The communication between stakeholders is another challenge for an effective and value-based service planning, in particular considering the eGovernment domain and the role of public administration emerging in the service economy which characterizes the information society [43].

In this context public administrations involved in the process of planning and production of e-services in eGovernment initiatives tend to privilege the development of administrative services, namely prescriptive public administration obligations, strictly related to laws to be enforced, disregarding the importance of value-added services. Value-added services, besides minimizing the waste of resources (money and time), have the primary objective of producing effective outcomes for

the constituencies, namely citizens and businesses. An example of administrative service is the provision of a certification, while a value-added service is the provision of territorial information that may be useful for marketing processes. The distinction between the two kinds of services is not clear-cut; in fact, an administrative service that contributes to the efficiency of a business is also a value-added service. Providing a support for business modeling in service planning activity is another critical issue for eGovernment initiative planning. Indeed, a service scenario involves different organizations that have proper representations of business domain and of the implemented Web services.

The focus on business models draws attention to the different layers of service design that span from the business domain, where a service is supposed to have an outcome, to the technological layer that concerns the implementation of the e-service. In order to make accountable the relationships between the concepts involved at the different layers a sharable representation of the objects and of the concepts involved in each domain is required.

1.3 Information Systems Strategic Alignment in eGovernment

The diffusion of electronic transactions and the Internet contributes to the diffusion of new models of interactions between actors. e-Business emerges as a fundamental model to move organizational and business activities from physical infrastructures to computer-based networks, enacting a digital connection among traditional stakeholders in a competitive environment [191, 224].

In general, *e-business* can be defined as "any business transaction or service conducted over the Internet" [191], allowing to provide a direct access to users, by lowering transaction costs defined by transaction costs economics [227]. Further, to be able to exploit e-business benefits the organizations have to reconfigure their value chains [204] and to adopt new technological resources allowing to exploit information as the critical economics and strategic resource [174, 175, 206] emerging in the information society as a service economy.

Besides the new economy claims about a transfer of all business interactions to the Internet, e-business represents more an evolutionary change rather than a disruptive change [191], involving new roles of business modeling [162] in defining value propositions adapted to the new flexible value systems. A *value proposition* is "a statement of how value is to be delivered to customers. It is important both internally and externally. Internally it identifies the value drivers it is attempting to offer a target customer group and the activities involved in producing the value together with the cost drivers involved in the value producing activities. Externally it is the mean by which the firm positions itself in the minds of customers" [219]. Business modeling allows the implementation of value proposition through more efficient operations and flexible organizational structures [191].

It is important to note that the concept of e-business is associated not only with businesses, but has been extended to the transactions involving public administrations and other institutions. As eGovernment, the concept is used to define the way that public administrations exploit to interact with citizens and businesses in order

to provide government services [205]. Moreover, it is worth noting that e-business development has driven the public sector interest in eGovernment between 1995 and 2001 [54, 228].

Taking this into account, on the basis of the actors involved in the interactions it is possible to define the following typologies of Internet-based transactions associated with the concepts of e-business, namely business to consumer (B2C), business to business (B2B), consumer to consumer (C2C), government to government (G2G), government to citizens (G2C), and government to business (G2B).

Furthermore, it is worth noting that in the context of eGovernment the goal is not to obtain a competitive advantage and shareholder value as in the private sector; on the contrary, eGovernment value heavily depends on political and social objectives such as trust in government, social inclusion, community regeneration, community well-being, and sustainability [93]. In general terms, in the context of eGovernment, value relies mainly on *public value*. As stated by Grimsley and Meehan [93] on the basis of Moore's conceptualization [150], public value can be interpreted as

> the value that citizens and their representatives seek in relation to strategic outcomes and experience of public services

Taking these issues into account, as noted above, business models allow to achieve better planning and to guide the change, supporting a better alignment between strategic and operational levels (organizational processes and ICT) on the basis of evolving value propositions. In fact as argued by Porter [177] ". . .strategy involves a whole system of activities, not a collection of parts. Its competitive advantage comes from the way its activities fit and reinforce one another."

Business models represent the way to share value propositions between the different facets of an organization, either private or public (in this latter case value proposition in business models implements political objectives). eGovernment requires a focus on better quality and enhanced business processes, under a value proposition (or political vision), challenging three critical issues claimed, namely (a) IT governance to ensure strategic positioning of IT in the public administration, (b) human resource alignment to dynamically allocate key information systems (IS) resources to critical IS projects, and (c) users connectedness through effective channels and infrastructures [191].

The debate in the literature about what alignment actually is points out that there is little agreement on conceptualizing alignment. Many concepts and definitions are used in the literature to define strategic alignment, such as *fit* [177], *integration* [36, 223], *bridge* [49], *harmony* [132], and *linkage* [105, 106]. Alignment can assist a firm by (i) maximizing return on IT investment; (ii) helping to achieve competitive advantage through; and (iii) providing support to react to new opportunities [11]. Through the alignment of strategy and infrastructure, businesses may not only achieve synergy and facilitate the development of business plans but also increase profitability and efficiency. Nevertheless, the critics of strategic planning and alignment argue that the effectiveness of a structured and formalized strategy process is doubtful in the information society where uncertainty and flexibility predominate; due to these issues, they point out the complexity of obtaining articulation and coordination of the strategic intent and operational level [49].

In fact, strategic alignment presumes a full control capability of the management and an information infrastructure easily adaptable to its constraints, while real-life infrastructure and situated human action hardly satisfy these issues [49, 83]. Nevertheless, strategic alignment can be seen also under a perspective not considering it as rigid imposition.

Reich and Benbasat [180] see IS planning as a mechanism to achieve linkage, requiring that business and IT plans are internally consistent with the mission and that they are balanced to external business and IT environments. Furthermore, they point out that strategic alignment may be approached from a process perspective (investigating planning activities) or from an outcome perspective (involving the implementation of strategies) [181]. They suggest that there are two dimensions to strategy creation: (i) an intellectual dimension, investigating the content of plans and the planning approaches, and (ii) a social dimension considering the people involved in producing alignment. This latter dimension is poorly considered, whereas strategy is mainly analyzed as a rational process and alignment as a static end state rather than a moving target. Taking these issues into account, a business model is a relevant tool for alignment and should represent and not evaluate properties that allow for a classification, analysis, and comparison of business strategies [229]. A *business model* can be defined as follows:

> a conceptual tool containing a set of objects, concepts and their relationships with the objective to express the business logic of a specific firm. Therefore we must consider which concepts and relationships allow a simplified description and representation of what value is provided to customers, how this is done and with which financial consequences [229].

At the state of the art, the business model concept is adopted to refer both to the way an organization does business and to the way it can be modeled for requirements engineering [92, 162, 229]. This latter perspective refers to a conceptualization of the way an organization does business or provides services in order to reduce complexity to an understandable level.

Conceptual business modeling supports organizations in understanding and sharing, analyzing, managing, prospects, and patenting of business models [162]. In this context, ontologies and meta-models representing elements and relationships are proposed [162]. Furthermore, business modeling is different from business process modeling [91]. The distinction is clearly stated in the following definition:

> A business model gives an high level view of the activities taking place in and between organizations by identifying agents, resources and the exchange of resources between the agents. So, a business model focuses on the *what* in a business. A process model, on the other hand, focuses on the *how* as it deals with the operational and procedural aspects of business communicationsĚ In other words, a business model takes a declarative view, while a process model takes a procedural view [116].

The business model concept is generally representing the logic guiding the way an organization creates and commercializes value, while the business process model is about how a business model is implemented in processes. Besides the state of the art of IT strategy analysis and business modeling in the private sector, there are few

researches and frameworks dedicated to the analysis of these topics in the public sector, in particular considering them in the context of eGovernment initiatives.

In the following chapter we discuss how the methodological approach proposed in this book supports IT strategy alignment analysis and business modeling in the strategic planning of eGovernment projects and services. In particular, eGovernment also offers useful insights for the private sector, because of the role and the impact of rules and laws on the business models and on the alignment between the projects chosen, the political vision, the related strategy, and the enabling technologies.

1.4 The Role of Rules in eGovernment Initiatives

eGovernment initiatives involve and impact on institutions and the related social environment. Institutions are nested and coevolve together with their linkages [138, 139]. Routinization and repetition as rule-based actions for their social construction [27] can be the source of change when related to reinterpretation of their rule-based roles. eGovernment is related to institutional change and adaptation in public administrations, if considered in its evolution as resulting from the interaction between two different and converging goals: on the one hand, the research of solutions for the public administrations performance (i.e., in terms of efficiency and effectiveness of the organizational processes and service provision); on the other hand, the request for transparency and accountability of public managers from the public administrations constituencies (citizens, businesses, and other stakeholders).

A major issue in eGovernment planning is to provide access to the systems of rules of the institutions involved, as sharable meaning in order to improve their reinterpretation and to focus on the constraints they introduce in the planning of further initiatives. At the state of the art various types of rules have been proposed on the basis of their orientation, namely rules as solution-guiding mechanisms, rules as behavior controlling mechanisms, or rules as behavior constraining mechanisms [88]. In particular, rules are relevant in system design methodologies aiming to analyze and provide solutions to soft problems [45, 46], such as the ones impacting on eGovernment initiatives as institutional technology-based interventions. Following Giddens [87] we distinguish between *rules of social life* applied in the enactment/reproduction of social practices and *formulated rules*. These latter are those that characterize administrative procedures in a public administration, where laws are both rules and resources that define roles of action through the attribution of power and the imposition of duties [102].

In fact, a *legal system* can be considered as a system of rules [102], where rules can be classified in terms of *primary rules* that express rules of conduct and *secondary rules* that define the roles of the civil servants who have to administer the rules of conduct [102]. A complementary distinction is made between *regulative norms* which describe obligations, prohibitions, and permissions and *constitutive norms* that regulate the creation of institutional facts like property or marriage, as well as the modification of the normative system itself [197]. These latter are related

to secondary rules. As pointed out in [29] "Hart's notion of secondary rule emphasizes the complexity and the evolutionary nature of the legal orders, indicating the instrumental and not directly regulatory aspects of the systems."

In this book we focus mainly on secondary rules and, in particular, on the three issues pointed out by Hart [102],

- the *uncertainty*, namely the criteria of validity of a law in the context of eGovernment (this issue is related to the rules that allow a group of public administrations to provide a common service);
- the *rigidity* of rules that deals with the capabilities offered by the actual legal framework and the evaluation of the required changes in laws to carry out the initiatives;
- the *resolution of legal disputes* such as the consistency between national and international laws for the definition of jurisdiction under which the eGovernment initiatives are carried out.

Furthermore, laws have an impact on the effectiveness of investments on ICT, on the redesign of administrative procedures defined by laws and on service provision processes which implement administrative procedures. Among the tools aiming to help governments to assess the impact of regulation, the regulatory impact analysis (RIA) has been widely adopted in the countries of the Organization for Economic Co-operation and Development (OECD) also in the context of eGovernment initiatives, in particular to reduce the regulatory burden [156, 179]. Besides other frameworks, a key feature of RIA is its consideration of the potential economic impact of regulatory proposals [98, 136, 185]. Notwithstanding, the impact of laws on eGovernment project planning has been seldom investigated, whereas the aim of this book is to propose a methodology which considers laws and regulatory issues in the strategic and operational planning of eGovernment initiatives, in order to better evaluate the effectiveness and appropriateness of their final outcome. Indeed, rules cannot be described or analyzed as a lexicon separated from the practices that they organize and refer to [86].

1.5 The eG4M Multidisciplinary Approach

Today, attention paid to planning methodologies has diminished by both scholars and practitioners. These latter are more inclined to adopt trial-and-error paths without a standard methodology to follow or, as an alternative, to build their own methods, i.e., a highly situated way to achieve business goals, mainly focused on the operational and development phases [13]. Nevertheless, our point of view is that methodologies for planning are a relevant issue to master the complexity of the different facets of information systems, even more in service provision, where value configurations change dynamically, requiring flexibility but also modular tools tracing the paths followed in the project development, showing clearly what is at

stakes in the competitive environment where service provision acts, and allowing communications between all the stakeholders.

As pointed out by Checkland [46], these facets, indeed, cross the boundaries of procedural methodologies and point out to an integrated approach involving social and organizational perspectives. This is even more true for the case of eGovernment services planning that, due to the characteristics of services in the information society, we consider a special case of information systems planning. Moreover, eGovernment planning presents original aspects, due to the complexity of the alignment of different disciplinary facets (see Sect. 1.3); these aspects are also relevant for the future evolution of service provision from businesses aiming to present themselves as *sustainable* [178].

At the state of the art, the frameworks proposed for eGovernment project planning introduce different *critical factors*, such as the complexity of the integration of the different functionalities [127], the degree of acceptance by citizens [65], and the level of customization of the services [123]. A shared goal among methodologies is the creation of a strategic value network involving both governments and citizens [208]. Among the examples of critical issues for the successful implementation of any ICT system, Kawalek and Newman [122] stress the importance of top management support, organizational adaptation, and training of employees. In order to challenge these issues, perspectives from different disciplines are to be considered in their interaction, leading to the concepts of multi-, inter-, and transdisciplinarity.

In *multidisciplinary* approaches, various disciplines develop their research topics without going beyond their proper disciplinary boundaries, even in the final produced results [38], whereas *interdisciplinarity* requires that methods are transferred from one discipline to the others [84] in order to integrate the research results in a holistic or systemic outcome [77]. Besides these approaches, *transdisciplinarity* has acquired a major relevance in the eGovernment research. Galliers [84] points out that transdisciplinarity concerns joint problem solving in science, technology, and society, involving cooperation and shared understanding between disciplines, public bodies, and politicians [77, 84].

In this book we discuss the eG4M methodology grounded on a systemic perspective on eGovernment, where transdisciplinarity attains the whole context of eGovernment planning, since it requires commitment and cooperation of all the different kinds of participants; in this context, the methodological frame can be a qualifying factor for the adoption of a transdisciplinary approach. Furthermore, eG4M is an *interdisciplinary* methodology which exploits various scientific results in order to achieve coherence between theoretical and methodological frameworks. Among the different disciplines, we focus now on social and technological issues.

Referring to *social issues* in eGovernment planning, a number of contributions claim for the adoption of a wide definition of eGovernment, as a system of ICT-enabled innovation policies for PAs and the government system. Indeed, eGovernment programs are policies for innovation and development and are effective catalysts for reshaping the government system. In this view, eGovernment projects can be considered high context-sensitive interventions aimed at introducing and assimilating gradual changes [52] and, at the same time, aimed at fostering more general

transformations over the long-term period. Through appropriate socio-organizational and technological solutions eGovernment programs aim to enhance and deeply transform the organizational structure and the PAs' internal (G2G) and external (G2C and G2B) relationships.

As noted in previous sections, two paradigms extensively investigated in the above research context are *homology* and *appropriateness*. The concept of *homology of the system* [33] may provide useful insights and may help to grasp the tangle between socio-cultural and technical issues. Boudon [33] introduces the concept of homology to describe a methodological principle often used in sociological analysis, which consists in establishing a structural correspondence between two phenomena or between two coherent systems of meaning and action. Homology refers to a correspondence and coherence between different structures of a system: (i) the cultural capital of a population and its behavior with respect to a new technology, such as early adoption or rejection, and (ii) the main functions of a system and the operations allowed, e.g., the requirements of the research in the field of hard sciences and the computational power made available by networks of computers. In our work the concept of homology contributes to explain the level and degree of diffusion of a certain technology within a social context (or between different contexts) and guarantees the coherence between technologies and social systems.

Focusing on *appropriateness*, a number of papers indicate it as a key factor in eGovernment project planning [35, 170]. Appropriateness is the capability of detecting and enhancing the potential of the context. The analysis in [35] indicates as dimensions of appropriateness:

- the locally relevant content, which concerns the availability and development of services and applications, whose contents are meaningful for the users;
- the integration into daily routines, that is the extent to which ICT-enabled innovations facilitate daily tasks;
- the users' and constituency's needs matching, which concerns the degree of satisfaction of the user's needs.

Taking these issues into account, sociological theories of the relationships between technology and society provide a number of tools for dealing with the appropriateness of (i) infrastructural and physical access and (ii) technological diffusion and usage, e.g., the perceived ease of use, perceived usage, media richness. In eG4M, appropriateness concerns the adaptation of eGovernment services and of social, organizational, and technological solutions to the context, at both the macro- (scenery) and micro (user's context)-levels. It is also possible to distinguish the appropriateness with reference to internal (public administration) and external (among users of public services, constituencies, society) levels.

So far we have considered interrelationships between social and technological issues in the general context of methodological frameworks. Now we extend our discussion to specific phases of the methodology, namely eReadiness assessment, quality assessment, new target quality definition, and the design of new processes architecture.

eReadiness refers to the extent an organizational and social network is ready to accept and take advantage of ICT-enabled innovations [221]. Several papers relate eReadiness as the capacity of a country or community to participate in the incoming information-based, knowledge-based, and highly interconnected society [6, 39, 50, 142]. Other contributors [111] link eReadiness to the "real access/real impact" framework, developed by Bridges.org [35], which looks at how ICTs lead to concrete improvement in people's lives.

In eG4M, eReadiness is considered as part of the assessment phase. eReadiness assessment should support public decision makers in the strategic planning of eGovernment projects, fixing the socio/political environment constraints, in order to enable evaluation of the risk associated with selected projects and make projects feasible with respect to the social, economic, and political context. Hence, it should have as practical goals the following (i) to predict the linkages between the introduction of ICT-enabled innovation processes and expected outcomes, such as the creation of public value, enhancement of efficiency and effectiveness, and (ii) to identify the most appropriate technological and organizational solutions.

The above vision of eReadiness is influenced by the theoretical perspective that evaluates the *capability* [199, 200] of a system to achieve valuable goods or ways of being, namely *functionings* [155, 199, 200] such as the management of information and knowledge and to convert them into *utilities*, e.g., the provision and enhancement of services [62–64, 155, 199, 200].

Proxy indicators for capabilities can be the levels of infrastructural, economic, human capital, and technological resources. However, it is important to notice that the concept of capability does not refer merely to the condition of being in possession of a certain set of resources. It concerns the dynamic aspect of resources, namely the possibility of using them in order to achieve goals and fulfill needs. Thus, proper indicators for capabilities should entail the level and conditions of access to resources, not just their presence. They should also refer to the competence people have to use resources, e.g., the ICT literacy, and to the cultural orientations that guide this use, e.g., the organizational culture. Our eReadiness assessment is based on the evaluation of the available resources and the capabilities within the specific organizational and social context in which the eGovernment interventions are going to take place.

Besides the capabilities that define the eReadiness of an organization, *quality assessment* is another major issue for the planning of effective eGovernment initiatives. The *quality evaluation* of the services, and of the organizational, process, information, and technological systems involved in eGovernment projects, has been analyzed in the literature related to information system quality.

In particular, Pitt and Watson [173] discuss the use of the *SERVQUAL* instrument originally proposed in marketing science [168, 234] and adapted to an IS context version. SERVQUAL is theoretically grounded in a "gap" model that represents the basis for the operationalization of a service quality construct, separately measuring the *expected service* level and the *perceived service* level, calculating service quality scores as the results of the difference between them. The IS-adapted SERVQUAL model has been adopted by a large number of IS researchers [124, 125], whereas

others point out conceptual and empirical difficulties in adopting the model [69] and propose to integrate SERVQUAL with other instruments for the IS quality [125], such as UIS [17], including dimensions such as the degree of training provided to users by the IS staff. SERVQUAL will be discussed in more detail in Chap. 7.

In eG4M we consider a wide set of qualities that refer to all the different layers of the organizational and technological system involved in eGovernment, exploiting metrics from models such as the previously cited SERVQUAL; for example, the metrics for the evaluation of user's expectations are relevant for measuring the effectiveness dimension, while the contribution to IS quality plays a major role in the definition of accountability dimension. Furthermore, we do not consider qualities as independent from each other; qualities, inside layers and between different layers are considered in their relationships, leading to a more complete representation of quality knowledge and consequently, to a more effective project planning. Quality-related topics will be discussed in detail in Chap. 7.

For what concerns data and information, it is worth noting that our perspective considers them as the main resources and assets for carrying out administrative processes and the provision of public services having a public value.[2] For a comprehensive introduction to these issues see Chap. 2.

The activity and the step of new quality target definition is often intertwined in planning methodologies with strategic targets and the definition of goals, namely with business modeling. Kaplan and Norton [119] introduce the *balanced scorecard* as a set of measures that allow for an integrated view of business performance, extending traditional financial measures. The balanced scorecards show how organizational goals and the related measures interact to support overall organizational performance, considering the organization from four perspectives, namely financial, internal business, innovation and learning, customer. Furthermore, drawing on the balance scorecard, Kaplan and Norton [120] define three categories of intangible assets which are essential for implementing any strategy, namely human capital, information capital, and organization capital. Taking these issues into account, they develop a strategy map [120], defining the value proposition that will deliver the revenue growth, identifying the most critical processes to create and deliver the value proposition, and determine the human, information, and organization capital the processes require [120]. In eG4M, we follow an approach in line with the balanced scorecard and strategy map perspective, adopting matrices in order to relate quality dimensions to the political vision and objectives and to the different organizational layers involved in the eGovernment initiatives.

Quality issues provide the basis for the operational planning phase, where an operational model is preliminarily designed. An operational model defines the necessary level of business process integration and standardization for delivering services, identifying critical IT and business process capabilities [190]. In eG4M,

[2] Besides these instrumental roles of data and information, we are aware of the change implied by the technological developments of information growth becoming "a comprehensive platform for framing, instrumenting, and acting upon the world [118, p. 155]." For further details on the institutional implications of this technological change we refer to Kallinikos [118].

the operational model is seen as a preliminary design of the new process and ICT architecture, aiming to achieve quality targets.

Concerning the design of the new process/ICT architecture, Hammer and Champy [101] introduce the concept of *business process re-engineering* (BPR) as a radical analysis and redesign of processes toward the achievement of new quality and performance standards according to the context. Since the seminal paper of Davenport and Short [58], BPR strategies see ICT as a leverage to assist, motivate, and foster a deeper change in processes. Other perspectives conceive the role of ICT in BPR as that of "key enabler" [142] in order to obtain significant results in terms of efficiency.

In the literature, as well as in field applications, there is much evidence that just putting ICT besides traditional processes may fail and even backfire, especially in contexts where public administration operations are highly dependent on quite rigid organizational structures. In eG4M we point out the relevance of the identification of reference ICT architectures in operational planning. In fact, a reference ICT architecture provides a common framework to support the choice of the most appropriate solution for eGovernment projects. At the state of the art, cooperative ICT architectures result as being the most effective for eGovernment initiatives [22].

Several paradigms and technologies are proposed to cope with the development of distributed cooperative systems. In [37, 152] a *cooperative information system* is defined as a large number of cooperative component systems distributed over large, complex computer and communication networks which work together cooperatively, requesting and sharing information. The technologies supporting these kinds of systems are growing rapidly, see [22] for a comparison of architectures that can be adopted in eGovernment applications.

More recently, the most important approaches investigated in the literature are service-oriented systems [165, 212], based on Web services [2, 146, 203], data integration in cooperative systems [128], intelligent agent systems, and agent-based methodologies [126]. In this book we draw on the state-of-the-art results from the research areas of Web services and cooperative information systems. They represent the technological basis for the development and implementation of eG4M outcomes. Notwithstanding, we argue that the methodology is not tied to a specific IT solution, but exploits the effectiveness of the adopted solutions by embedding them in the social system through a quality framework.

1.6 Summary

In this chapter we have discussed different issues which define the background for the eG4M methodology: from the multidisciplinarity required in the planning of e-Government initiatives to the specific needs for more effective ways of representing alignment between strategy and operational levels by means of business models. Moreover, we have introduced the concepts at the basis of methodology, namely appropriateness, homology, and quality. In the following chapter we discuss in detail the central role of data governance as a central issue for public administrations, a consequence of the current information growth challenge.

Chapter 2
Data Governance

Data and information are the fundamental resources managed by public administrations to provide services to users. So, the reader should not be surprised that at the beginning of the book we focus on the part of the eG4M methodology that deals with data. To give an example, in the Italian Central Public Administration more than 500 large-sized databases are managed, while in each one of the 21 regions more than 1000 large-sized databases are used. Each one of the above databases has been designed independently from the other by different teams and is updated by different sources and data flows.

As a consequence, administrative processes making use of such heterogeneous variety of data result in costly and low-quality services. To mention another typical phenomenon of eGovernment initiatives, data are often considered ancillary to software applications, so in order to solve a problem, the most important issue is considered to produce a new software application, without worrying about the data involved. We arrive at the conclusion that data deserve a special attention in eGovernment initiatives, from different perspectives, that are discussed in this chapter. Section 2.1 introduces the concept of data governance and of its different facets. Section 2.2 discusses the most important of such facets, namely *data quality*, providing an introduction to data quality dimensions and methodologies for data quality assessment and improvement. Section 2.3 introduces the reader the representation of data by means of graphical models that allow us to represent data classes by means of schemas, so as to understand more clearly their meaning and relationships among them. In Sects. 2.4 and 2.5 we deal with the problem of integrating data schemas, to achieve a comprehensive and reconciled description of the information content managed in an administration or a set of public administrations; in Sect. 2.4 we discuss schema integration in the small, say, when performed on 5–10 schemas, while Sect. 2.5 discusses schema integration in large, when abstraction mechanisms are needed to govern the complexity of schema representation. An encompassing comment is needed for the terms data and information. When we use the term *data* we refer to values represented in a database by means of n-ples of attributes whose domains are usually numeric or alphanumeric, such data are

This chapter is authored by Carlo Batini.

G. Viscusi et al., *Information Systems for eGovernment*,
DOI 10.1007/978-3-642-13571-2_2,

also called in the literature *structured data*. The term *information* is referred to as any type of representation such as maps, images, videos, semi-structured text, and unstructured text.

2.1 Data Governance Issues

Data governance can be defined as the formal orchestration of people, processes, and technology to enable an organization to leverage data as an enterprise asset. Several different issues related to data governance exist:

1. *Data quality*: The set of issues that allow to assess different dimensions of data quality (e.g., accuracy, timeliness, consistency) and to improve such dimensions by means of activities that may operate directly on data or else on processes that interchange or elaborate data.
2. *Data modeling*: The representation of classes of data in terms of a conceptual model, namely a model whose linguistic categories highlight the aspects related to the meaning of data, instead of their representation in a computer.
3. *Data integration*: The technologies that allow to query and access different independent databases as they were virtually a single, integrated database.
4. *Schema integration*: The process of harmonizing conceptual descriptions of data across heterogeneous databases.
5. *Data architecture governance*: The process that considers the overall architecture of data, namely the representation of data in different databases of the organization, and conceives a new architecture that, making use of data integration solutions, maximally increases the amount of queries that can be expressed on it.
6. *Data governance management*: The asset of responsibilities and activities and their collocation in the organization that allow to manage, monitor, govern, improve the quality and level of integration of data.

Although all of the above issues are relevant in data governance, in this chapter we focus on data quality, data modeling, and schema integration. Data quality is relevant due to the negative impact of loose quality data in administrative processes and in service provision. Data modeling provides all the users of data a common model and, consequently, a common understanding of the data resource. Schema integration is relevant since it gives all the users of data to proceed to their reconciliation in terms of a common integrated description, notwithstanding the heterogeneous representation of data in databases.

2.2 Data Quality

In this section we deal with data quality issues at an introductory level, since the whole matter has been thoroughly discussed by one of the authors in the book [23]. Data quality has serious consequences, of far-reaching significance, for the

efficiency and effectiveness of organizations and businesses. The report on data quality of the Data Warehousing Institute (see [70]) estimates that data quality problems cost US businesses more than 600 billion dollars a year. The findings of the report were based on interviews with industry experts, leading edge customers, and survey data from 647 respondents.

A frequent problem of data quality in organizations concerns the so-called customer matching problem. Information systems of public and private organizations can be seen as the result of a set of scarcely controlled and independent activities producing several databases which are very often characterized by overlapping information. In private organizations, such as marketing firms or banks, it is not surprising to have several (sometimes dozens!) customer registries, updated with different organizational procedures, resulting in inconsistent, duplicate information. The customer matching problem is indicative of the growing need to integrate information across completely different data sources, an activity in which poor quality hampers integration efforts.

Awareness of the importance of improving the quality of data is increasing in many public domains. In the public sector a number of initiatives address data quality issues at international, European, and national levels. Two of the main initiatives concern the Data Quality Act in the US and European directives on reuse of public data.

In 2001 the president of the USA signed into law important new data quality legislations, concerning "Guidelines for Ensuring and Maximizing the Quality, Objectivity, Utility, and Integrity of Information Disseminated by Federal Agencies," in short the Data Quality Act. The Office of Management and Budget (OMB) issued referred guidelines for policies and procedures on data quality issues (see [158]). Obligations mentioned in the guidelines concern agencies, which are to report periodically to the OMB regarding the number and nature of data quality complaints received and how such complaints were handled. OMB must also include a mechanism through which the public can petition agencies to correct information that does not meet the OMB standard. In the OMB guidelines data quality is defined as an encompassing term comprising utility, objectivity, and integrity. Objectivity is a measure to determine whether the disseminated information is accurate, reliable, and unbiased, and whether that information is presented in an accurate, clear, complete, and unbiased manner. Utility refers to the usefulness of the information for its anticipated purpose, by its intended audience. Integrity refers to the security of information, namely protection of the information from unauthorized, unanticipated, or unintentional modification, to prevent from being compromised by corruption or falsification. Specific risk-based, cost-effective policies are defined for assuring integrity.

The European directive 2003/98/CE on the reuse of public data (see [76]) highlights the importance of reusing the vast data assets owned by public agencies. The public sector collects, produces, and disseminates a wide range of information in many areas of activity, such as social, economic, geographical, meteorological, business, and educational information. Making public all generally available documents held by the public sector, concerning not only the political process but also

the legal and administrative processes, is considered a fundamental instrument for extending the right to information, which is a basic principle of democracy. Aspects of data quality addressed by such a directive are the accessibility of public data and availability in a format which is not dependent on the use of specific software. At the same time, a related and necessary step for public data reuse is to guarantee its quality in terms of accuracy and currency, through data cleaning campaigns. This makes it attractive to new potential users and customers.

2.2.1 Data Quality Dimensions

Data are normally considered to be of poor quality if typos are present or wrong values are associated with a concept instance, such as an erroneous birth date or age associated with a person. However, data quality is more than simply data accuracy. Other significant dimensions such as completeness, consistency, and currency are necessary in order to fully characterize the quality of data. In Fig. 7.4 we provide some examples of these dimensions. The relation in Fig. 2.1 describes movies, with title, director, year of production, number of remakes, and year of the last remake.

In the figure, the cells with data quality problems are shaded. At first, only the cell corresponding to the title of movie 3 seems to be affected by a data quality problem. In fact, there is a misspelling in the title, where `Rman` stands for `Roman`, thus causing an accuracy problem. Nevertheless, another accuracy problem is related to the exchange of the director between movies 1 and 2; `Weir` is actually the director of movie 2 and `Curtiz` the director of movie 1. Other data quality problems are a missing value for the director of movie 4, causing a completeness problem, and a 0 value for the number of remakes of movie 4, causing a currency problem because a remake of the movie has actually been proposed. Finally, there are two consistency problems: first, for movie 1, the value of `LastRemakeYear` cannot be lower than the value of `Year`; second, for movie 4 the value of `LastRemakeYear` cannot be different from null, because the value of `#Remakes` is 0.

Over 50 quality dimensions have been proposed in the literature, referring both to qualities of data schemas and to quality of data values. The most frequently mentioned concerns are as follows:

Id	Title	Director	Year	#Remakes	LastRemakeYear
1	Casablanca	Weir	1942	3	1940
2	Dead poets society	Curtiz	1989	0	NULL
3	Rman Holiday	Wylder	1953	0	NULL
4	Sabrina	null	1964	0	1985

Fig. 2.1 A relation `Movies` with data quality problems

1. *Accuracy* is defined as the closeness between a value v and a value v', considered as the correct representation of the real-life phenomenon that v aims to represent. For example, "Jon" is an inaccurate representation of the name "John."
2. *Completeness* is defined as the extent to which data are of sufficient breadth, depth, and scope for the task at hand. A null value in a data set is an example of incomplete data.
3. *Currency* concerns how promptly data are updated. A change of address of a business that is updated after 1 month in a business registry is an example of out of date data.
4. *Consistency* is the absence of any violation of a business rule in a database. In the relational model of data, any violation of referential integrity is an example of inconsistency.

A detailed list of DQ dimensions can be found in [23]; we suggest that the reader read this book for a thorough description of dimensions and proposed classifications.

2.2.2 A Methodology for Data Quality Assessment and Improvement

We define a data quality methodology as a set of guidelines and techniques that, starting from the input information concerning a set of databases, defines a rational process for using the information to measure and improve the quality of data of an organization through given phases and decision points. In [23] the methodology shown in Fig. 2.2 is proposed.

Phase 1: State reconstruction

1. Reconstruct the state and meaning of most relevant databases and data flows exchanged between organization structures and build the *database + dataflow/organization matrices.*
2. Reconstruct most relevant business processes performed by organizations and build the *processes/organizations matrix.*
3. For each process or group of processes, reconstruct the norms and organizational rules that discipline the processes and the services provided .

Phase 2: Assessment

4. Check with the internal and final users the major problems related with the services provided. Fix these drawbacks in terms of process and service qualities and identify the causes of the drawbacks due to low data quality.
5. Identify relevant DQ dimensions and metrics, measure data quality of databases and data flows, and identify their critical areas.

Phase 3: Choice of the optimal improvement process

6. For each database and data flow, fix the new DQ levels that improve process quality and reduce costs under a required threshold.
7. Conceive process re-engineering activities and choose DQ activities that may lead to DQ improvement target sets in step 6, relating them in the data/*activity matrix* to clusters of databases and data flows involved in DQ improvement targets.
8. Choose optimal techniques for the DQ activities.
9. Connect crossings in the *data/activity matrix* in reasonable candidate improvement processes
10. For each improvement process defined in the previous step, compute approximate costs and benefits and choose the optimal one, checking that the overall cost–benefit balance meets the targets of step 6.

Fig. 2.2 Phases and steps of a methodology for data quality assessment and improvement

The overall strategy of the methodology sees the measurement and improvement activities as being deeply related to the business processes, services provided by processes, and the costs of the organization due to low data quality. In phase 1 all the most important relationships between organization units, processes, services, and data if not known are reconstructed. Phase 2 sets new target quality dimensions that are needed to improve process qualities and evaluates cost savings and new benefits. Phase 3 identifies the optimal improvement process, i.e., the sequence of activities that has the optimal cost-effectiveness ratio.

We refer the reader again to [23] for a detailed description of the methodology and the discussion of a case study.

2.3 Data Modeling

In our life we frequently need to conceptualize the physical objects we perceive in everyday life. With the term "conceptualize" we mean the process of extracting and representing common features from physical objects pertaining to the same class, e.g., human beings are very different among populations, but are characterized by common physical and intellectual features, such as arms, eyes, and the ability to reflect and think.

The public administration makes intensive use of data to provide services. Databases are the most common technology we use to represent, manage, query data. Database management systems (DBMSs) are software applications that are built in functionalities to represent, manage, and query data. Every DBMS represents data in terms of a *logical model* that provides linguistic primitives to represent classes of data (e.g., the classes `Person`, `Business`, `City`, here and in the following we give singular names to classes of data) and relationships between them (e.g., the relationship `Born` that relates the class `Person` to the class `Municipality`). In the early years of data management programs were written using programming languages such as Cobol that uses a representation such as the one shown in Fig. 2.3 to represent classes of data. At a first glance it is quite difficult without knowing the technicalities of Cobol to understand that the Cobol representation describes two different classes of `Person`, namely `Man` and `Woman`, their `birth` relationship with the birthplace, represented as the administrative class `Municipality`, and the administrative/territorial relationship of municipalities with regions that are represented by the class `Region`.

As another example, relational DBMSs, the most frequently used ones, adopt the relational model which represents data in terms of tables, tuples, and columns. Also the relational model, though simple to understand, reveals unfit to represent classes of data and relationships among them. When we conceive classes of data which are used to provide services in eGovernment information systems, we need a model that is at the same time (i) simple to understand and (ii) rich of linguistic features that allow an intuitive description of classes of data and hide physical aspects of the computer implementation. Since the 80s of the past century, the model adopted

```
DATA DIVISION.
    WORKING-STORAGE SECTION.
    01      PERSON.
    05          MAN.
    10              MAN.-CODE     PIC X(5).
    10              MAN-DESCR     PIC X(80).
    05          WOMAN REDEFINES   UOMO.
    10              RECORD-TYPE   PIC X.
    10              WOMAN-CODE    PIC 9(5).
    10              WOMAN-DESCR   PIC X(80).
    01      AGENCY.
    05          REGION.
    10              REGION-CODE   PIC X(3).
    10              DUMMY         PIC X(6).
    10              REGION-DESCR  PIC X(80).
    005         MUNICIPALITY REDEFINES REGION.
    10              REGION-CODE   PIC X(3).
    10              MUNIC-CODE    PIC X(3).
    10              MUNIC-DESCR   PIC X(80).
    01      PERSON-ADMINISTRATION
    05          LINK.
    10              .CODE   PIC X(5).
    10              MUNIC-CODE    PIC X(3).
```

Fig. 2.3 A piece of a Cobol program

for this goal is the *entity – relationship model* (ER model in the following) that uses intuitive linguistic primitives for classes, properties of classes, relationships among classes. Furthermore, the ER model adopts a diagrammatic representation that provides even more intuitive flavor. Here we provide an example of schema represented in the ER model, while the next section is dedicated to a more detailed introduction to the model. In Fig. 2.4 we see the same piece of reality described in Fig. 2.3 represented using the ER model. We see the class `Person`, with a `Code`, a `Description`, and classified in terms of the classes `Man` and `Woman`; then we see `Municipality`, with a `Code` and a `Description`, and the relationship `Born` between `Person` and `Municipality`. Finally we see the class `Region`, again with a `Code` and a `Description` and its administrative/territorial relationship, called `Located in`, with `Municipality`.

2.3.1 The Entity – Relationship Model

We provide here a simplified description of the entity – relationship model, for a more comprehensive discussion see [21]. The ER model makes use of the following concepts to represent in an easy-to-understand way a reality of interest.

1. An *entity* is a class of things or events of the reality of interest having common properties, e.g., a `Person` is an entity in a registry of living persons having residence address in a `Municipality`. Things or events are also called *instances* of the entity. An *attribute* is an elementary property of an entity, e.g., a `Social Security Number`, a `Name`, a `BirthDate`. An *identifier* is an attribute or a set of attributes of an entity whose values uniquely identify a single instance of the entity, e.g., `Social Security Number` is an identifier of the entity `Person`, since every person has a specific `Social Security Number` that uniquely identifies the person.
2. A *relationship* is a set of facts relating instances of two entities, e.g., `Owns` defined among entities `Person` and `Car` describes for each person the cars he/she owns. Also the relationships may have attributes associated, e.g., the relationship `Owns` may have an attribute `StartDate` that, for each person and for each car owned, provides the start date of the ownership.
3. An *IS-A relation* is defined among two entities, Entity1 and Entity2 and expresses the property that every instance of `Entity2` is also an instance of `Entity1`, e.g., the IS-A relation among the entities `Person` and `Woman` expresses the property that all women are persons.
4. A *generalization* is defined among an entity `Entity0`, called ancestor, and a set of entities `Entity1`, `Entity2`,..., `Entityn`, called children, and expresses the property that each child entity is in the IS-A relation with the `Entity0`.

We call *ER schema* a set of interconnected entities, relationships, attributes, IS-A relations, and generalizations representing a reality of interest. The ER model is popular due to its intuitive and simple diagrammatic notation. In Fig. 2.5 we provide a notation that simplifies the one adopted in Fig. 2.4. We will use this notation in the following.

In Fig. 2.6 we reproduce the ER schema of Fig. 2.4 using the notation of Fig. 2.5. We have added some more attributes to the entities.

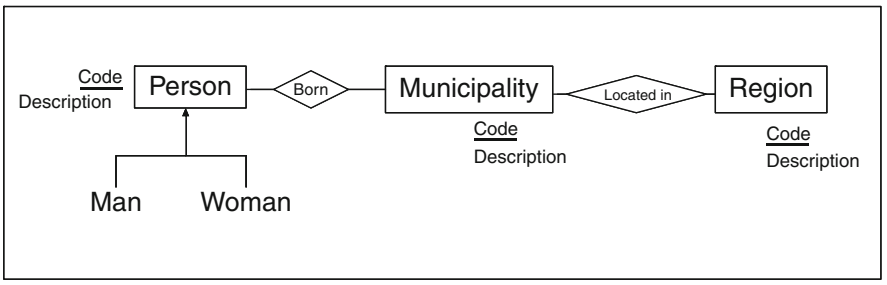

Fig. 2.4 An example of entity – relationship schema

Symbol	Concept represented
Person	Name of entity/attribute/relationship
Owns	Binary relationship
Person (SSN, Name, Last Name)	Attributes of an entity, identifier
	IS-A Relationship
	Generalization among entities

Fig. 2.5 A diagrammatic notation for the entity – relationship model

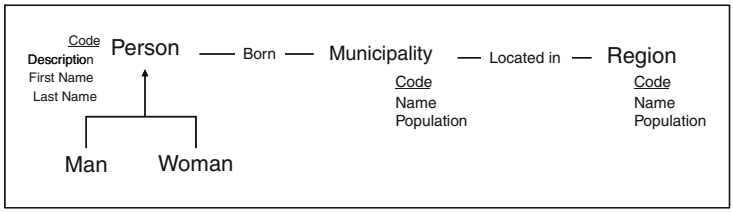

Fig. 2.6 The previous ER schema represented with the notation of Fig. 2.5

2.4 Schema Integration in the Small

The structure of public administration (PA) consists in many countries of central and local administrations that together interact with and offer services to citizens and businesses. For example, in Italy central PAs are of two types: ministries such as internal affairs, finance and other central agencies such as social security, accident insurance, and the chambers of commerce. Main types of local PAs correspond to regions (21 in Italy), provinces (about 100), and municipalities (about 8000). Each one of these administrations usually manages its own databases and registries. A crucial aspect in changing the relationship between PAs and citizens consists in the design of a new technological architecture that, contrary to the past, offers the services to citizens by means of a common front-office layer, on the basis of the one-stop shop paradigm; furthermore, a cooperative back-office layer has to be developed that allows administrations to share information and application services, in order to re-engineer the administrative procedures and reduce the burden to users. Concerning the data architecture, redundancies should be discovered and controlled, data have to be interchanged in an interoperable format, all the administrations have to assign the same meaning to the same data, achieving integration in the long term. To be able to

1. discover redundancies and heterogeneities among databases of different administrations;
2. reconcile the different meanings of data;
3. reuse entities in the design of new databases achieving semantic interoperability

a unified conceptual and reconciled description is needed of the different databases. In the following, we call such a description an *integrated schema*. Integration is the mechanism by which a set of local schemas is merged into a unique global schema, after solving all heterogeneities present in the input schemas.

In order to be able to reconcile the (usually) heterogeneous representations of data managed in databases of different administrations, we have to perform an activity of *schema integration*, whose goal is to homogenize two or more ER schemas and produce a reconciled representation of all the entities and relationships into a new schema called the *integrated schema*. Schema integration has different approaches when the number of schemas is small, say, less than 10, and in the case when the number of schemas is large. In the two cases we will use the terms *schema integration in the small* and *schema integration in the large*. Schema integration in the small is discussed in this section, while schema integration in the large is described in Sect. 2.5.

The activity of schema integration can be divided into three main steps: (i) conflict analysis, (ii) schema merging, and (iii) schema enrichment and rearrangement. We will describe the methodology for schema integration, considering as an example the land department inside a hypothetical ministry of finance. This department is in charge of the evaluation of real property in order to determine direct and indirect tax assessment and to issue real estate certifications. Moreover, this department administers and records all state properties in regard to their financial affairs. Its responsibilities include the acquisition of new state properties; the disposal of properties when authorized; the care and supervision of state properties; and the maintenance of an inclusive inventory. The above activities are in charge of two offices, the general land office and the state property office.

Seven databases are located within the information system of the land department, namely

1. General land office: urban database
2. General land office: land database
3. Mortgage registry database
4. State property office: real estate database
5. State property office: property grant database
6. State property office: confiscated private database
7. State property office: private estate renting database

Among them, in the following we consider the first three databases, whose schemas are described in Figs. 2.7, 2.8, and 2.9. Notice that we represent only entities, relationships, IS-A relations, and generalizations; we do not represent identifiers, attributes, and names of relationships. Only in the case of urban schema we

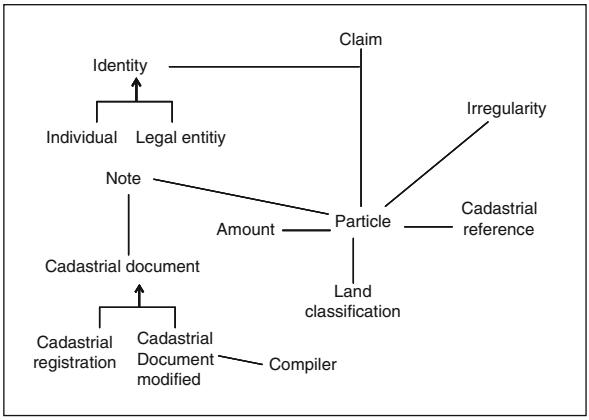

Fig. 2.7 The land schema

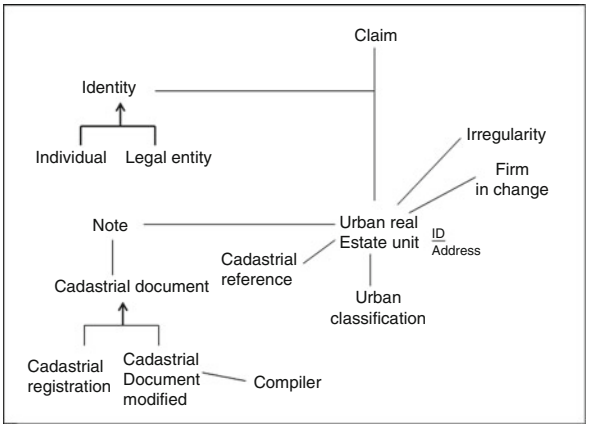

Fig. 2.8 The urban schema

represent for the `Urban real estate unit` entity two attributes, the identifier `Id` and the attribute `Address`.

2.4.1 Conflict Analysis and Schema Merging

The aim of the conflict analysis and schema merging step is to discover and solve every type of conflict among data representations in different schemas. Two main activities may be distinguished:

1. *Name conflict analysis*, to establish naming correspondences for concepts. There are basically two sources of name conflicts: synonyms and homonyms. *Synonyms* occur when schema objects with different names represent the same concept

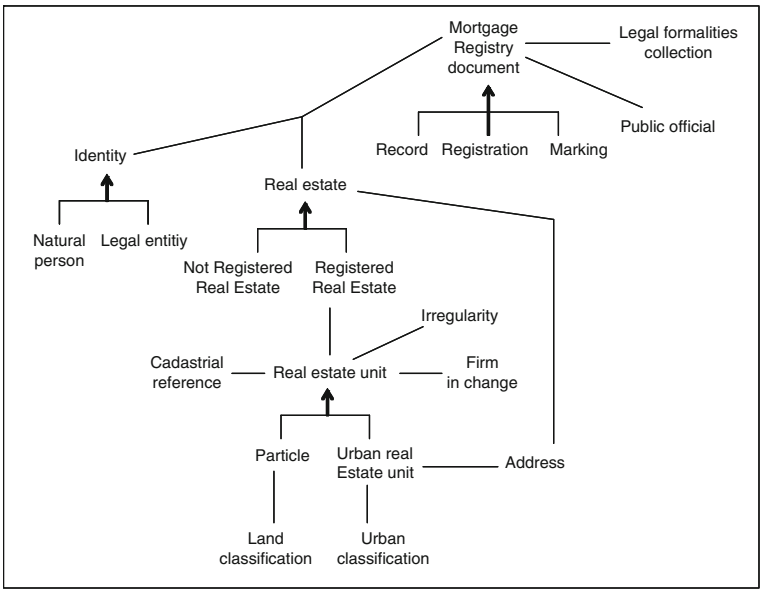

Fig. 2.9 The mortgage registry schema

while *homonyms* occur when the names are the same, but different concepts are represented. Therefore, whenever synonyms or homonyms are detected, a concept renaming is required to solve the conflict.

2. *Structural conflict analysis*, to discover conflicts between different representations of the same concept. The use of an entity and an attribute to represent the same concept in two different schemas is a typical example of structural conflict. Each difference in representing the same reality can be solved by applying an *equivalence transformation* (a transformation which does not change the schema information content) to the schemas involved. At the end of this stage, we obtain a set of amended schemas that can be syntactically integrated, all the name and structural conflicts having been solved.

In our case study we have the following conflicts.

1. A synonym among `Individual` in the `Urban` and `Land` schemas and `Natural person` in the `Mortgage` schema; we choose the term `Individual` and consequently amend the `Mortgage` schema.
2. A structural conflict between the attribute `Address` in the `Mortgage` schema and the entity `Address` in the `Urban` schema; we choose for `Address` the entity type and consequently transform the attribute `Address` in the `Mortgage` schema into an entity.

The activity required at this point, called *schema merging*, is a simple superimposition of common concepts belonging to the amended schemas, thus building the integrated schema.

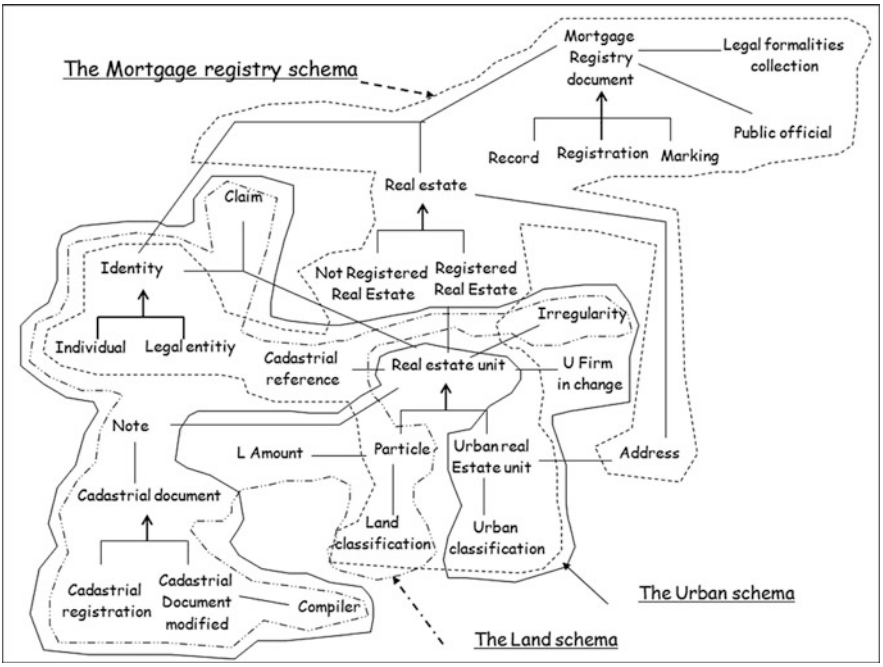

Fig. 2.10 The integrated schema together with the three input schemas

2.4.2 Enrichment and Rearrangement

This phase aims to detect *interschema properties*, corresponding to redundancies and cycles within the global schema in order to build the final *integrated schema*; with the term "interschema property" we mean mutual constraints between concepts appearing in different schemas. Due to their cross-schema nature, in fact, these relationships have not yet been represented in the global schema and therefore require a specific analysis at this point. In the case study, analyzing the `Urban` schema and the `Land` schema it is easy to discover that the entity `Particle` in the `Land` schema and `Urban real estate unit` in the `Urban` schema have many related concepts in common, so they are concepts which are in an IS-A relation with a common generalized concept, whose name can be `Real estate Unit`. At the end of the integration activity we obtain the integrated schema, represented in Fig. 2.10 together with the three amended schemas, identified by differently shaped closed lines.

2.5 Schema Integration in the Large: The Repository of Schemas

When the number of schemas to be integrated is high, building the integrated schema becomes unfeasible, as Fig. 2.11 expresses in graphical/metaphorical terms. Reconsidering the integrated schema of Fig. 2.10 we perceive that when a schema has

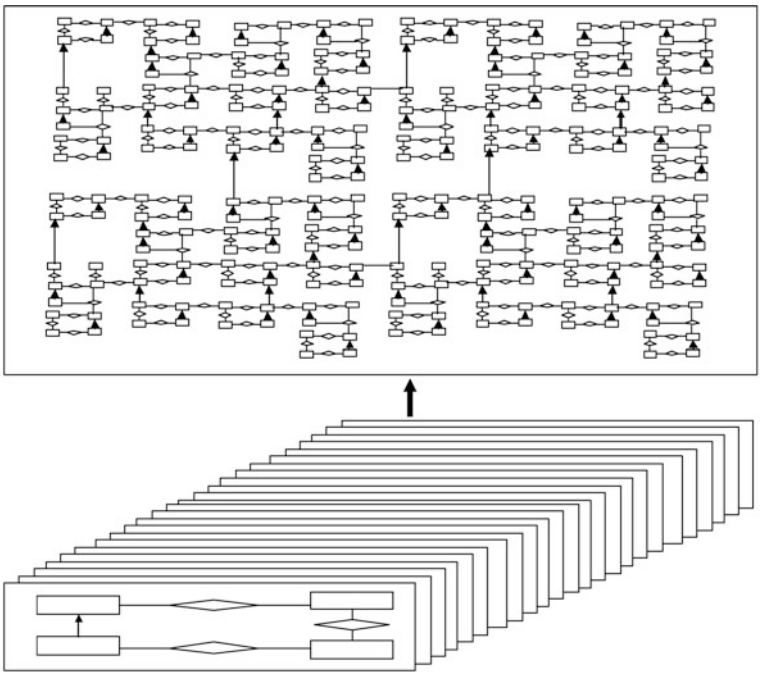

Fig. 2.11 Unfeasibility of the integration of a large number of schemas

more than 20/30 entities, it becomes difficult to perceive at a glance the *semantics* of the reality represented, namely the meaning of concepts and of relationships among them.

When the reality becomes complex, besides integration we have to adopt another paradigm that we call *abstraction* (see also [20]). Given a schema S, we define abstraction of S a new schema obtained from S, clustering and collapsing groups of concepts into a unique entity. The new schema, in a sense, describes the same reality of S with a more concise representation. Given a schema S, we may iterate the use of abstractions producing schemas that describe the same reality at different levels, from detailed to abstract ones. We will call *refinement* the inverse primitive that allows to proceed from abstract representations to more detailed ones.

We call *repository of schemas*:

1. A set of ER schemas, representing the set of databases of an organization, one schema for each database. We will call these schemas *basic schemas*.
2. A set of ER schemas obtained from basic schemas by iterative joint usage of the two integration and abstraction primitives.

In Fig. 2.12 we show an example of repository, where in the bottom row in the second, third, and last columns the `Production`, `Sales`, `Department` basic schemas of a production and sales organization are represented. The `Company`

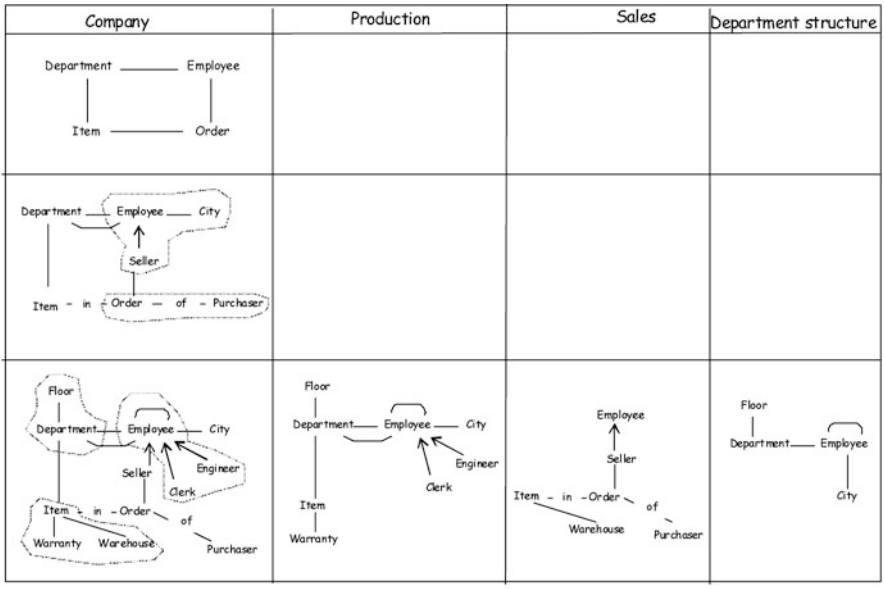

Fig. 2.12 An example of repository

schema in the bottom row, in the first column, is the result of their integration. For the `Company` schema we show in the second and first rows two abstractions. In the first column groups of concepts abstracted at the upper level into single concepts are highlighted in closed lines (see next section).

We now have to provide more detail on the abstraction step (Sect. 2.5.1); furthermore, putting together all issues introduced so far, in Sect. 2.5.2 we discuss a methodology for building a repository of schemas.

2.5.1 Schema Abstraction

In Fig. 2.13 we show a methodology for producing an abstract schema.

We apply the methodology to the schema represented in the bottom of Fig. 2.14. Typical candidates for groups of concepts to be abstracted are generalization hierarchies, sometimes alone (as in the case of `Identity` (ancestor), `Individual`, `Legal entity`), other times together with less relevant concepts related to the generalization (as in the case of the group `Cadastral document` (ancestor), `Cadastral registration` and `Cadastral document modified`), to which the `Compiler` entity is added due to its unique relationship with the generalization.

Another group concerns two relationships, among respectively: `Urban Real Estate Unit` and `Urban Classification`, and `Urban Real Estate Unit` and `Address`. In this case, the most relevant concept is clearly `Urban Real Estate Unit` that is chosen as the abstract concept in the upper level abstract

1. Group concepts in the schema S according to the following rules:
   - Each group is made up of a small number of entities, relationships, IS-A relations, and generalizations
   - Concepts in each group have a "strongly related" meaning, while they have a looser relationship w.r.t. entities in other groups.
   - The set of groups covers the whole schema.
2. Associate to each group a unique abstract entity or abstract relationship, whose name represents the whole information content of the group in an abstract way.
3. Link abstract entities or relationships resulting from step 2 with the relationships that link in S the corresponding groups.

Fig. 2.13 A methodology for producing an abstract schema

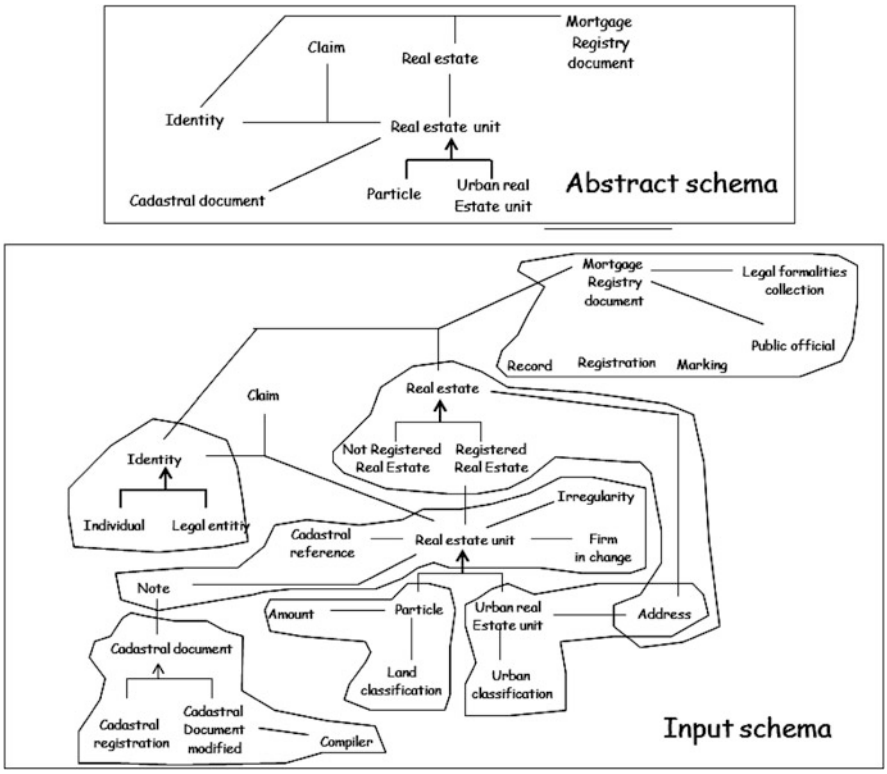

Fig. 2.14 A schema and one possible abstraction

schema. In previous cases the ancestors in generalizations were chosen as abstract concepts.

Notice that the abstraction process is subjective, and it is not easy to provide quality criteria that distinguish between a good abstraction and a bad abstraction. In our example it is not evident why we leave the entity `Claim` untouched in the process. Groups made of a single entity have to be avoided, since their presence tends to create an asymmetry in the balancing of concepts in groups. In our case, we could adjoin `Claim` to one of the adjacent groups.

2.5.2 A Methodology for the Construction of a Repository of Schemas

A methodology for the construction of a repository of conceptual schemas is described in Fig. 2.15 (see also [20] for a more comprehensive discussion). In the case of a repository made of dozens or hundreds of schemas, schemas have first to be clustered; the clustering activity can be performed putting together schemas that pertain to the same topic, e.g., finance, internal affairs, justice. As a second step, schemas in the same cluster are integrated producing a unique integrated schema. At this point integrated schemas are abstracted and the process of clustering/integration/abstraction proceeds until a unique schema is produced. Notice that when the group of schemas to be integrated is made of a huge number of concepts, resulting in a complex integrated schema, the two integration and abstraction steps can be applied in the inverse order.

We apply the methodology to the land office case study. Initially we populate the bottom level of the repository with the basic `Land`, `Urban`, and `Mortgage registry` schemas. Then we generate the integrated schema.

At this point we may abstract the integrated schema at two different levels, leading in the end to a six-entity schema, compact enough to conclude the abstraction procedure (see Fig. 2.16).

1. Produce basic schemas.
2. Cluster schemas in groups, using areas of interest for choosing clusters
3. For each cluster of schemas, produce an integrated/abstract schema through
   - 3.1 Integration
     - Perform integration activities on the schemas in the cluster
   - 3.2. Abstraction
     - Perform abstraction activities on the integrated schemas

   Until a unique abstract schema is obtained

Fig. 2.15 A methodology for the construction of a repository of conceptual schemas

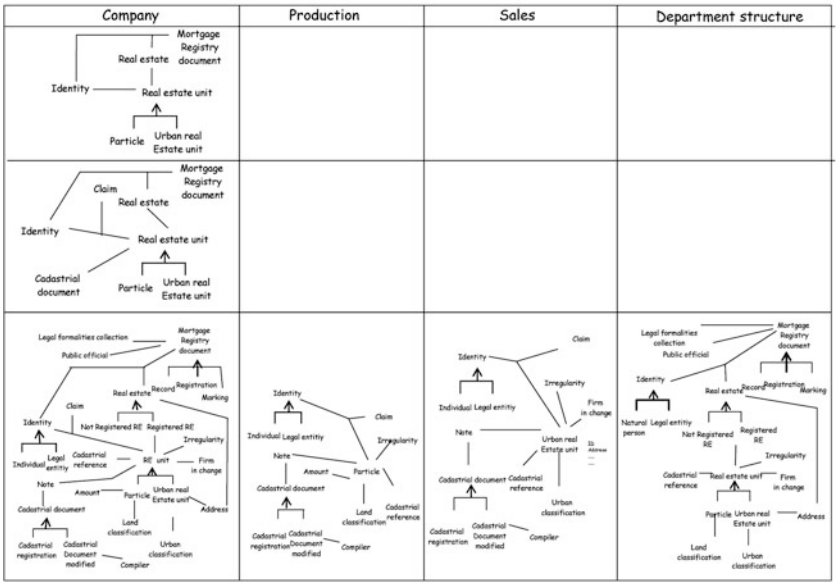

Fig. 2.16 The repository of the land office

2.5.3 Usages of the Repository of Schemas in eG4M Planning Activities

In this section we discuss several analyses that can be made on the repository of schemas that provide useful insight for planning activities and for defining joint eGovernment projects in groups of administrations.

The analyses we show have been performed on a repository made of about 300 databases managed in the Italian Central PA (*central PA repository* in the following); the repository has been produced using the methodologies for schema integration, schema abstraction, and the methodology for repository structuring described above. In order to build the repository, about 200 person-months were needed to first produce the 300 basic ER schemas, while about 24 person-months were needed to produce the 59 abstract schemas of the upper part of the repository (approximately 14 person-days per schema, both for the basic and for the abstract schemas).

The analyses performed on the central PA repository led to significant planning decisions and to the conception of innovative projects that significantly improved the relationships among PAs and citizens and businesses.

2.5.3.1 Choosing Priorities and Planning New Initiatives

The repository provides useful knowledge on the information resource to define priorities in eGovernment projects, e.g., at a very high level of analysis we may

Area	Subarea	Min of foreign affairs	Foreign trades	De-fence	Reve-nues	Justice	Internal affairs	Cultural heritage	Com-merce and trades	Wel-fare	Edu-cation	Agri-culture	Health	Trea-sury	Transpor-tations	Re-search	Total	%
Resources	Financial	21	19	8	345		82	51		5		40		145			716	20
	Real estate				68		59							86			213	6
	Support				25		28							3			56	2
	Human	67	16		102	6	136	12		11				127	14		491	14
Total resources		88	35	8	540	6	305	63		16		40		361	14		1476	41
Services	Direct	78		24		203	149							93			547	15
	Economic		156				24		55	107		70		0	84		496	14
	General				66		143		27					0	84		320	9
	Social	14					40	153			120	93	204	0		116	740	21
Total services		92	156	24	66	203	356	153	82	107	120	163	204	93	168	116	2103	59
Grand total		180	191	32	606	209	661	216	82	123	120	203	204	454	182	116	3579	100
%		5	5	1	17	6	18	6	2	3	3	6	6	13	5	3	100	

Fig. 2.17 Macroareas and corresponding number of entities of schemas owned by a set of central administrations

evaluate the distribution of entities among the different areas of interest and among the different administrations which are owners of data. In Fig. 2.17 we show such a distribution for the two service and resource macroareas and the related areas of interest.

We see that the 50% of the entities are concentrated in three agencies, namely finance, treasury, and internal affairs, while referring to areas, over 40% of entities are managed for resource-related support processes, while less than 60% of entities are used for processes that produce services to citizens; this means that for every five employees, two of the five work for managing themselves and the other three for the employees! Such distribution increases the costs of public administration and reduces the effectiveness of its mission in providing services to users. Similar figures can be produced for the distribution of instances. On the basis of such figures, several projects can be conceived and set up to balance this unequal distribution of information.

A second analysis concerns the redundancy related to managing the same entity in different schemas and administrations; in such analysis we may initially focus on macro-entities of interest in public administration that are `Person` and `Business`. Focusing on `Business`, in Fig. 2.18 we represent attributes associated with the `Business` entity in common with the three agencies that own national registries on businesses, namely chambers of commerce, social insurance, and social security. Due to such overlapping, common attributes regarding any particular business are likely to be duplicated, with no guaranteed consistency among the copies. A project that can be launched concerns the coordination of updates, choosing, e.g., to update only one reference database and subsequently to coordinate the updates to be performed in other databases with an asynchronous communication between the reference and the other databases.

Furthermore, high costs for agencies and for businesses are related to the multiple updates. In [23] a project setup to tackle the above issues is described, showing that in the new coordinated ICT architecture overall costs for agencies and businesses can be reduced yearly by approximately 200 million euros.

Attributes	Chambers of commerce	Social security	Social insurance
Fiscal code	X	X	X
Vat number	X	X	X
Name	X	X	X
Company deed of partnership	X		X
Activity	X		X
Legal status	X		X
Registered office	X	X	X
Code in the national registry	X		X
Registration date	X		X
Company structure	X	X	X
Administrative office	X	X	X
Address	X	X	X
Start date of activity	X	X	X
Suspension date of activity	X	X	X
End date of activity	X	X	X
Number of workers	X	X	X

Fig. 2.18 Common attributes of the entity company among different administrations

2.5.3.2 Coverage Analysis

Public administration in its relationship with citizens exercises a different degree of attention as to different types of individuals, such as workers, retired persons, emigrants, immigrants. In Fig. 2.19 we show an analysis of the instances of entities referring to individuals, state employees, retired persons, and students, compared with the corresponding size of the universe in Italy, as results from the national bureau of census statistical tables.

The comparison puts in evidence uneven coverage between the four categories, e.g., students are neglected, despite a much greater availability of information (in terms of instances) for public employees. These analyses can also be used for choosing priority areas to focus eGovernment projects on.

Concept observed	# of instances	Size of the universe
Individual	250,000,000	58,000,000
State employee	2,500,000	1,700,000
Retired person	4,900,000	10,500,000
Student	240,000	3,500,000

Fig. 2.19 Instances represented in databases and sizes of the real universe for several relevant entities in the repository of schemas

Type of identifier	Number	Percentage
Fiscal code	124	25
Other non-standard identifiers	370	75

Fig. 2.20 Common standard identifiers and other identifiers of individuals

2.5.3.3 Reconciliation of Identifiers and Knowledge Potential

The knowledge represented in the information systems of public administrations is huge, but is fragmented in databases managed by different administrations. The possibility of integrating the different databases and retrieving and joining related data are enabled by having common identifiers defined in the different databases. An analysis on the repository has shown (see Fig. 2.20 referring to individuals) that among all the identifiers of individuals and companies only 25% standard identifiers such as fiscal code are for individuals and VAT code for companies.

2.6 Summary

Languages, models, tools, and methodologies introduced in this chapter can be used in eGovernment projects for several purposes, namely to improve the quality of data and consequently, of administrative processes, to understand more clearly the types of data managed in an information system, to analyze the redundancies and overlapping existing between different databases, to reconcile heterogeneous databases, to launch projects for shared usage of databases managed by different administrations, in a word, to govern data, the most important resource managed in public administration. Further usages will be shown in the following chapters.

Chapter 3
The eG4M Methodology at a Glance

The eG4M framework differs from traditional technology-driven approaches to eGovernment, considering both how ICTs affect organizations and how the social context and the organizations influence the use of technologies. Indeed, the conceptual framework underlying the methodology is based mainly on neo-institutionalism [80, 231] and social constructivist approaches to the study of the evolution of technology [30, 171].

The focus of the analysis is on the different ways the different stakeholders interact when introducing ICTs and the way these interactions can affect institutions and society at large. On the one hand, the design and development of eGovernment initiatives must take into account both the constraints and the opportunities in terms of potential incentives offered by the institutions. As pointed out, e.g., in [231]

> eGovernment as envisioned by many is not simply about service delivery. It means a set of innovative institutions. The evolution of eGovernment is a process of institutionalization.

On the other hand, eG4M considers how social phenomena develop in social contexts characterized by ICTs and emerging technologies. The approach also assumes that interactions between various stakeholders are made with the understanding that their respective perceptions of reality are related and, as they act upon this understanding, their common knowledge of reality becomes reinforced. These issues impact on the potential contribution of ICT-based initiatives to the efficiency and effectiveness of administrative reforms, where the main challenges are ICT adoption, application, and management [195]. Due to these issues, ICTs-related strategic choices in the early planning phase are more and more relevant for the effectiveness of the final deployment of the eGovernment initiative.

According to this analysis, the planning activity results in the choice of projects which start from the current features of the social/technological system better fit the achievement of new target requirements. Figure 3.1 shows the shift from a technology-driven approach to the technology-enabled eG4M approach.

To these ends, starting from the eG4M approach we have developed a methodology which analyzes from a multidisciplinary perspective the institutional and

This chapter is authored by Gianluigi Viscusi.

G. Viscusi et al., *Information Systems for eGovernment*,
DOI 10.1007/978-3-642-13571-2_3, © Springer-Verlag Berlin Heidelberg 2010

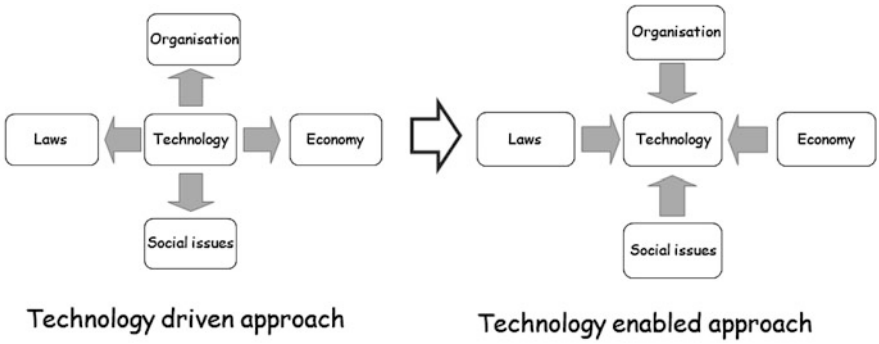

Fig. 3.1 From technology-driven approach to the technology-enabled eG4M approach

socio-economic context under review. It proposes practical interventions from a strategic and technological perspective, which fit the environment and accompany the changes required for their implementation.

The general idea of the eG4M methodology is that the planning process should be driven by social, economic, legal, and technological issues considered in their strict relationship. The systemic perspective proposed considers both the outer and the inner context (see Sect. 3.2) to preserve context diversity in planning eGovernment initiatives [10], where the starting point is the available services and the requirements of constituencies (i.e., citizens and businesses). According to this analysis, the planning activity results in the choice of projects which, starting from the current features of the social/technological system, better fit the achievement of new target requirements considered in terms of quality for the different layers in Fig. 3.2.

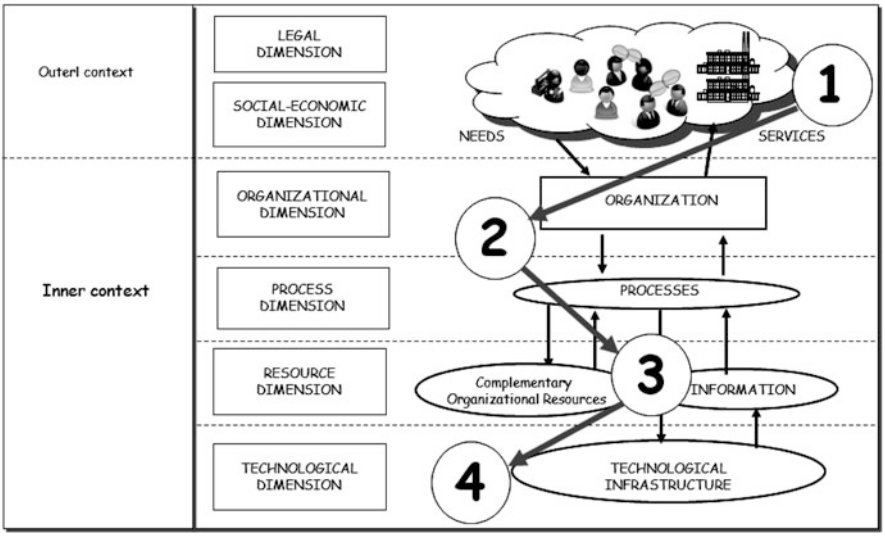

Fig. 3.2 Layers and dimensions considered in the methodology

As pointed out in Chap. 1, the focus on quality in the eG4M approach and methodology is related to the perspective on public value that can be considered not only as economic but also as the degree to which public policies improve the quality of life of constituencies (namely citizens and businesses) by improving the quality of public services and of the public administration organization and processes. A systemic perspective on quality is required.

In Sect. 3.1 we provide an overview of the methodology both from a black-box and white-box perspectives. In Sect. 3.2 we describe the running example adopted throughout the book to illustrate the various phases, steps, and activities of the methodology.

3.1 Black-Box and White-Box Description of the Methodology

Figure 3.3 shows a black-box representation of the methodology with the main inputs and final outputs. The inputs depend upon the scope of the project, which may involve one administration, a group of administrations, a specific administrative process or service, or a group of processes/services. In the most general case inputs are as follows:

- The political vision, priorities, and strategic objectives enacted by the central government and local authorities that have to be considered as high-level intentions to be achieved in conjunction with quality targets. The political vision influences all phases of the planning process.
- The social context in which the planning activity takes place is expressed by means of socio-economic indicators. The considered set of general socio-economic/legal/technological indicators facilitates the measurement of the quality level of the system and establishes new quality targets. These indicators have to be adapted to the specific social and technological context.
- The legal framework of the considered context (country, region, municipality, etc.) together with the laws/rules that regulates activities and procedures of the considered organizations (e.g., central or local public administrations).

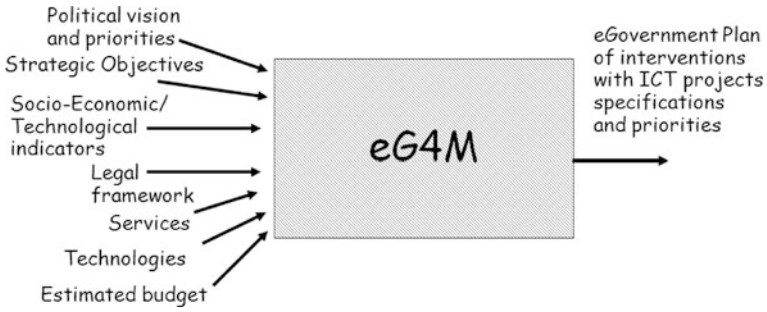

Fig. 3.3 An input – output view of the methodology

- The available services together with the running projects that have been launched in the past to improve their quality. These projects have to be coordinated with and adapted to new projects defined in the planning activity.
- The existing technological solutions, namely (i) the technological infrastructures realized in the past which have to be considered to take into account possible migration or adaptation to the new technological solutions and (ii) the technological solutions offered by the evolving market of ICT, such as new channels, new telecommunication services, and new middleware solutions.
- The estimated budget for the eGovernment initiative.

These inputs must be elaborated by the eG4M methodology in order to produce as output the eGovernment plan of interventions with ICT projects' specifications and priorities. The black-box description allows to identify as inputs the main factors which impact on the overall public value of the resulting project. Consequently, they have to be taken into account in every phase of the methodology.

In order to better understand the consequences of the claims made on the black-box representation of the methodology we now provide a white-box description of the methodology. The white-box description gives a clear picture of the factors that define the requirements of projects and priorities of the eGovernment plan as final output.

Figure 3.4 shows a white box representation of the methodology with the phases, steps, and related major inputs and outputs. There are two main phases of the methodology, (1) strategic planning and (2) operational planning, which we detail in the following by also considering the specific inputs and outputs for each step as shown in Fig. 3.5.

Strategic planning is the core phase of the eG4M methodology. The strategic planning is composed of four main steps: (1) eGovernment vision elicitation (EGEL in Fig. 3.5), (2) state reconstruction (SREC in Fig. 3.5), (3) eReadiness (EREA in Fig. 3.5), and (4) quality assessment (QUAL in Fig. 3.5).

The *eGovernment vision elicitation* (see Chap. 4) aims to provide as output a structured documentation eliciting the eGovernment vision for the following steps and phases of the methodology in terms of macro- and micro-objectives to be reached. The inputs to the step are

- a set of principles and policies underlying the intentions and strategies of the political vision declared by public decision makers;
- the legal framework of the context of intervention;
- the available enabling technologies.

The goal of *state reconstruction* (see Chap. 5) is to provide a clear understanding and knowledge of the general context in which the eGovernment intervention takes place. During this step, the knowledge of the social context, laws and rules, services delivered (and administrative processes that produce them), information flows, and technological infrastructures is collected and related. The outputs are a set of matrices, a simple but expressive graphical representation, showing the relationships among the types of knowledge described before.

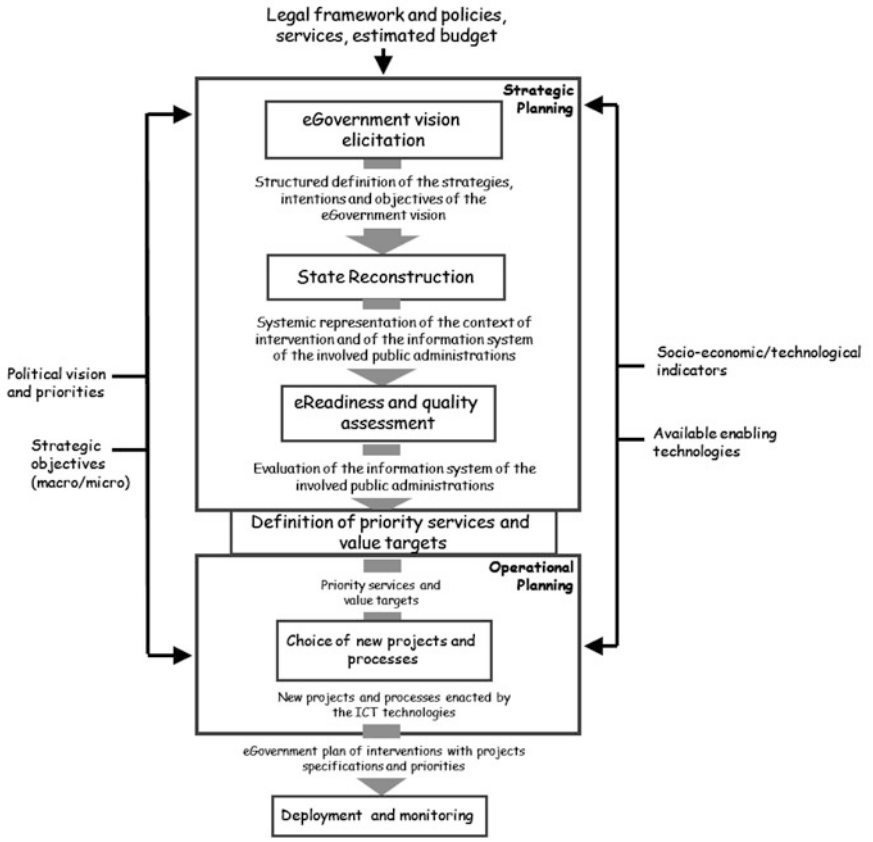

Fig. 3.4 The eG4M methodology

The *assessment* step of the methodology evaluates both the eReadiness (see Chap. 6) and the relevant qualities (see Chap. 7) for the organizations involved in the eGovernment program and other facets of the context of intervention, providing an objective picture of the value of the socio-economic indicators together with the relevant qualities and their interrelationships.

The *definition of priority services and value targets* step (SERV in Fig. 3.5) introduces the operational planning phase and represents the critical step to exploit the strategic planning outputs in order to identify and choose at the operational level the most appropriate projects and technological architectures for the eGovernment initiatives to plan (see Chap. 8 for a detailed description). The step considers as inputs

- the state reconstruction matrices;
- the current eReadiness and quality levels;
- the macro- and micro-objectives output of the elicitation of the eGovernment vision.

Phase	Strategic planning				Operational planning		
Step/issue	EGEL	SREC	EREA	QUAL	SERV	PROJ	PROC
Legal framework	I	I		I			
Political vision	I						
Principles	I						
Policies	I			I			
Available enabling technologies	I						
Strategies	IO						
Intentions	IO						
Macro-objectives	O				I		
Micro-objectives	O				I		
Priority macro-objectives					O	I	
Priority micro-objectives					O	I	
Available services		I		I	I		
Enacted laws and rules		O			I		
Socio-economic context indicators		O	I	I	I		
Descriptions of major facets involved in eGoverment projects (organization, processes, technologies, information, data, etc.)		O	I	I	I		
Matrices showing the interrelationships between the facets involved in eGoverment projects		O			I		
eReadiness indicators			O	IO	I		
Access indicators			O	IO	I		
Innovation indicators			O	IO	I		
Productivity indicators			O	IO	I		
Organizational structure			O	IO	I		
Communication and cooperation indicators for the involved public administrations			O	IO	I		
IT investments (previous)			O	IO	I		
Quality dimensions for the different layers considered in the eGovernment initiatives				IO	I		
Quality indicators for the different layers considered in the eGovernment initiatives					O		
Priority services					O	I	
Priority qualities					O	I	
Value targets					O	I	
Chosen projects						O	I
Chosen project–related processes						O	I
Informal description of the administrative processes		O					I
Design specification of the administrative processes							O

Fig. 3.5 An input output view of the steps of the methodology

Taking these issues into account, the step is in charge of defining the appropriate services target levels for qualities to be achieved during the time interval of the planning, typically 2–3 years. The service and value target outputs are relevant for the overall steps of the *operational planning* phase:

- the *choice of projects* (PROJ in Fig. 3.5: see Chap. 9) and the identification of *reference technological architecture*(see Chap. 10);
- the *specification of new administrative processes* (PROC in Fig. 3.5: see Chap. 11), aiming to improve effective service provision and bureaucracy efficiency.

The final output of the methodology is an eGovernment plan describing the projects chosen, the reference architecture, and the specification of the new administrative processes to implement. Thus eGovernment projects that allow for the achievement of previous target qualities are conceived and selected on the basis of the quality/cost ratio. Projects are defined in terms of process architecture and of the data, software, hardware, and network architectures.

The measuring of technologies is usually performed in subsequent activities of detailed design, together with cost – benefit analysis, leading to the project realization where the architecture is defined and deployed. These latter steps are not considered in the eG4M methodology because of its focus on strategic and operation planning issues: we refer to state-of-the-art tools and approaches for information systems deployment and realization.

For what concerns the monitoring of the project outcome for the stakeholders (public administrations and constituencies, e.g., citizens and businesses), it is important to note that iterative application of the eReadiness and quality assessment steps allows to control the effectiveness of the results.

It is important to note that the main inputs introduced in the black-box representation of Fig. 3.3 are exploited and have impact on every step of the methodology. Due to these issues, each step can be adopted by public managers on the basis of their current needs. Indeed, each phase and step inherits the systemic perspective of the overall methodology and exploits it for specific requirements and constraints of intervention. This way, the eG4M methodology is highly modular and flexible. Due to these characteristics, it can be adapted to different kinds of specific goals as shown in Fig. 3.6, such as

1. improve the quality of a service or a group of services (see application scenario *a* in Fig. 3.6);
2. improve the quality (e.g., the efficiency) of a process or a group of processes (see application scenario *b* in Fig. 3.6);
3. perform a complete assessment of an organization (in terms of eReadiness and quality of information governance as in the application scenario *c* in Fig. 3.6), an information system, a technological infrastructure (see application scenario *d* in Fig. 3.6).

Furthermore, eG4M can be applied for eGovernment planning of a single administration or else for several administrations characterized by a common involvement

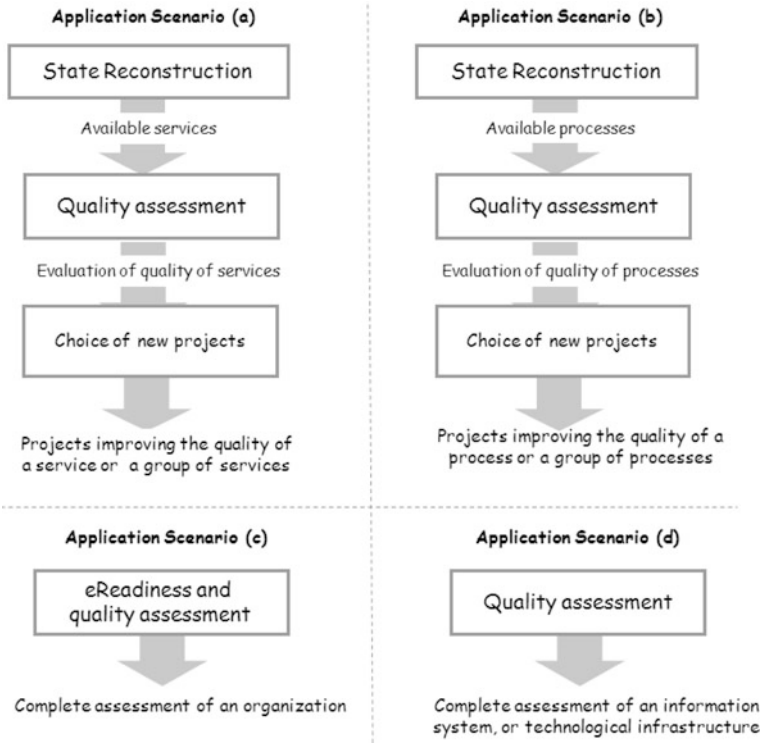

Fig. 3.6 Different application scenarios for the methodology

in administrative activities. In this last case, eG4M is able to produce specifications for interadministrative projects, optimizing the usage of a common technological infrastructure (see Chaps. 9 and 10).

3.2 Running Example

The eG4M methodology is based on experiences in strategic and operational planning in the context of Italian public administration from 1994 to 2007. A first draft version of the methodology was continuously enhanced during those years. On the basis of these experiences, we have been involved in further enhancement, application, and testing of the methodology in Mediterranean countries interested in adopting ICT to promote government services. In particular, we decided to focus on the Maghreb area, where a sociological analysis performed in Morocco and Tunisia has shown that the majority of the Maghreb population still prefers face-to-face interactions, due to the lack of computer literacy, in particular in the rural areas. In this context, enabling the access to government services for the population is particularly critical to help rural residents not to have to travel to major cities for certification or other core administrative services [7]. In the cited countries, a second critical issue

concerns provision of services for the urbanization phenomena, supporting citizens moving from rural areas to cities or suburbs. Due to their complexity, these issues require planning activities which consider the social context at both the macro- and micro-levels. This is necessary in order to promote a broad consensus among officials and citizens and to provide a holistic perspective for senior government leadership, promoting their active involvement and commitment [196].

Taking these issues into account, we have chosen to apply the methodology to a few specific issues, basically to two case studies in Morocco and Tunisia, exploiting context knowledge based on analyses on secondary data, eGovernment initiatives documentation, and direct interactions with central authorities and eGovernment teams. In the following chapters we describe the methodology on the basis of a running example that generalizes the real-world experiences carried out in Morocco and Tunisia:

> Public decision makers of a Mediterranean country have decided to set up an eGovernment initiative aimed at facilitating citizens' access to public administration services. The general objectives to be achieved are
>
> 1. Efficiency and effectiveness of the administrative processes that deliver services to citizens and businesses, in terms of use of resources and achievement of the final outcomes.
> 2. Transparency of institutions, government, and public administration, i.e., the right of citizens and businesses to access all types of information and knowledge produced by institutions and administrations, not covered by secret (so-called public data).
> 3. Simplification of administrative activities, i.e., the elimination in administrative activities of all types of interactions and burdens not strictly needed by law.
> 4. eInclusion and overcoming of the digital divide, the establishment of the right of every citizen, independently from their gender, culture, language, economic and physical conditions to access and benefit from eGovernment services.
>
> Besides these general objectives, two critical social phenomena, such as the urbanization of rural population and the low quality of basic health services, are considered as priority areas of intervention. In the present context of services offered by the public administration, urbanization is considered in a bureaucratic perspective, as a change of state of citizens disciplined by an administrative procedure, namely the change of residency. In order to change the residency, citizens have
>
> 1. to inform the local administration they transfer from;
> 2. to inform the local administration where they transfer to and communicate their new address;
> 3. once obtaining the change of residency, they must go to the local health authority with a certificate of residency in order to update the local registry of health-care beneficiaries;
> 4. if they have a driving license, they have to go with their license to the traffic control authority to request an update of the residency information in the driving license.
>
> Moreover, in the current context, health-care services have difficulties in fulfilling users' demands, due to the burdensome and unfunctional organization of the bureaucratic procedures which mediate the relationships with citizens. In particular, the basic health services, such as medical examinations, entail lengthy procedures and long waiting periods. In order to ask for a medical exam, a health-care beneficiary has to
>
> 1. request a prescription made out by the family doctor;
> 2. choose the structure (hospital, surgery, outpatient clinic) to have the medical exam and ask for a reservation from the reservation center of that structure;

3. in case of a long waiting period for the examination, point 2 must be repeated at least in another structure;
4. once the appointment is made, pay the charge for the exam;
5. in the case where there is a shorter waiting period offered for the same medical exam, the procedure from point 2 must be repeated and a new procedure for the cancellation of the appointment and the refund of the amount paid must be opened.

We assume that services related to change of residency and to medical examination reservation are provided in the territory of reference through physical desks. In order to obtain the services, citizens have to go physically to the desks during their opening time and must fulfill a set of other requirements, e.g., they must produce certificates or documents and fill in forms. This results in several interactions with the front office of the administrations, and other activities are required at the back office to acquire and update relevant information.

In the following we will show how eG4M can help administrations to look at the change of residency not only as a bureaucratic procedure, but rather as an occasion to provide the rural population with new services, such as integrating and acquiring knowledge on the new social context and choosing the best solutions for education, health care, etc. These services can be provided in the occasion of the event of change of residency. Furthermore, eG4M can help the health-care service administration to look at the reservation of a medical examination as an opportunity to inform and to direct citizens to the most adequate health-care structure. The request of a medical exam can be the occasion to provide the users the information about the structures that can best fulfill their needs. It can also be the moment to properly orient the users to the structures that have less demand, in order to rationally distribute the users and reduce waiting times.

Besides the running example, we provide examples of eGovernment initiatives carried out in Italy (see Chaps. 10 and 12) and from the experiences in Tunisia (see Chap. 13).

3.3 Summary

In this chapter we have described the eG4M methodology phases and steps together with their main inputs and outputs. We have discussed eG4M at different levels of detail, from both a black-box and a white-box perspective, showing its modularity and the flexibility of its application. Finally, we have described the running example that will be used in the following chapters, in order to provide a case study-based description of the different phases and steps in their logical flow.

Part II
Strategic Planning

Chapter 4
eGovernment Vision Elicitation

Strategic planning is the most relevant phase of the eGovernment information system life cycle for achieving a clear understanding of the alignment between the political vision, the context of intervention, and the actual ICT goals, architectures, and infrastructures.

Nevertheless, eGovernment planning often lacks detailed and structured knowledge of the domain of intervention suitable to produce clear requirements supporting the choice of services and of the right project configuration implementing them. Part of this knowledge is the *eGovernment vision* that can be captured by strategic documents and interviews with the main stakeholders. This activity allows to clarify *macro-objectives* from the general vision of governmental institutions and a set of related *micro-objectives* (namely the specific initiatives that must be carried out).

Indeed, the aim of the *eGovernment vision elicitation* step is to collect and organize the knowledge about the principles and the policies adopted in the country where the eGovernment intervention is going to take place, in order to provide a detailed and structured perspective on the facets of the political vision and on the related goals (in terms of macro- and micro-objectives). In the right side of Fig. 4.1 we show the issues considered in the chapter for each layer of the eG4M methodological framework and, with straight lines, the relationships among them for which we provide a detailed description; dashed lines represent relationships described with less detail. The eGovernment vision elicitation step deals mainly with principles, policies, laws and considers both social context and the available technological systems.

The step considered in this chapter is composed of the activities shown in Fig. 4.2, namely

- preliminary eGovernment vision elicitation;
- strategy modeling, composed of the subactivities (i) building the AS-WISHED business model and (ii) documenting the AS-WISHED business model, where the AS-WISHED business model expresses the requirements of the eGovernment

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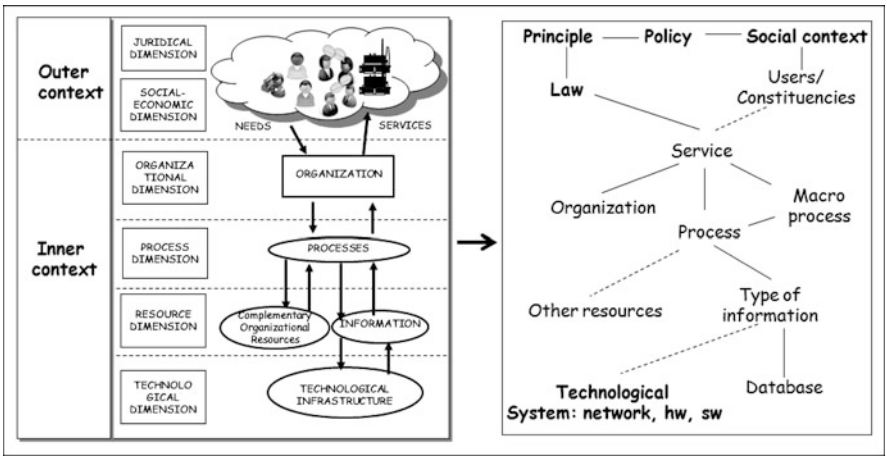

Fig. 4.1 Issues and relationship between them considered in eGovernment vision elicitation

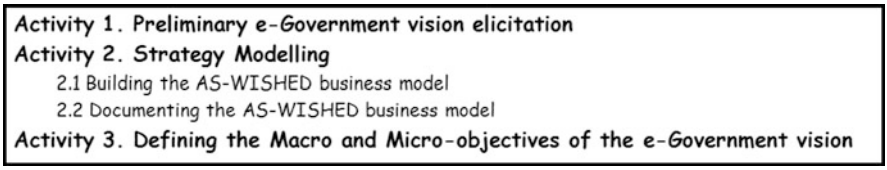

Fig. 4.2 Activities of the eGovernment vision elicitation step

initiative on the basis of the vision of the public decision maker who wants to adapt these requirements to the domain of intervention at hand[1];

- *defining the macro- and micro-objectives of the eGovernment vision*.

It is important to note that this step does not substitute strategy analyses carried out by eGovernment units or consultants, and its goal is to provide an instrument which allows (i) to reduce the complexity of the (often) huge documentation produced by these analyses, (ii) identifying the set of principles and rules supporting the definition of common strategies and goals in terms of macro-objectives, and (iii) focusing on a limited and precise set of area of interventions, defined by what we have called micro-objectives. Under this perspective, the eGovernment vision elicitation step is complementary to traditional approaches of strategic advisory.

The outputs of eGovernment vision elicitation are

- a set of descriptions of the principles, the policies, and the micro–macro-objectives of the eGovernment projects and
- a set of matrices showing the inter-relationships between principles, legal and technological drivers, and AS-IS socio-organizational impacts.

[1] For a discussion of the prevalent views on systems change and fitness relationships between business models and system functionality models, see [193].

Taking these issues into account, in Sect. 4.1 we discuss the role of principles and policies in the definition of strategies and goals of eGovernment initiatives. Then we discuss the main activity of the step, namely the *preliminary eGovernment vision elicitation* (Sect. 4.2) which provides the input to the *strategy modeling* activity described in Sect. 4.3. The modeling activity adopts the *map* model briefly introduced in Sect. 4.3.1. Finally, the resulting documentation (Sects. 4.3.2 and 4.3.3) is used to define the macro- and micro-objectives of the eGovernment vision (Sect. 4.4).

4.1 Policies and Principles

In general terms, a *policy* is "a definite course or method of action selected from alternatives and in light of given conditions to guide and determine present and future decisions. However, the term may also be used to denote what is actually done, even though it is unplanned" [148]. Furthermore, focusing on government, a policy can be defined as

> a set of decisions which are oriented towards a long-term purpose or to a particular problem. Such decisions by governments are often embodied in legislation and usually apply to a country as a whole rather than to one part of it [194].

Besides action, policies also involve *intention(s)*. A specific case of policy intention is a *principle* that can be defined as a general view "about how public affair should be arranged or conducted" [163].

Finally, as pointed out by Theodore J. Lowi a public policy can be considered synonymous with law, rule, statute, edict, and regulation, when considered as "an officially expressed intention backed by a sanction" [131]. Figure 4.3 shows the Lowi's classical typology of public policies [130, 201] with the dimensions corresponding to the likelihood of the application of the government's coercive power (*remote* or *immediate*) and the target of the potential coercion (*the individual* or *the environment of conduct*). These latter dimensions and targets produce four categories of policy:

- *Distributive policy* has a remote likelihood of coercion and mostly applied to individuals.
- *Regulatory policy* has an immediate likelihood of coercion and mostly applied to individuals.
- *Redistributive policy* has an immediate likelihood of coercion and mostly applied through the environment.
- *Constituent policy* has a remote likelihood of coercion and mostly applied through the environment.

Nevertheless, even if all public policies must be understood as coercive [131], coercion is only one of the characteristics of rules and laws that besides coercion may confer powers or privileges without imposing obligations [102]. In this regard, the final outcome of policies is strictly related to the inspiring principles and the

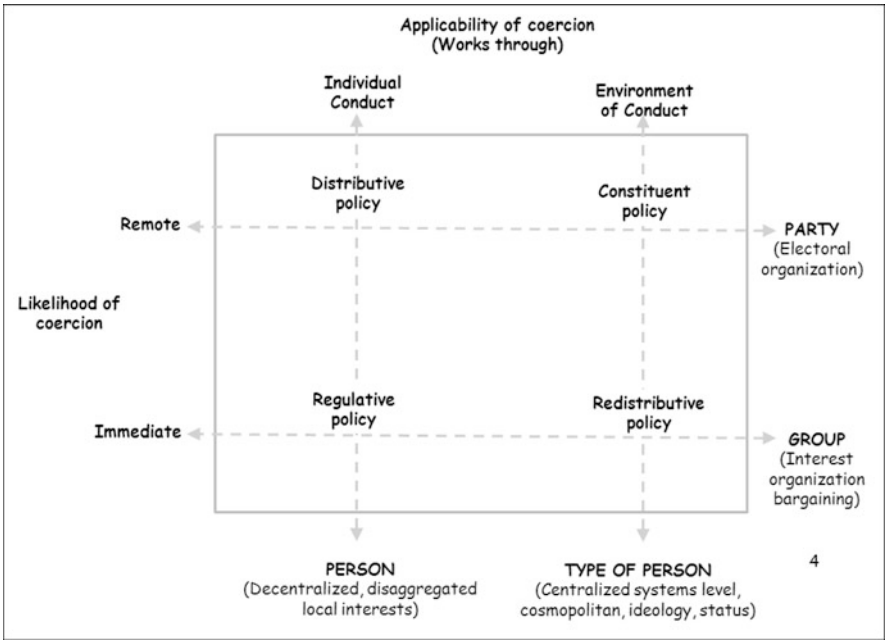

Fig. 4.3 Policies, politics, and related likelihood of the application of the government's coercive power and the target of the potential coercion, adapted from [130]

rules which enact the policies chosen. On the other hand, each principle can be described in terms of a corresponding quality dimension which supports the assessment of the policy achievements and targets for the considered principle in terms of quantitative measures (we broadly discuss quality issues in Chap. 7).

At the state of the art, two main policy perspectives characterize the different approaches to eGovernment, namely (i) a *market-oriented perspective*, whose goal is the efficiency of the action of the public administration evaluated in private sector terms such as cost reduction and return on investment [55], and (ii) a *public-oriented perspective*, where the main goal is the effectiveness in the achievements of government programs in terms of public value (see [150] and in this book Chap. 1). It is worth noting that market-oriented perspectives have been influencing new public management programs of public sector reforms (see again Chap. 1). As said above every policy considered as action is guided by principles defining the policy intentions. Some of the most important principles are, among others:

1. *Efficiency* of the administrative activities that deliver services to citizens and businesses, in terms of (efficient) use of resources and achievement of the final goals.
2. *Effectiveness* of the enactment of political programs in terms of public value.
3. *Transparency* of institutions, government, and public administration, i.e., the right of citizens and enterprises to access all types of information and knowledge produced by institutions and administrations, not covered by secret (so-called *public data*).

4. *Simplification* of administrative activities, the elimination from administrative activities of all types of interactions and burdens not strictly needed by law.
5. *Sustainability* of policies and projects, especially financial sustainability, i.e., feasibility of the initiatives connected to ICT projects within the available budget.
6. *Quality and effectiveness of the legal framework*, i.e., the characteristics of laws and norms that allow to apply them with effective results in the ICT initiatives.
7. *Security* and *privacy*, i.e., the right of the citizen to have sensitive and personal information protected with respect to incorrect use.
8. *eInclusion* and *overcoming of digital divide*, the establishment of the right of every citizen to access and benefit from eGovernment services, independently from their culture, economic condition, available access devices, or language.

Among these principles,[2] *market-oriented policies* consider citizens as customers of the government agency, interested in achieving principles such as (i) *efficiency*, often considered in terms of productivity; (ii) *effectiveness*, in terms of citizens (as customers) satisfaction and entrepreneurial attitude in the public administration management [66]; and (iii) *accountability* in terms of *transparency* of the process supporting the service delivery (at any time, citizens can control the stage of administrative procedures involving them, in the same way they could trace a book, e.g., on an online bookseller).

Whereas the *public-oriented policies*, on the one hand, share the goal of improving the *efficiency* of the public administration with the market-oriented ones; on the other hand, they relate this goal to the basic principles of democracy such as *impersonality* and *equality* of services provided by the public administration, where the *effectiveness* of the service is strictly related to public value and to the degree of *transparency* for citizens of the service provision in terms of impersonality and equality of the back-end procedures.

Besides these issues, the two perspectives show a different focus on the principle of *integration* of the information systems and of public administrations, where market-oriented policies are more focused on *disaggregation* of information systems in different administrations. It is important to note that the focus on disaggregation rather than on integration may result in the adoption of quite different types of technologies, which may enable eGovernment initiatives. Furthermore, defining the principles of the political vision and relating them to a corresponding policy allow to produce a first framework, which is useful to evaluate laws and rules and their impact on the initiatives to be planned.

As an example of political vision that is mainly focused on market-oriented and new public management policies, we shortly discuss the Italian experience during the 1990s (in the following we refer to [19, 89]). The need for an administrative reform in Italy in the early 1990s was driven by different factors, such as (i) an obsolete administration (no government-wide reforms since 1865), (ii) an inefficient administration with isolated cases of excellence, (iii) a costly administration, with consequent crucial need to balance the budget and reduce public debt.

[2] The proposed list of principles concern the highest ones cited in literature and eGovernment programs. The list can be enlarged on the basis of the context of intervention.

The most relevant tools of the Italian administrative reform have been

- a broad "delegating law," where parliament delegates to the government the power to adopt "legislative decrees" (primary-level regulation) in defined areas;
- a delegislation mechanism, i.e., the parliament authorizes the government to substitute primary laws with governmental decrees (secondary-level regulation) in two main sectors, namely administrative procedures and organization of public offices.

The main areas of the reform have been devolution, outsourcing and administrative federalism, reorganization of central government, civil service reform, a performance-oriented public sector management, simplification of the regulatory and administrative procedures, and the new public budgeting [19].

In the following sections we discuss the different activities of the eGovernment vision elicitation step, exploiting principles and policies in order to clarify the goals of the eGovernment initiatives.

4.2 Preliminary eGovernment Vision Elicitation

As discussed in the previous section, principles orient policies toward the different ways of conceiving and implementing the eGovernment strategy, influencing all future activities. Indeed, public managers in the first place need to be aware if they are working on a strategy defined by market-oriented or public-oriented policies. Furthermore, they need a way to share with other actors and stakeholders the knowledge related to their strategy in a fairly structured way in terms of requirements documentation.

To these ends, in the preliminary eGovernment vision elicitation activity we first introduce a simple checklist where principles are outlined for the main policies discussed in the previous section. On the basis of the policy orientation a first set of principles can be chosen in order to better detail them in terms of requirements for the strategy definition.

For reasons of clarity, we focus on two principles, listed in Fig. 4.4, namely *efficiency* and *effectiveness* of public administration, that we analyze in more detail in Fig. 4.5. As described above, efficiency is relevant for both the market-oriented and the public-oriented policies, while effectiveness, even if considered explicitly in an entrepreneurial way mainly by the market-oriented policies, in the public-oriented policies is strictly related and results from the realization of both the accountability and transparency principles.

The table aims to provide a first representation of the requirements related to the implementation of efficiency and effectiveness in terms of four dimensions:

- the specific *strategies* that satisfy the principle (in the running example, embedding administrative procedures in ICT for the efficiency principle, and information management and coordination for the effectivenes principle);

Principle/policy	Market-oriented	Public-oriented
Impersonality		✓
Fairness		✓
Equality		✓
Personalization	✓	
Decentralization	✓	
Delegislation	✓	
Subsidiarity	✓	
Wholeness	✓	
Disaggregation	✓	
Cooperation	✓	✓
Integration		✓
Uniformity		✓
Efficiency	✓	✓
Simplification	✓	
Productivity	✓	
Effectiveness		✓
Adequacy	✓	✓
Accountability	✓	✓
Transparency	✓	X

Fig. 4.4 The principle/policy matrix

Principle	Strategy	Rule	Enabling technology	Socio-organizational impact (AS-IS)
Efficiency	Embedding administrative procedures in ICT	Simplification laws	Cooperative architectures	Improve administrative processes
Effectiveness	Information management and coordination	Laws on digital signature	Digital signature technology	Reducing burden on citizens

Fig. 4.5 Principles, strategies, related rules, enabling technologies, and AS-IS socio-organizational impacts

- the *rule(s)* that facilitate the actuation of the principle (in the running example, simplification laws for the efficiency principle, and laws on digital signature for the effectiveness principle);
- the *enabling technologies* for the actuation of the strategy satisfying the principle (in the running example, cooperative architectures for the efficiency principle-related strategy and rules for digital signature for the effectiveness principle-related strategy);
- the actual *socio-organizational impacts* of the application of the principle (in the running example, improving administrative processes for the efficiency principle and reducing burden on citizens for the effectiveness principle).

This first set of requirements is based on a first analysis of the documents and unstructured interviews to public managers and previous experiences of the consultants and of the eG4M analysts leading the planning phase.

It is important to note that rules and enabling technologies in the table are only drafted at the very general level in this activity of eGovernment vision elicitation step, on the basis of the background knowledge of public managers or from available documentation considered by the eG4M analyst; further steps of the methodology are in charge of verifying their applicability in the context of the intervention and to validate them as the most suitable solutions.

In the running example, in order to implement the effectiveness principle, the table shows that a target strategy is to improve information management and coordination between public administrations and that this latter strategy can be achieved by enforcing laws for digital signature enabled by corresponding related technologies.

4.3 Strategy Modeling

A relevant activity in this step is to provide a formal representation of the strategy which leads the implementation of the political vision in the eGovernment initiative(s) and the alignment with IT and complementary organizational resources [106, 148]. Representing strategy in a formal and structured way is a major challenge in both the public and private sectors (for a wider discussion see also Sect. 1.3) [44]. A solution is provided at the managerial level by tools such as strategy maps [121], but as argued by Bleistein et al. [31] the alignment research focuses mainly on performance evaluation, ignoring the connections to system requirements.

As discussed in Sect. 1.3, business modeling provides a first set of frameworks for an explicit link between system requirements and the objectives of business strategy. Furthermore, concepts and tools supporting business modeling are fewer and less developed than tools and concepts that already exist for business process management such as the business process modeling notation (BPMN) discussed in Appendix B.

At the state of the art [116] the most comprehensive and well-defined languages and frameworks for business modeling (based on their own ontology) are the *resource–event–actor (REA) framework*, the *e3value framework*, and the *Business*

Model Ontology (BMO). The *REA framework* [141] is focused on representing increases and decreases of value in an organization, having its origins in business accounting. The core concepts in REA are `Resource`, `Event`, and `Actor`; every transaction can be described as two events where two actors exchange resources. *e3value framework* [92] explicitly focuses on resources exchange as value objects. The basic concepts in the e3value ontology are `actors`, `value objects`, `value ports`, `value interfaces`, `value activities`, and `value exchanges`. The *BMO* [162] provides a framework that consists of nine core concepts classified under four categories, as described in the following: the category `product` as a single concept, that is `value proposition`; the category `customer interface` has three concepts, namely `target customer`, `distribution channel`, and `relationship`; the category `infrastructure management` has three concepts, namely `value configuration`, `capability`, and `partnership`; the category `financial aspect` has two concepts, `cost structure` and `revenue model`.

In the *building the AS-WISHED business model* activity we adopt the *map* representation systems [187–189]. Map is based on a goal-driven approach aimed at going beyond the functionality-based view of conceptual modeling [220], to extend the modeling of the information about the universe of discourse [202] from "what is done by the system" approach to the "why is the system like this" [186]. To these ends, map conforms to existing *goal models*, such as *i**[4, 74, 151, 232], by recognizing the goal as intention, but departs from them by introducing the concept of strategy to attain an intention. As pointed out by Rolland [186], the introduction of the concept of strategy is motivated by the following reasons:

- the distinction between *what* to achieve (the goal) and *how* to achieve it (the strategy);
- the evidence coming from practice that managers do not distinguish between *goals* and *strategies*;
- increasing the size of the goal models and to a difficult recognition of alternatives for business;
- the need to introduce variability in the information systems, because of the new constraints of flexibility due to constant and dynamic changes in organizations and in the interactions with customers and other businesses;
- the need to capture the variability in goal models by means of strategy.

In particular, the *map model* has been used to provide a uniform representation of business goals and system functionalities; where to provide a shared view of the strategic level (business goals) and operational level (system functionalities), as we have seen, represents a major issue in the strategic alignment to business model.

4.3.1 The Map Model

Figure 4.6 shows an example of map that we discuss in the following in order to deepen the characteristics and the basic constructs of the map model. The discussion

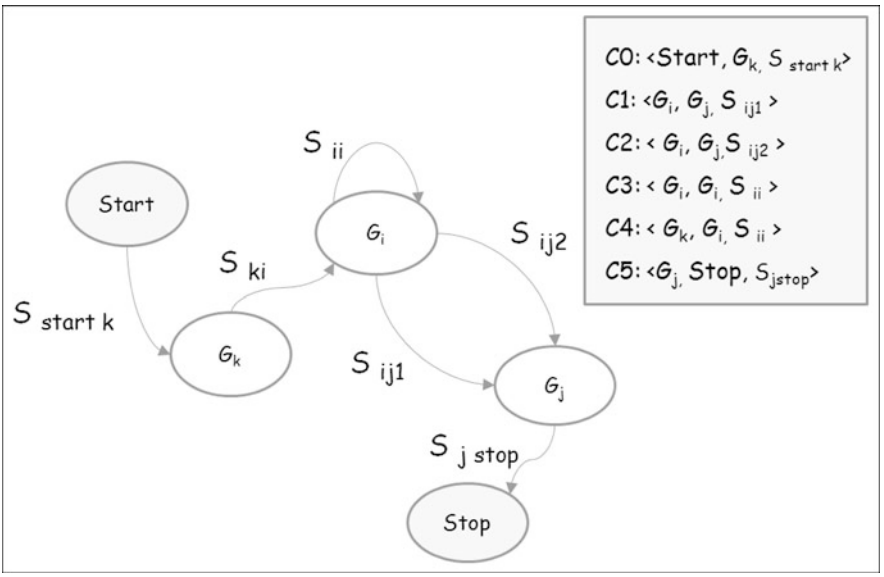

Fig. 4.6 An example of map, adapted from [193]

is based on Salinesi and Rolland [193] and Rolland [186]. A map is a labeled directed graph with *intentions* (intention is a goal to be achieved by the execution of the process) as nodes and *strategies* as edges between goals (in this context a strategy is a way to achieve an intention). A map is graphically represented through a begin *start* node and a final *stop* node. The directed nature of the graph shows which intentions can follow other previous intentions. An edge enters in a node if its strategy can be used to achieve the corresponding intention. A map can represent the different strategies that can be used for achieving an intention, by means of multiple edges entering a node.

An *intention* can be achieved by the performance of a process. As anticipated above, each map has two special intentions, start and stop, to start and end the process, respectively. A strategy is a way of achieving an intention. The strategy S_{ij} characterizes the flow from the source intention G_i to the target intention G_j and the way G_j can be achieved once G_i has been achieved.

A *section* is a triplet $\langle G_i, G_j, S_{ij} \rangle$ and represents a way of achieving the target intention G_j from the source intention G_i following the strategy S_{ij}. Each section of the map captures the condition to achieve an intention and the specific manner in which the process associated with the target intention can be performed. Sections of a map are connected to one another, allowing three relationships between sections, namely *thread*, *path*, and *bundle* leading to different map topologies, such as multi-thread and multi-path topologies. A *thread* relationship occurs when a given intention can be achieved with different strategies. This is represented in the map by several sections between a pair of intentions. Such a map topology is called a *multi-thread*.

A *path* occurs when a task can be performed by several combinations of strategies. This is represented in the map by a pair of goals connected by several sequences of sections. Such a topology is called a *multi-path*. In general, a map from its start to its stop intentions is a multi-path and may contain multi-threads.

A *bundle* relationship occurs when a given section which is bundle of other sections expresses only one of its sections that can be used in realizing the target intention. As an example, the map of Fig. 4.6 contains six sections $C0$–$C5$. It can be seen that $C1$ and $C2$ together constitute a multi-thread, whereas $C4$–$C1$ and $C4$–$C3$–$C2$ are two paths between G_k and G_i constituting a multi-path. Taking these issues into account, one of the most relevant features in the map model is to allow the refinement of sections from a higher general level to a very detailed section level. This is useful in order to challenge conceptual mismatches between the *whys* captured in the business model (BM) and the *whats* available in the *system functionality model (SFM)* [193], through the analysis of fitness relationships among them or strategic alignment [209, 210]. This coupling is achieved in the map formalism by simply relating each section of a map to a system functionality. Therefore, any section can be considered from two viewpoints: the business viewpoint and the system viewpoint. As a result, a map section expresses a direct relationship between a system function and a business process [193].

As seen in Chap. 2, *refinement* is the primitive that allows to proceed from abstract representations to more detailed ones. Indeed, *refinement* is a design mechanism by which a given entity is viewed as a set of interrelated entities; such a refinement mechanism is required for handling the fitness relationship in a systematic, controlled manner [193]. Refinement allows to see a fitness relationship not as a monolithic, flat structure. In the map approach a refinement is defined as a mechanism to refine a section of a map at level i into an entire map at a lower level $i + 1$ [193].

Therefore, a *fitness relationship* represented in a section of the map is refined as a graph of sections, corresponding to sub-relationships between the business and the system. Furthermore, to control the complexity derived from mastering different levels of abstractions in a refinement, Salinesi and Rolland [193] relate this issue to the black box/white box principle [222] that points out the usefulness of seeing an entity as a black box at a level of abstraction i and then as a white box at level $i + 1$. When a system is seen as a black box, its internal properties are hidden and the emphasis is on the relationship between the system and other systems and when it is seen as a white box, on the contrary, the internal area of the system is visible. The white box analysis shows the critical issues to be managed when the content of the black box covers different levels of abstraction (as in the case of a fitness between business model and system functionality model). These issues have also been challenged in recent works on map model focused on investigating its use to design strategic alignment between strategic and functional goals, by defining contribution links between the components of the strategic and of the functional model [209, 210].

To the end of strategy modeling, it is important to note that an *intention of strategic level* is specialized by (i) a *strategic objective*, that is an intention that motivates

an act on an imprecise temporal horizon and by (ii) a *strategic goal* that corresponds to the results an organization wants to achieve on a given date [209, 210]. Whereas an *intention of functional level* is specified by (i) a *non-functional goal* that represents an expected quality which cannot be expressed in a functional way (e.g., extensibility or maintainability) and (ii) a *functional goal* that corresponds to a service required by the user within its context of activity [209, 210].

Taking into account these issues, the map model is useful to integrate the set of matrices proposed above to support the planning activity in the *eGovernment vision elicitation* step. In the following sections we provide an example.

4.3.2 Building the AS-WISHED Business Model

The first task of the strategy modeling activity aims to build the AS-WISHED business model, namely the business model representing the desired strategic outcomes before having made any assessment of the AS-IS state of the context of intervention.

In order to better detail the requirements for the AS-WISHED business model of the eGovernment projects [193], we consider the elements in the table represented in Fig. 4.5 as input to a modeling task where we adopt the map formalism.

Figure 4.7 shows a map at the more abstract level which represents the project intentions and strategies for the political vision of the running example that aims to *improve public administration service quality*. For the sake

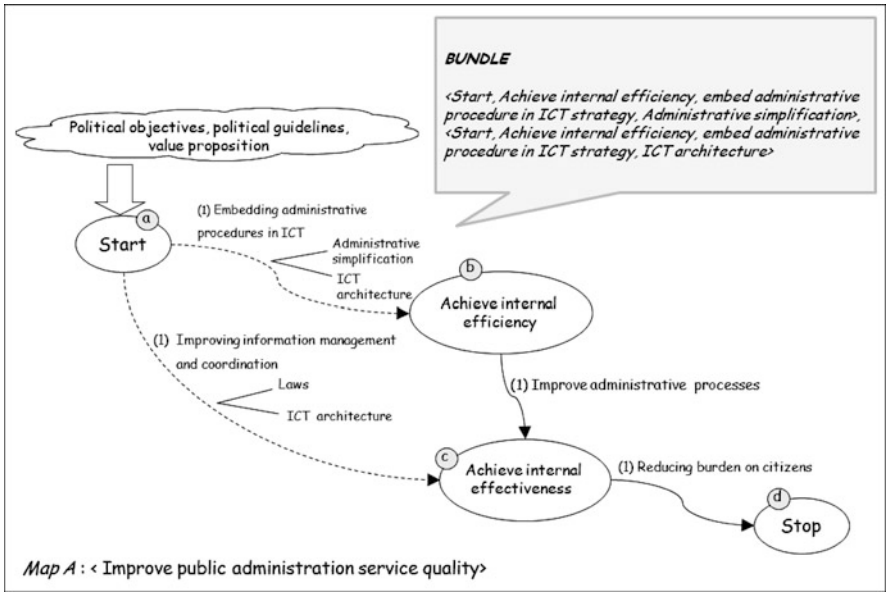

Fig. 4.7 Higher level map which represents policy that aims to improve internal efficiency and effectiveness

of simplicity, in a unique map we have represented strategies and intentions for the implementation of both the *efficiency* and the *effectiveness* principles, where `Achieve internal efficiency` is the general intention for what concerns *efficiency* and `Achieve internal effectiveness` is the general intention for the *effectiveness* realization in public administration service quality. It is important to note that the strategies for achieving internal efficiency and effectiveness, namely `Embedding administrative procedures in ICT by administrative simplification` *or* `ICT architecture strategy` and `Improving information management and coordination by laws or ICT architecture strategy`, respectively, are *bundles* of exclusive *or* strategies.

At this level the map shows a possible choice for the project requirement definition. In fact, choosing a legal strategy for efficiency (i.e., `Embedding administrative procedures in ICT by administrative simplification`) could have a positive final outcome in terms of effectiveness in reducing the administrative burden on citizens. Indeed, administrative simplification could improve administrative processes, supporting the achievement of internal effectiveness by means of the strategy `Improving information management and coordination by an ICT architecture`.

In brief, the requirements for the AS-WISHED projects could ask for an integrated initiative considering (i) a legal intervention for process simplification (achieve internal efficiency) and (ii) a technological intervention for information management and coordination.

In order to detail these hypotheses and verify the correct interpretation of the available documentation, we further refine the map of Fig. 4.7 in a map that details the strategy aiming to `Improve information management and coordination` (see Fig. 4.8). Indeed, this latter encompasses both technological and legal strategies.

First, we consider the paths of the two intermediate intentions aiming to `Improve information management and coordination`, namely

1. `Improve administrative cooperation` (specializing the higher level intention of efficiency)
2. `Reduce burden for administrative services` (specializing the higher level intention of effectiveness).

For what concerns the first intention we choose the following path (*ab1–bc1–cd1* in Fig. 4.9):

<*Start, Improve administrative cooperation, enforcing simplification laws*>,
<*Improve administrative cooperation, reduce burden for administrative services, improving data governance*>
<*Reduce burden for administrative services, Stop, digitalizing information flows*>

The path specializes the higher level hypothesis of a legal intervention for process simplification (achieve internal efficiency), by defining the requirements in terms of the enforcement of simplification laws.

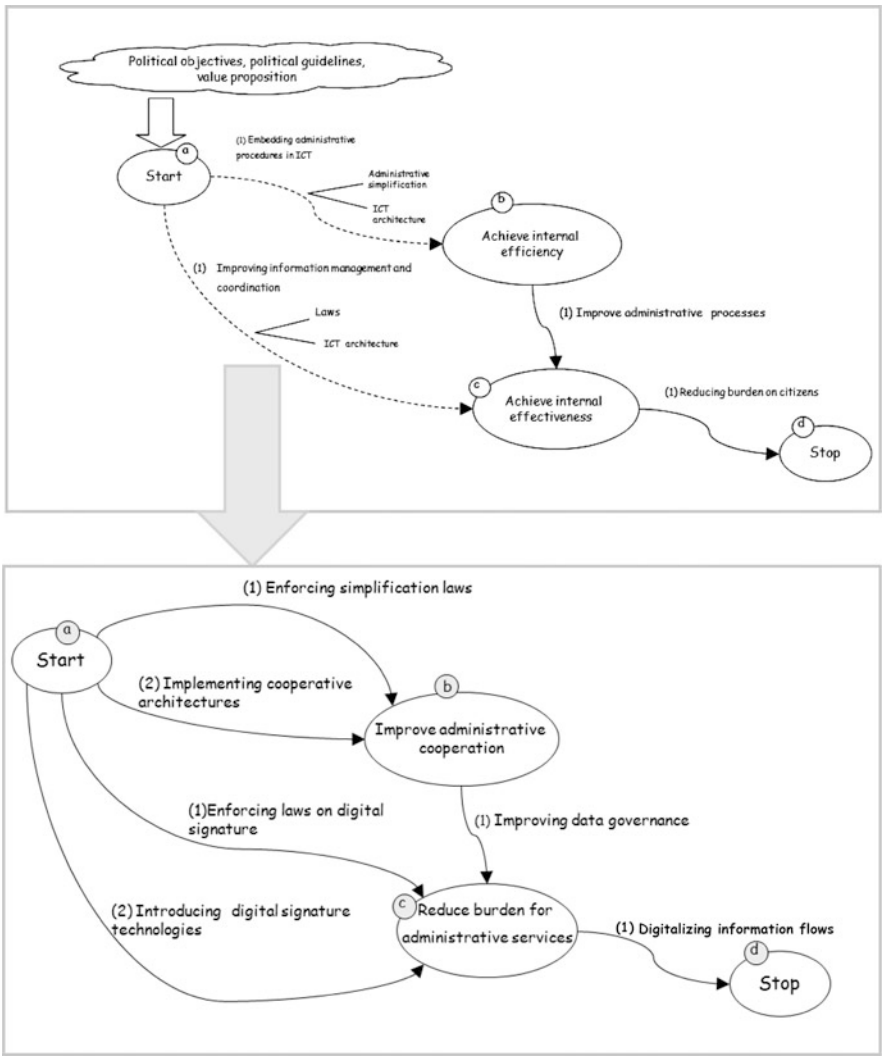

Fig. 4.8 The refinement of the high-level map of Fig. 4.7 into a detailed map of section ac1 in Fig. 4.9

For what concerns the second goal (specializing the higher level goal of *effectiveness*), we choose the following path (*ac1cd1* in Fig. 4.9):

<Start, Reduce burden for administrative services, Introducing digital signature technologies>,
<Reduce burden for administrative services, Stop, digitalizing information flows>

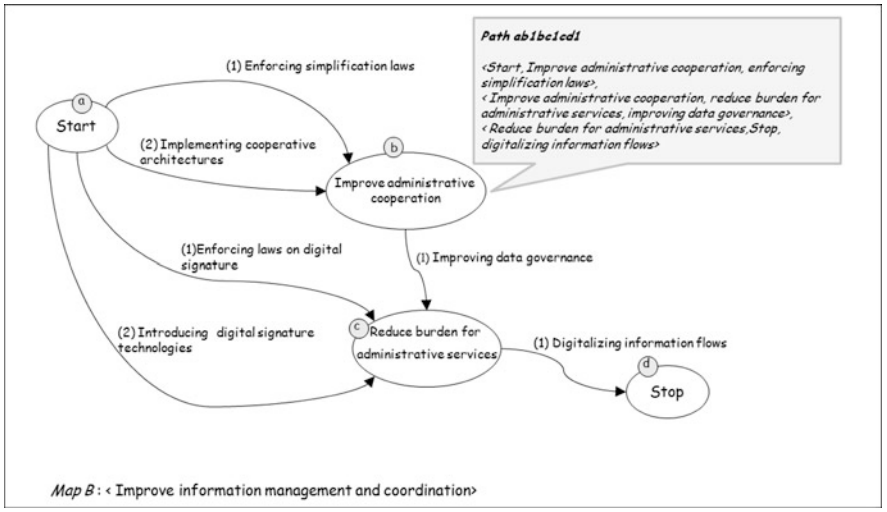

Fig. 4.9 A map which represents the intentions and strategies refining policies of Fig. 4.7

At this level, we notice that the strategy for effectiveness cannot be merely technological if laws on digital signature are not available in the considered country. In this case, the public decision maker should start the eGovernment initiatives by adopting a legal strategy to improve both the efficiency and the effectiveness of public services.

As an alternative, the choice could be the adoption of (i) a technological strategy for efficiency by *implementing cooperative architectures* (*ac2* in Fig. 4.9) and (ii) a legal strategy for effectiveness by *enforcing laws on digital signature* (*ab1* in Fig. 4.9). Both the alternatives must be evaluated on the basis of further results of *assessment* steps (see the following Chaps. 6 and 7). Nevertheless, at this level of analysis the map representation points out the legal requirements as constraints for an effective adoption of the technological solutions: too often the lack of consideration of legal issues in the planning phase leads to technological initiatives which could ask for additional investments.

4.3.3 Documenting the AS-WISHED Business Model

Finally, the produced maps are documented in a form which is sharable with the involved public managers, allowing the comparison between the intentions of different strategies implementing the different principles for a common vision. The form template encompasses the following fields:

- *Principle* is the policy intention represented in the map.
- *Vision* is the declared intention of the political initiative.
- *Code* is the section in the map.
- *Starting intention* is the initial intention.

- *Strategy* is the means leading to a final intention.
- *Type of strategy* refers to the facets of the context of intervention where the strategy impacts (legal, organizational, technological, social, economic facets).
- *Final intention* is the target intention of the strategy adopted.

Figures 4.10 and 4.11 show, respectively, the documentation for the efficiency and effectiveness principles of the political vision which aims to improve public administration service quality in the running example.

Focusing on Fig. 4.10, the form documents the higher level map shown in Fig. 4.7 for the efficiency principle in terms of

- *intentions* (starting and final) and
- *strategies* (classified on the basis of the facet on which they impact (in this case juridical, organizational, and technological) implementing the considered intentions.

Whereas Fig. 4.11 documents the higher level map shown in Fig. 4.7 for the effectiveness principle.

Principle	Efficiency			
Vision	Improving public administration service quality			
CODE	Starting intention	Strategy	Type of strategy	Final intention
ab1	Realizing efficiency	Embedding administrative procedures by means of administrative simplification	Legal	Achieve internal efficiency
		Embedding administrative procedures by means of ICT architectures	Technological	
bc1	Achieve internal efficiency	Improving administrative process	Organizational/ technological	Achieve internal effectiveness
cd1	Achieve internal effectiveness	Reducing burden on citizens	Organizational/technological/legal	Efficiency realized

Fig. 4.10 A refined documentation for eGovernment vision (focus on efficiency principle)

Principle	Effectiveness			
Vision	Improving public administration service quality			
CODE	Starting intention	Strategy	Type of strategy	Final intention
ac1	Realizing effectiveness	Improving information management and coordination by means of laws	Legal	Achieve internal effectiveness
		Improving information management and coordination by means of ICT architectures	Technological	
cd1	Achieve internal effectiveness	Reducing burden on citizens	Organizational/technological/legal	Effectiveness realized

Fig. 4.11 A refined documentation for eGovernment vision (focus on effectiveness principle)

At this level, the documentation shows a common final intention for both the principles, i.e., the achievement of internal effectiveness of the public administration realized by means of different strategies (see the gray boxes in Figs. 4.10 and 4.11).

In order to provide a synthesis of the previous documentation, we introduce the form shown in Fig. 4.12. Here we have a concise representation for both the efficiency and effectiveness principles of the common intentions (2 of 4 total intentions) and strategies (6 of 13 strategies). It is important to note that we document here the results for both the higher level map (see Fig. 4.10) and its refinement (see Fig. 4.11). The resulting common intentions to focus on in order to choose the appropriate objectives for the eGovernment initiatives are as follows:

- Achieve internal effectiveness (of the public administration).
- Reduce burden for administrative services.

In the following section we further discuss how the documentation output of the task *documenting the AS-WISHED business model* is exploited to define macro- and micro-objectives in the running example.

# of principles	# of intentions	# of strategies
2	4	13
Principles	**Common intentions**	**Common strategies**
‹Efficiency, effectiveness›	2	6
Map A	‹Achieve internal effectiveness›	‹Improving administrative processes, improving information management and coordination by means of laws, improving information management and coordination by means of ICT architecture›
Map B	‹Reduce burden for administrative services›	‹Improving data governance, enforcing laws on digital signature, introducing digital signature technologies

Fig. 4.12 Documentation for eGovernment vision resuming the common goals and strategies for the considered principles)

4.4 Defining the Macro- and Micro-objectives of the eGovernment Vision

According to the analyses carried out in the *strategy modeling* activity and the resulting documentation, the planning activity now is devoted to finding a first set of strategic/political objectives (in the following *macro-objectives*) compared with the actual strategies of development (in the following *micro-objectives*). Macro- and micro-objectives depend, respectively, on the final intention and associated strategies, resulting from the *strategy modeling* activity; in the example of Sect. 4.3 a macro-objective is defined on the basis of the final intention *achieve internal effectiveness*, while the micro-objectives are defined on the basis of the strategies `improving administrative processes` and `improving information Management and coordination by means of laws or ICT`. The set of macro-objectives must be clustered on the basis of their impacts on the context of interventions in terms of laws, services, organization–processes, technology adopted. The set of micro-objectives must be defined on the basis of macro-objectives, starting from the available documentation and asking opinions of public decision makers and managers by means of questionnaires or involving them in focus groups.

In the running example (see Fig. 4.13), due to the relevance of providing an accountable way for evaluating the effectiveness of the processes supporting the

Common intentions	Common strategies	Macro-objectives	Micro-objectives
<Achieve internal effectiveness>	<Improving administrative processes, improving information management and coordination by means of laws, improving information management and coordination by means of ICT architecture>	1. Effectiveness of the administrative activity (organization–process) 2. Simplification of administrative activities (laws) 3. Improve registry services (service) 4. Use innovative ICTs (technology)	1. Simplify administrative procedures for registry services (organization–process–laws)
<Reduce burden for administrative services>	<Improving data governance, Enforcing laws on digital signature, introducing digital signature technologies>		2. Deploy new proactive registry services (service) 3. Services accessible with multiple channels (technology)

Fig. 4.13 Documentation for eGovernment vision defining the macro- and micro-objectives resulting from the common goals and strategies for the considered principles

available services (actually provided also in a non-digital way), a macro-objective is *to improve registry services* to *achieve internal effectiveness*. This macro-objective can be implemented through the achievement of a set of micro-objectives such as (i) *to simplify administrative procedures for registry services* (specifying the strategy `improving administrative processes`) and (ii) to *deploy new proactive registry services* which ask for innovation at the legal and technological levels (specifying the strategy `improving information Management and coordination by means of laws` *or* `ICT`). For what concerns innovation at the technological level, issues such as digital signature ask for the *use of innovative ICTs* as macro-objective in order to provide *services accessible with multiple channels* (a relevant condition also to provide new proactive services).

The resulting macro- and micro-objectives together with the outputs of the strategy modeling activity are the inputs for the following steps of the strategic planning phase and in particular for the definition of priority services and value target step of the operational planning phase.

4.5 Summary

In this chapter we discussed how the eG4M methodology allows to define clear objectives for the eGovernment initiatives to be planned. In particular, we have shown how to model the (implicit) strategy adopted, starting from the set of principles and policies underlying the statements of the political vision declared by public decision makers. The output is a structured documentation eliciting the eGovernment vision for the following steps and phases of the methodology.

Chapter 5
State Reconstruction

Strategic planning of initiatives in eGovernment may effectively be performed only when adequate knowledge is available on all the facets introduced in previous chapters. Such knowledge is usually fragmented and dispersed among PA offices and sometimes among PA officers, who seldom document the information related to laws, organization, and other issues. Thus, frequently at the beginning of an eGovernment project a recognition is needed whose goal is to reconstruct the state of the social and information system considered in the project. This is the state reconstruction activity considered in this chapter.

The aim of *state reconstruction* is (i) to collect and organize the knowledge about the area in which the eGovernment intervention is going to take place, in order to highlight major resources of the social system, the public administration organizational, information, and technological system to be dealt with and (ii) to ground the subsequent phases of the planning activity. State reconstruction considers all the facets endorsed in Fig. 4.1, namely, principles, policies, social system, services, organization, processes, ICTs. The outputs of state reconstruction are as follows:

- a set of indicators describing the broad context in which the eGovernment intervention takes place;
- a set of descriptions of major facets involved in eGovernment projects;
- a set of matrices showing the inter-relationships between the facets.

In this chapter, first we consider in Sect. 5.1 the facets, providing several models at different levels of expressiveness to describe them. The more the model is expressive, the more rich knowledge on the facet is collected and represented, but the more the process costs. Thus, the models provided have to be seen as a kit of representations, to be chosen according to the importance of the facets they aim to describe. Then, in Sect. 5.2 we discuss relationships in terms of a common representation, namely two columns of matrices. The running example and other local examples are used thoroughly in this chapter.

This chapter is authored by Carlo Batini and Gianluigi Viscusi.

G. Viscusi et al., *Information Systems for eGovernment*,
DOI 10.1007/978-3-642-13571-2_5, © Springer-Verlag Berlin Heidelberg 2010

5.1 How to Represent eG4M Facets

In this section we examine all the facets in Fig. 5.1, namely social context, laws, services, public administration organization, processes, types of information, and data.

5.1.1 Social Context

The aim of this step is to reconstruct the scenery in which the eGovernment intervention takes place. The knowledge of the social context helps to properly orientate the eGovernment intervention toward appropriate goals. Depending on the kind of services and organizations involved, the *social context* to be considered can be at a national, regional, or local level. The outputs of the social context reconstruction phase are a set of tables, giving details of the actual state of the considered social context through a set of indicators.

The main focus of the context reconstruction in our methodology regards *ICT diffusion*, namely the extent and patterns of ICT spread across society, and *ICT access*, namely to what extent people, groups, and organizations can reach and use ICT channels and applications. Several factors exceeding the technological issues shape the access and the diffusion of technologies in a social context, especially when related to technologies like ICTs. For instance, economic factors at the macro- and micro-levels (e.g., presence and growth of the ICT sector, economic affordability of ICT diffusion and usage) are involved, as well as political factors, such as freedom of expression, freedom of access to communication technologies, and legal factors, e.g., laws on privacy. Here we are especially concerned with social and cultural factors, in their intertwining with technological ones. In this area, elements like skills in ICT usage, the effective usage and integration in a number of daily practices, and the cultural orientation toward ICT are key components of diffusion and access of ICTs.

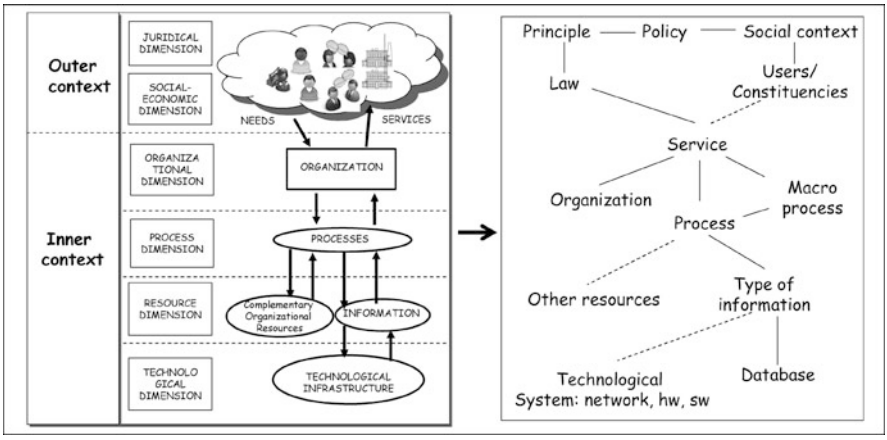

Fig. 5.1 Issues and relationship between them considered in state reconstruction

The diffusion of a technology varies within the same social context among the different sectors which compose it, according to the level of homology between these sectors and the given technology (for a discussion on homology, see Chap. 1). Therefore, in this step ICT diffusion among different sectors should be considered, namely (i) business sector, (ii) educational sector, (iii) scientific and academic research, (iv) administrative sector, (v) associative and third sector, (vi) households and daily life. Figure 5.2 provides some examples of indicators for the educational sector and for usage in daily life.

On the other hand, ICT access encompasses infrastructural indicators and indicators of real usage and integration of ICT in daily practices (see Fig. 5.3). Since these indicators vary among different social groups, main indicators shaping the inequal capacity of access to ICT should refer to the well-known dimensions of social differentiation, such as gender, age, socio-economic class, urban or rural context, linguistic or cultural minority, and presence of disabilities.

In this step the amount of resources involved in data collection and analysis should be properly sized, taking into account the specific planning needs and the availability of data. In eG4M, *social context reconstruction* is grounded on the secondary analysis of available data, focusing on some key issues (e.g., ICT access and diffusion) and avoiding an overspending of resources to get an exhaustive and detailed snapshot of the context. The sources of data for secondary analysis vary,

	ICT DIFFUSION IN THE EDUCATIONAL SECTOR	ICT USAGE IN DAILY LIFE
INDICATORS	– ICT access in educational institutions at different levels (% of schools equipped with computers; total number of Internet connected PC for student) – ICT access at University (total number of Internet connected PC for 1000 students) – eLearning diffusion (% of secondary and tertiary schools providing online courses)	– Locally relevant contents (total number of web sites under the dominion of the country; total number of web sites in local languages) – Languages of the visited web sites – Methods of access/bandwidth (% of DSL connection for Internet use in households/at work/at public access points) – Location of the most frequent use of Internet (home, work, public access points, private access points) – Frequency of Internet usage – Purposes of PC use – Purposes of Internet use

Fig. 5.2 A set of indicators for ICT diffusion

	INFRASTRUCTURAL ACCESS	ICT CAPACITY AND TRAINING
INDICATORS	– % population reached by electricity – % population that have access to a fixed line telephone – % population covered by mobile cellular telephony – % people with Internet connection at home – % of population that can have access to an Internet connection (in schools, hospitals, government buildings, Internet, and phone centers)	– ICT basic literacy rate (% of people with basic knowledge of the use of a PC) – Availability of specific ICT training programs (total number of ICT training programs in secondary and tertiary education) – Enrollments in ICT training programs – Availability of trained workforce (total number of IT specialists, engineers, and programmers)

Fig. 5.3 A set of indicators for the ICT access

Indicator	Value
% of on population covered by mobile cellular telephony	45
% of population with Internet connection at home	3
% of people that can have access to Internet (at school, work, other access points).	20%
Cost of Internet access	High
Cost of mobile phone services	Medium
IC T literacy rate (% on total population)	25%
IC T literacy rate (% among 14 to 25-year-old)	45%
% of schoolsequipped with computers	60%

Fig. 5.4 Indicators resulting from the social context state reconstruction in the running example

depending on the context; they can be administrative data, census data, household surveys, and ad hoc ICT household surveys.

In the running example we assume that the secondary analysis has produced the results shown in Fig. 5.4.

The indicators offer a representation of the present-day ICT access and diffusion in the country, showing that mobile telephony is a more diffused technology than Internet and that many people have easier access to the former than to the latter due to their costs.

The indicators also show a very high ICT literacy rate among young people (45% of 14- to 25-year-old, which represent 30% of the total population, have a basic knowledge of the use of a PC) and a high diffusion of ICT in the educational system (60% of schools are equipped with computers).

A reading of these indicators suggests that, on the one hand, due to the large number of users of cell phones with respect to the users of Internet and due to the costs of Internet access, eGovernment initiatives in our hypothetical country have to consider the service provision through multichannel systems as a major issue. On the other hand, indicators suggest that in the long-term period it is possible to invest efforts in the progressive extension of the Internet service provision, due to the high rate of young population and to the ICT diffusion in the educational system.

5.1.2 Services

The concept of service has been thoroughly defined and discussed in Chap. 1. Here we provide several possible classifications according to which services can be organized and several metadata that can be used for the description of their properties.

A first type of classification has the definition of *classes* of services as a goal on the basis of their functional characteristics (e.g., a service that produces as output a certificate is an instance of the class *certification*). We will call this classification *functional*. Most relevant classes of services are shown in Fig. 5.5, in same cases

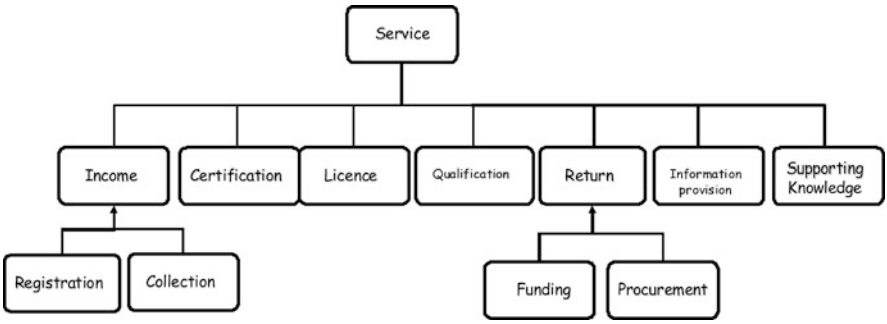

Fig. 5.5 The functional classification of services

related by IS-A relationships of the same kind we introduced for entities in the ER model in Chap. 2.

The classes have the following meaning:

- *income* is an action or payment due to public administration by a law or rule; income can be further classified in terms of
  - *registration*: services related to recording object- or person-related data in official registers with respect to administrative obligations [40];
  - *collection*: payment of an obligation, such as a tax;
- *certification*: provision of a document testifying to a property or the truth of something;
- *license*: official or legal permission to do or own a specified task;
- *qualification*: meeting the proper standards and requirements for position or task;
- *return*: every type of payment from public administration to persons or businesses; among return services we distinguish
  - *funding*: an amount of money or other resources set aside for a specific purpose, usually for supplying a project or an activity;
  - *procurement*: payment for service or goods provision;
- *information provision*: the action of providing information to public administration of an event or state;
- *supporting knowledge*: every type of knowledge managed in public administration archives and databases that public administration can provide to citizens and businesses.

In Fig. 5.6 we see examples of services belonging to the above classes.

In functional terms, each class of services can also be associated with the conceptual schemas of data that have to be accessed in order to provide the service. We may call such schema the *service data schema*. To give an example, consider the service `Certification of birth`; the service data schema associated with the service is made of entities `Citizen`, with attributes `Social Security Number`

Class	Examples
Registration	•Birth Registration •Land and property registration
Collection	•Licence tax payment •Patent tax payment
Information provision	•Change of place of a retail activity •Value added tax statement •Customs declaration
Collection	•Licence tax payment •Patent tax payment
Certification	•Birth certification •Permanent address certification
Licence	•Real estate restructuring •Planning permission
Qualification	•Authorization to start a business •Authorization for perishable goods transportation
Funding	•Small business financing •Real estate restructuring loan
Procurement	•Access to public auction •Call for bids
Information provision	•Change of place of a retail activity •Value added tax statement •Customs declaration
Supporting knowledge	•Access to laws •Information on services provided •Territorial marketing

Fig. 5.6 Examples of services

and `Municipality`, with attribute `Name`, and the relationship `Born-in` between entities `Citizen` and `Municipality`.

Another typical classification used for services is the classification based on *events of life*. The motivation for introducing this metaphor comes from the fact that citizens and businesses perceive the need to request services from the public administration mainly when some event occurs in their life, such as the need to travel abroad for citizens or the start up of a business. The classification based on events of life has been proposed in order to simplify the interaction with users, grouping services for significant events. The more the grouping is granular and distinct for a wide number of events, the more the users need to understand and identify the administrations to interact with is simplified. An example of classification of services for citizens in terms of life events is shown in Fig. 5.7.

The above two classifications can be considered together as first types of metadata that may be associated with services represented in a *repository of services*. Such a repository aims to be a rich description of services actually provided by administrations in terms of several descriptive properties expressed by metadata.

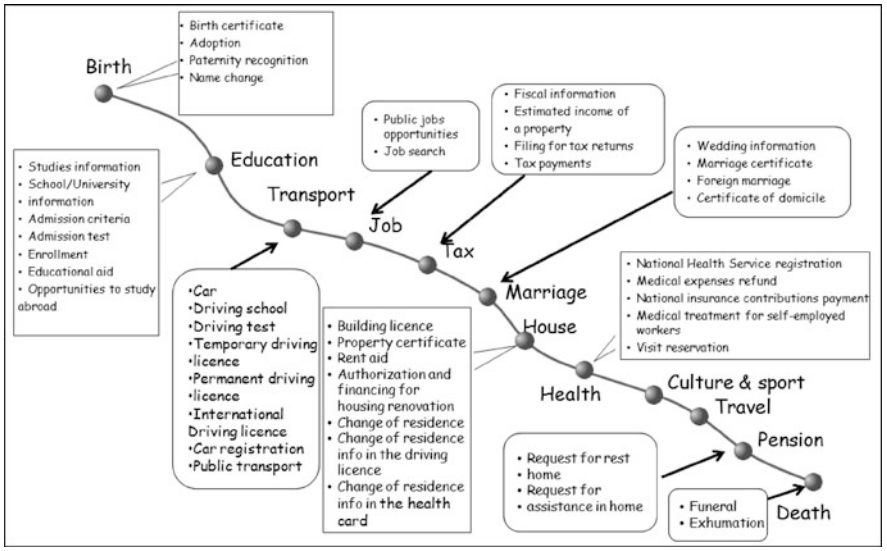

Fig. 5.7 Classification of services for citizens in terms of life events

The repository of services can be useful in principle for three types of players, namely (i) public administrations, (ii) external users, and (iii) service developers and providers. For a discussion on this issue see [16].

A snapshot of a repository is provided in Fig. 5.8. Apart from the two classifications introduced above, other properties concern

1. a service description, a short natural language description of the service, which should emphasize as much as possible how the service is perceived by users;
2. the classification of the service in terms of functional- and life events-based classifications;
3. the types of users who may need the service;

Service description	Service provider	Type of users	Classification	# of potential users (national)	Yearly service frequency	Access channels
Provision of fundings for agriculture	Province of Rome	Farmers	Return	600,000	1,200,000	– Physical desk – Call center – SMS
Communication of change of address	Municipality of Milan	All businesses	Registration	5,000,000	1,000,000	–Physical desk & Internet –Call center and SMS – Kiosk and SMS

Fig. 5.8 A snapshot of a repository of services

4. the estimated number of users who need to access the service and their evolution in time. For instance, the service `Obtain a fishing licence` is needed in a country by fishermen the first time they go fishing and has to be confirmed after a given interval time; here we have to quantify the approximate number of fishermen who need a license every year;
5. the frequency of use, in terms of average number of invocations of the service per user in a given interval of time (e.g., a year);
6. statistics on access channels (e.g., physical desk, Internet, cell phone) presently provided to invoke the service.

Services may be represented in the repository both at an abstract level, namely, services described independently from their implementation, and at a concrete level, which corresponds to real services offered by the administrations and providers. The representation of services at the concrete level may be used

- by public administrations, to reuse services developed by other administrations in order to make the investments more efficient;
- by providers, to support business predictions in terms of (i) the size and characteristics of the potential market and (ii) the attitude of the users to spend money for a service.

In the running example, we may distinguish the following list of services:

1. certificate of residency;
2. driving license provision;
3. driving license update;
4. health card provision;
5. obtaining a doctor.

5.1.3 Types of Users

Services are requested from the public administration by citizens and businesses. Thus, to be able to plan their development we have to know for each service or group of services who are its users. In previous sections we have examined this issue; now we have to proceed to deepen the analysis and represent more precisely the types of users. The description of services in the repository introduced above usually gives some insight on the users. For instance, all services related to tax payments refer to citizens and businesses whose universe is identified by law, resulting in two types of users *individual tax payers* and *business tax payers*. In case, as usual, different types of taxes have to be paid, we can refine the above types of users into, e.g., *personal property tax payer* and *vat tax payer*, and similarly the same for other relationships with the different public administrations. This activity in marketing is called *user segmentation*.

Coming back to the repository of conceptual schemas introduced in Chap. 2, one of the macro-entities of the most abstract schema is `Individual`. If starting

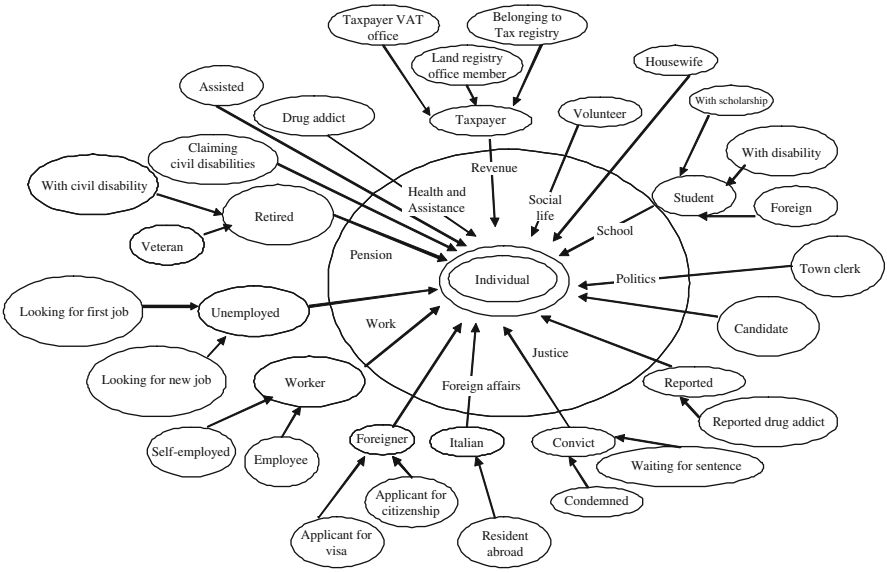

Fig. 5.9 Types of individuals according to their relationship with the public administration in Italy

from `Individual` in the most abstract schema we produce all refinements resulting from `Individual` in the lower level schemas, we obtain a taxonomy of types of individuals such as the one in Fig. 5.9. Such a taxonomy can be used in this phase as a source of knowledge to be linked to the repository of services, as we will see in Chap. 9.

5.1.4 Laws

A *law* is a system of rules, usually enforced through a set of institutions. Laws are enacted over the years, resulting in a corpus of rules and obligations which altogether are defined as a *legal framework* or legislation framework. Laws can be of different types, such as constitutional laws or decrees. Consequently, legal frameworks are in general structured as a hierarchy of rules; Fig. 5.10 shows an example that generalizes the legal framework of Italy and other Mediterranean countries such as Tunisia. Besides constitution, international treaties are the highest set of rules governing all the other types of rules, namely, decrees, decrees with force of law, ordinance, and administrative rules, these latter governing specific administrative procedures.

The above model of legal framework is quite general and has to be specialized to specific legal contexts of the different countries, e.g., in Italy local public administrations such as regions may issue laws, called *regional laws*, which discipline several themes in which regions have jurisdiction, such as health, welfare, agriculture, whose only obligation is not to contrast with national laws.

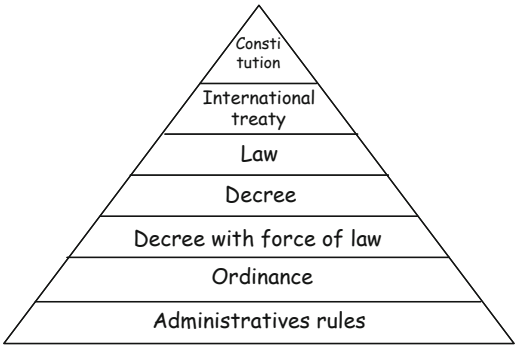

Fig. 5.10 Example of legal framework

In this phase we are not interested in reconstructing the whole body of laws, but only laws related to eGovernment issues and specifically, laws whose goal is to regulate the usage of ICTs to achieve principles and policies discussed in Chap. 1. In Fig. 5.11 we see (some of) the legislative initiatives that have been undertaken in the last years in Tunisia, in the areas of privacy, digital economy, digital administration, electronic commerce, all related to eGovernment according to different visual angles.

Notice that privacy has been the object of a complex legislative path, from the modification of the constitution updated with new principles and warranties to the enactment of a law and a decree for the concrete implementation of the initiatives. Other issues request for a more limited path, in terms of a law and a decree. Notice

Issue	Type of rule	Year	Objective
Privacy	Constitution	2002	Modified an article to introduce the principle of personal data protection
Privacy	Law	2004	An organic guidance law on privacy
Privacy	Decree	2007	Creates a national authority to govern the privacy principle
Digital economy	Law	2007	An organic guidance lawon digital economy
Digital economy	Decree	2007	List of activities included in digital economy
Digital economy	Decree	2007	Institution of the higher board of digital economy
Electronic administration	Law	2000	Juridical validity of electronic documents
Electronic administration	Decree	2005	Creation of the electronic administration unit in the prime minister cabinet office
Electronic commerce	Law	2000	An organic guidance law on electronic commerce
Electronic commerce	Decree	2000	Creation of the national certification agency
Electronic commerce	Decree	2001	Rules for the certification provider activity

Fig. 5.11 Example of legal framework oriented to enact eGovernment issues

also that sometimes the articulation of the theme needs more than one decree to cover all aspects to be governed.

5.1.5 Organization

Several models have been proposed to describe organizations; we choose one of the most popular and common ones, the organizational chart. An *organizational chart* is a diagram that shows the structure of an organization and its parts in terms of functional units and the relationships and relative ranks of its parts, functional units, and positions/jobs. The literature on this issue is quite vast, see [56, 149] for an introductory discussion. In Fig. 5.12 we show a typical organizational chart of a university, with the head, the *rector*, the most important bodies which govern a university, and the administration, with the most relevant functional units.

The structure of public administration in many countries consists of central and local agencies that together offer services to citizens and businesses. For example, in Italy, central PAs are of two types, *ministries* such as internal affairs, finance, and other *central agencies* such as social security, accident insurance, and the chambers of commerce. Main types of local PAs correspond to regions (21), provinces (about 100), and municipalities (about 8000).

The previous four-tier model (central administrations, regions, provinces, municipalities) is adopted only in certain countries, in others a three-tier model holds, and so on.

In this phase of state reconstruction, starting from the above-mentioned high-level organizational chart, we should refine the representation of public administrations involved in eGovernment, producing at least one- or two-level descriptions which comprise (notice that the nomenclature may change from country to country)

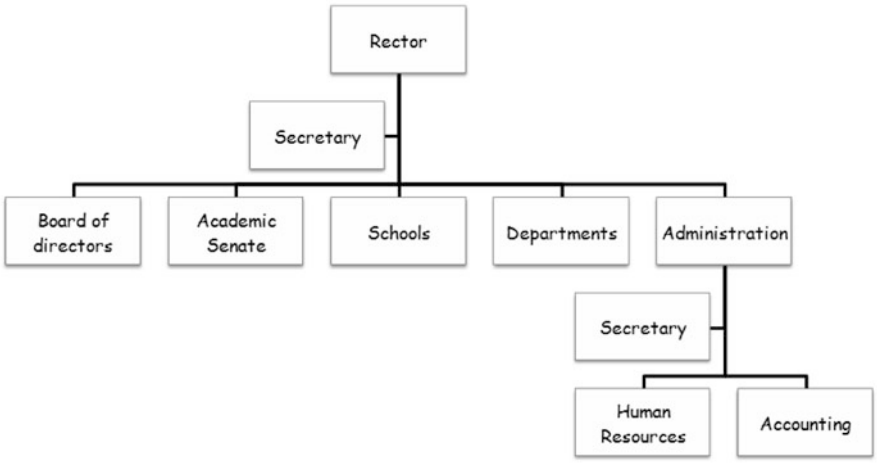

Fig. 5.12 Example of an organizational chart

the directorates, divisions, or offices. The refinement should stop when the office responsible for the service is found. Typically, the attribution of competence on services to an administration is established by law, and a public entity (in the following, the *service owner*) is chosen as responsible for service issue; a central PA or, collectively, a type of local PA can be chosen as owner of a service, e.g., in Italy municipalities are owners of service that "certify the residence address of a citizen." While the owner is unique, the service may be supplied by one or more public or private providers.

Another consequence of the above discussion is that for many services the administrative process which performs the service provision may involve information systems both of several central and of several local administrations, resulting in the need to establish a technological framework which makes both central and local administrations to cooperate in service provision.

5.1.6 Process

In the context of eGovernment, an *administrative process* or *process* is a set of activities, or subprocesses, performed to produce a service to be used internally in an administration, which we call *internal service* or else a service to be delivered to an external user that we call *external service*. If the process produces an internal service in order to transform the internal service into an external one it has to be an input to a new process. A *macro-process* is a sequence of processes that altogether satisfy a service request made by an external user producing the required external service.

Besides administrative processes, we are also interested in modeling a second type of processes, namely *business processes*, i.e., the activities performed in businesses to produce and sell goods and services. When not ambiguous, we will use the terms process and service instead of administrative or business process and internal or external service.

The concept of process is central in eG4M, since in order to provide high-quality services for citizens and businesses we have to act on processes producing them. In the book we provide three models at different levels of expressiveness and related complexity in order to represent processes, namely hierarchical classification, metadata, and a formal language. We now discuss the first two models; we will see a language-based model of process description in Appendix B.

5.1.6.1 Hierarchical Classification of Processes

This model corresponds to a hierarchical representation of processes in terms of subprocesses, together with a short definition of them. As an example, we may express the process of *procurement* in terms of the following subprocesses:

1. *Demand estimation* is the first phase of a procurement process in which an organization estimates its needs: basically, it responds to the question "what do we need?."

2. *Budget definition* is the one through which the previously identified needs are related to the available economic resources.
3. *Needs specification* matches the needs detected in the first process with available resources in order to determine the actual specifications of the goods and services that can be procured to fulfill the users' needs.
4. *Supplier scouting* consists in looking for vendors who could provide services and goods compliant with the specifications drawn in the previous process.
5. *Supplier qualification* aims to verify if the potential suppliers selected in the previous process satisfy some general prerequisites fixed by the buyer organization in terms of quality and reliability.
6. *Request for proposal* is the process in which the buyer organization can request that the suppliers fulfill the criteria defined in the previous process to formulate proposals which could satisfy the specific requirements drawn in the needs of specification process.
7. *Tendering* is the process by which offers to perform activities or provide goods are called for in a competitive environment. It covers the preparation of an offer by tenderer and its submission to the awarding authority.
8. *Awarding* is the one that begins with the opening of tenders that are checked in order to select the winning tender. The chosen tenderer and rejected suppliers are informed of the results of the evaluation.
9. *Contracting* is the process in which the awarding authority establishes commercial agreements with the awarded supplier. In this process a negotiation process may take place about the provision stipulations.
10. *Ordering* is the process in which the buyer issues an order to the supplier for the services or goods it needs. Obviously it is necessary to distinguish between orders of common use and non-common (or extraordinary) use according to the complexity and frequency of procurement of such objects.
11. *Supplying* is the process in which the supplier, once he has accepted the order, provides the buyer with the ordered goods or services.
12. *Invoicing* is the process in which after the successful delivery accomplished in the previous process, the supplier issues the invoice and actual payment from buyer to supplier.

Notice that the above list does not provide the description of the control sequence of execution of the subprocesses, neither exceptions and other typical flows of control primitives; such aspects can be described using the language provided in Appendix B.

5.1.6.2 Form Description with Metadata

The second model provided for processes is in terms of a set of metadata that can be organized with a form such as the one in Fig. 5.13 that describes several characteristics and properties of the process `Invoice accounting`. The fields in the form have an intuitive meaning; we do not provide further details.

Process goal Invoice accounting	Organizational units involved Accounting office
Input/activation events Invoice supply	Output (documents/goods/services) Update of expense item Order of payment emission
Databases Accounting database	
Activities 1. Check of cash on hand 2. Update of balance sheet 3. Order emission	
Internal/external users Responsible of accounting/suppliers	Volumes 100 transactions a day
Reference laws/norms Accounting laws	
ICTs Server + sw accounting package + DBMS + local network	Sw applications Accounting package

Fig. 5.13 Example of the form describing the process of invoice management

5.1.7 Data

In the case of data, we may use all the machinery discussed in Chap. 2, to which we address the reader. Since every artifact production activity requests resources, we have to carefully plan the production of conceptual schemas. On the basis of the previously mentioned experience we had in Italy, the production of an ER schema with about 20–30 concepts among entities and relationships requests approximately a two-person-week effort. Another representation that can be used when less effort is requested is the hierarchical representation introduced for processes. This representation may be preferred when available documentation is in terms of interviews and when we do not have enough material to be able to produce a conceptual schema.

5.2 How to Represent Relationships Among Issues

Once adequate documentation is produced on the relevant issues in eGovernment, we have to investigate the relationships among issues. Here we simplify the overall problem, focusing on binary relationships, namely relationships among pairs of issues and among them, on the most relevant one. The tool that we will uniformly use to represent the relationships is the *matrix*, where in rows and columns we represent the possible instances of two related facets and in the cells the type of relationship defined among the instances. To achieve compactness, in this section we introduce tables and matrices directly expressing them in terms of the running example.

5.2.1 Services and Laws

The first relationship we investigate considers services together with the related laws. The table in Fig. 5.14 shows the services of the running example together with related laws, providing useful information on several relevant topics that we discuss in the following. In particular the `Main issues addressed` field points out the different roles by law of the public administrations involved in the service provision, together with the ownership of the official registries and archives or databases. Furthermore, the table provides a first representation of the up-to-date status of the juridical framework related to strategic issues for the provision of electronic services, whose collection has been discussed in Sect. 5.1.2.

Here we show the Italian legal framework, referring to laws on digital archives, the legal validity of digital documents, the exchange of electronic data between administrations, and on support for the authentication in the access to public administration web sites or desks (such as smart card, digital signature). In particular, considering the certification of residency, it is important to note that

- the municipality is the owner of the registry office (law 1128/1954);
- the ministry of interior is in charge of the national record of the registry office (law 470/1988);
- the electronic data and documents have a legal validity by law (law 59/97).

Other laws related to the driving license provision show that this service has been the object of several innovative projects and consequently of innovative legislative

Service	Law reference	Year	Main issues addressed
Certificate of residency	Law 1228/1954	1954	– The municipality ownership of registry office – The information to be held by the registry office – The definition of rules for personal data and certificates
	Law 470/1988	1988	– The institution by the ministry of interior of the national record of the registry office
	Law 59/97	1997	– The simplification of laws, rules, and administrative processes – The legal validity of electronic data and documents – Rules for the change of the organization of public managers
Driving licence provision	Decrees with the force of law 396/2000 285/1992	1992/2000	– The municipality ownership of the registry office for civil status – The creation of a digital archive for civil status in the municipality – The creation of a nation digital archive for civil status – The obligation for local public administration to exchange data in electronic format through the national public network – The creation of a digital archive for the roads by the ministry of transports – The creation of a digital archive for vehicles
Driving licence update	Law 326/2003	2003	– Rules for the suspension of the driving licence
Health card provision	Law 23/12/1978 n. 833 Decree 437/1999	1978/1999	– The rules for the registration to the national health system – Role and ownership of local office of the ministry of health – Rules for the electronic health card
Health card update	Law 1228/1954 Law 23/12/1978 n. 833 Decree 437/1999	1954/1978/1999	– The rules for the registration to the national health system – Role and ownership of local office of the ministry of health – Rules for the electronic health card
Obtaining a doctor	Law 59/97 Decree 270/2000	1997/2000	– Roles of the physicians in the public administration – Rule for obtaining a doctor

Fig. 5.14 Services and related laws in the running example

production. These laws establish the creation and ownership of digital archives and registries (in the example digital archive for vehicle, civil status, and a national record of the registry office) and the obligation for local public administrations to exchange data in electronic format.

5.2.2 Services, Processes, Macro-processes

The services we are interested in this book are requested by citizens to be able to perform a wide set of activities, such as to go abroad, to get a driving license, and by businesses to perform their business processes, such as to open a new sales point. Due to this aspect of the relationship between PAs and businesses, we are interested in this section to model

1. from one side the relationship between services provided and the internal *administrative processes* and
2. from the other side, the relationship between *business processes* and services requested by businesses.

The first representation is useful since it allows us to understand how ICTs can be used to provide better services through administrative process automation and/or re-engineering and the second representation is useful for businesses to understand how their own processes can be improved when the execution of the process proceeds, making use of some service provided by the public administration. We examine them separately.

5.2.2.1 Services and Administrative Processes

In order to model the relationship among services and administrative processes and macro-processes we may use two different types of representations, namely a simple matrix-shaped representation and a richer representation in terms of the BPMN language described in Appendix B. An example of the matrix-shaped representation is shown in Fig. 5.15 that represents all processes and services involved in a specific macro-process M. It is important to note that in this case the matrix is generic and does not refer to the running example.

Service/process/ macroprocess M	Service1	Service2	Service3	.....	Servicen
Process 1	X		X		X
Process 2		X	X		
Process 3		X			X
.....					
Process n	X		X		X

Fig. 5.15 Administrative processes, macro-process, and related services

5.2.2.2 Services and Business Processes

Businesses, to perform their business processes, need authorizations and other types of interactions with public administrations. If we see business to government interactions from the point of view of businesses (see Fig. 5.16), the execution of a business process can be seen as a chain of activities internal to the business (some of them require the interaction with other businesses) interwoven with requests of services to the public administration. A more effective provision of services by the public administration results in more effective business processes.

As an example, consider the process of choosing a new point of sale, typical of chains of shops, retail businesses, restaurants which expand their activity. The process can be described using the hierarchical classification of Sect. 5.1.6.1 in terms of the following subprocesses and activities:

- *Location search and identification*:
  1. Data collection and analysis.
  2. Real estate identification.
  3. Technical activities.
- *Design of the new point of sale*:
  1. Execution phase.
  2. Dressing of premises.
  3. Personnel selection and training.
- *Operations start up*:
  1. Communication and advertising.
  2. Go live.

For each subprocess and activity we may investigate which services are needed by law from the public administrations or else which services may be offered to businesses to make more efficient and effective their business and the PAs involved. An analysis of requirements and interviews with businesses may produce the matrix in Fig. 5.17.

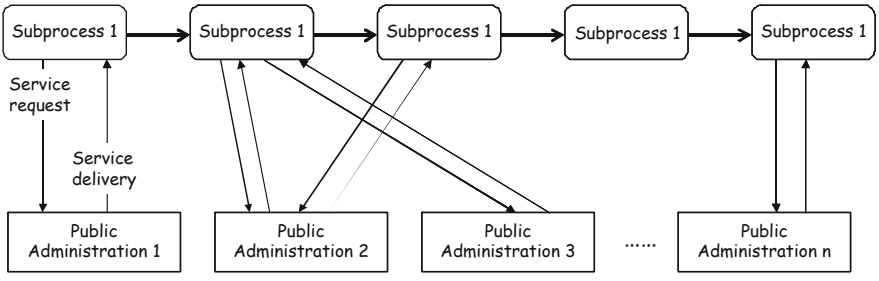

Fig. 5.16 Business processes and services requested

Subprocess	Service	Agency involved	Classification of service
Data collection and analysis	Collection of socio-economic information on a given area	Central and local bureau of statistics	Supporting knowledge
Data collection and analysis	Collection of information on competitors	Chamber of commerce	Supporting knowledge
Real estate identification	Collection of information on available real estate in the area	Land registry office	Supporting knowledge
Execution phase	Authorization for security in the working environment	Social security agency	Qualification
Execution phase	Send communication to chamber of commerce	Chamber of commerce	Communication of administrative data
Execution phase	Send communication to rubbish collection agency	Rubbish collection agency	Communication of administrative data
Execution phase	Request of authorization to firemen office	Fireman unit	Qualification
Execution phase	Request for administrative license	Municipality	License
Execution phase	Request of authorization for signs	Municipality	Communication of administrative data
Execution phase	Request of compliance of electrical grounding	Local health unit	Qualification
Execution phase	Request for sanitary authorization	Local health unit	Qualification

Fig. 5.17 Subprocesses, services requested, and public agencies in the point of sale business process

Looking at the classes of services we see that

1. three services are of *qualification* type;
2. one service is of *license* type;
3. three services are of *information provision* type;
4. three services are of *supporting knowledge* type.

From the point of view of expected sales and revenues, services which support knowledge may be crucial, since having rich and updated information on the territory where to locate the point of sale may significantly optimize the revenues resulting from the new activity. When we discuss issues related to qualities in Chap. 7, we will see that in this case we refer to the *effectiveness* of the service. At the same time, the value related to services providing qualifications and licenses is in the fact that they enable the new activity, so acting on them reduces the total time needed to conclude the process; consequently, it influences the *efficiency* of the process. Finally, the services related to information provision are less significant from the point of view of effectiveness and efficiency. At any rate, they have to be activated on time and should provide correct information. Effectiveness and efficiency of business processes have been investigated in the area of the value chain; here we do not address this issue and the interested reader may refer to [176].

5.2.3 Processes and Organizations

In the *process/organization* matrices we describe for each process the roles of the various organizational units involved in the process. There are two possible roles, namely *decides* and *collaborates*. When the external user of the service is involved in bringing data and documents from one administration to another, a *collaborates* role is assigned to the external user for the process. Figure 5.18 illustrates the matrix for the three main processes of the running example.

5.2.4 Organizations and Types of Data

Organizations have different roles in creating and managing data. Figure 5.19 shows such roles in terms of the running example. Roles are given below:

- *Governs*: the administration controls the management of information in service provision, assuring the correctness and the accountability of the procedure and in case (e.g., when a national registry for citizens is available) maintaining and preserving the data used in the information flows.
- *Certifies*: the administration is responsible by the law for certification and service provision of the related data;
- *Provides*: the administration (or a private delegated actor) physically provides the data for the related services;
- *Uses*: the administration (or other actors) uses the information to accomplish further activities related to service provision.

The representation of the types of data exchanged and the roles of the involved organizations put in evidence governance constraints in service provision, at both the technological and organizational levels. Roles indicate which administrations have to be involved in the eGovernment initiatives in further phases. In our example, the ministry of finance certifies data both for residency and for health card provision

Process/ organization	Change of residency	Provide/update driving license	Provide/update health card
Citizen	Cooperates	Cooperates	Cooperates
Old municipality	Cooperates-	–	–
New municipality	Decides	Cooperates	Cooperates
Traffic authority	–	Decides	–
Health authority	_	–	Decides

Fig. 5.18 The process/organization matrix

Type of data/ organization	Type of public administration	Residency	Driving licence	Health card
Municipality	Local	Provides updates	–	–
Traffic authority	Central	–	Certifies/ provides	–
Regional health authority	Local	–	–	Provides
Local health…	Local	Uses	–	Provides
Ministry of interior	Central	Governs	–	–
Ministry of finance	Central	Certifies/ uses	Uses	Certifies/ governs
Ministry of health	Central	Uses	–	Governs

Fig. 5.19 The organization/type of data matrix

and co-governs with the ministry of health the health card provision data flow. Whereas, the ministry of interiors governs the residency data flow. This situation suggests the undertaking of a common initiative for the certification of residency and health card provision, where the overall governance is led by the ministry of finance.

To conclude, note that in the above matrix data are expressed in terms of names of concepts, without any reference to the ER conceptual schema. Another possibility, as we said before, is to describe in the header of the column the ER schema which represents the concept, e.g., the concept residency may be seen as an ER schema defined in terms of a relationship `Residency` that connects two entities `Person` and `Municipality`.

5.2.5 Organizations and Data Flows

Public administrations exchange data which are used to create new data or to update existing ones. Such data can be directly exchanged between administrations or else brought by users from one organization to another, according to the well-known metaphor of the "pony express citizen." Such data flow can be represented by means of the *organization/data flow matrix*.

In Fig. 5.20 we show the current exchange of data in the running example. The citizen communicates with the old municipality her/his intention to change the residence, then communicates the data on the old and new residence with the new municipality, then communicates the data on the new residence with the traffic authority and finally with the health authority. Notice that also in this case data can be described by means of an ER schema.

Data flow organization	Old residency registry	New residency registry	Certificate of residency	Driving licence registry	Driving licence	Health aut. registry	Health card
User	Uses	Provides	Uses	Provides	Uses	Provides	Uses
Old municipality	Provides						
New municipality		Uses	Provides				
Traffic authority				Uses	Provides		
Health authority						Uses	Provides

Fig. 5.20 The organization/data flow matrix in the running example

5.2.6 Types of Data and Databases

Here we have to relate the types of data with the databases where they are represented. It may occur that some data are not currently managed in any database; this is an indication of the need for a new area of development in future projects. Figure 5.21 provides the *type of data/database matrix* that focuses on databases and shows for each type of data in the example:

- the database in which the information is represented and
- the public administration owner of the database.

The absence of a reference to a database in a row means that the data are not currently managed by a database. If only part of the data in a row are managed, it is convenient to split the column into two rows to highlight the two parts.

Database / Type of data	National registry of residents	Local registry of residents	central tax registry	Central registry of the road traffic office	Regional health registry	Local health registry
Residency	Ministry of interior	Municipality				
Driving licence				Traffic authority		
Health card			Ministry of finance		Region health authority	Local health authority

Fig. 5.21 The type of data/database matrix

5.2.7 Other Relationships

Other relationships among issues which are relevant in state reconstruction can be represented with the same matrix structure. We comment here, among others the following:

- The *process/resource matrix* provides a map of the different types of resources, such as human, logistics, financial, and data resources used in the execution of administrative processes.
- The *type of data/technological system matrix* provides a map of ICTs, such as system software, custom software, hardware, networks currently used in processing and exchanging data.

In previous matrices, resources and ICTs may be represented in terms of units of measure such as the number of person/year for the human resources, the number of instructions or number of function points for customized software. This matrix gives an idea of the present allocation of resources among different activities of administration and may be useful in the operational planning phase to plan the allocation of new resources.

5.3 Enriching Matrices with Quantitative Data

Matrices introduced so far prevalently contain qualitative information on the state of social, organizational, and technological systems, e.g., the fact that a specific organization uses a specific type of data. So far, quantitative data appear

- in the service repository, referring to the estimated number of users and the frequency of use of the services and
- in the process/resource matrix, referring to the amount of resources used by processes.

Other quantitative data can be obtained by elaborating qualitative data, e.g., we may count the number of processes in the service/process matrix which have to be executed to produce the service. New quantitative data can be added to qualitative ones in all the matrices, e.g., we may enrich the organization/data flow matrix by adding the size of the data flow, which can be expressed in terms of the average number of records and/or data fields associated with the single data flow issued, together with the frequency of issue.

5.4 Usages of Knowledge Collected in the State Reconstruction Phase

The knowledge collected in the state reconstruction phase has a cost, due to the activities (and resources involved) related to the analysis of available documentation and interviews needed. Thus, it is worthwhile to sustain such costs only if it is possible to use the data collected and to perform useful analysis on it.

Once matrices have been filled, several possible navigations and aggregations can be performed on the whole set, e.g., one may want to rank services according to the frequency of use by the users or else according to the frequency of use by administrative processes, in order to establish criteria in the planning phase for the selection of services. We may also perform a social investigation that ranks the types of users according to the present availability of automated services, where the level of automation is ranked according to the widely accepted scale [42, 108]:

- *Level 1 – information*: only the information needed to activate the procedure for service provision is provided online.
- *Level 2 – one-way service*: users can download the forms needed, but have to send them back using traditional channels.
- *Level 3 – two-way interaction*: services can be activated online, including user authentication, but data are only received and not necessarily processed.
- *Level 4 – transaction*: the site allows users to complete operations online, including any payments.
- *Level 5 – pro-active*: the administration informs proactively users on what they have to do and provides forms filled with available data; these forms are then sent by the citizen/company to the administration.

Other analyses which provide useful indication on the state of the information system we are dealing with are discussed in the following.

First, we consider the instance of the organization/types of data matrix shown in Fig. 5.22.

If we look at the first column, we see that while there is an organization which provides type 1 data, no organization uses it. This can be a symptom of incompleteness in data collection or else a symptom that type 1 data are of no utility in the information system and have to be excluded in further steps of the planning activity. Looking at the second column, we see that type 2 data are used by many organizations, but are never provided. This may be an indication that type 2 data are provided outside the organization or else that the data collection activity was

Types of data/ organization	Type 1	Type 2	Type 3	Type 4	Type 5
Organization 1		Uses	Uses	Uses	Provides
Organization 2		Uses		Uses	Uses
Organization 3			Provides	Provides	Uses
Organization 4		Uses	Provides	Provides Uses	Uses
Organization 5				Provides Uses	Uses
Organization 6	Provides	Uses	Uses		

Fig. 5.22 Examples of analyses enabled by the matrix organization/type of data

Service/ Process M	Serv 1	Serv 2	Serv n
Class	x	x	x
Process 1	x	x	
Process 2		x	x
Process n	x		x

X

Process/ organization	Org 1	Org 2	Org n
Process 1	D	C	C
Process 2	C		D
Process n	C	C	D

=

Service	# interactions
S1	N1
S2	N2
Sk	Nk

Fig. 5.23 Examples of analyses enabled by the matrix organization/types of data

incomplete. Looking at the column associated with type 3 data, we see that there are two organizations with role *provides*. The presence of two organizations responsible for providing type 2 data may lead to an inconsistency, resulting in multiple incoherent copies of the same data.

Consider now a second case, in which we analyze together the process/organization matrix and the service/process matrix (see Fig. 5.23). If for every service we consider all the processes involved and for every process we count the organizations involved (this operation is called the *rows per columns product operation* on matrices), we obtain as a result the table in the right-hand side of Fig. 5.23, where for every service we evaluate the number of passages among organizations involved by the macro-process that produces the service. Such number of passages can be considered a rough measure of the effort (and the cost) required to automatize the service.

5.5 Summary

In this chapter we have examined several representation techniques on the state of social, organizational, and technological systems involved in the eGovernment planning activity. Such techniques refer to languages, models, forms, metadata, and data structures such as matrices. We are not obliged to use all of them; what is important is to know that they exist and they require an effort that has to be sized before starting the state reconstruction phase. The actors involved in the planning activity need sufficient insight on the long-term objectives of planning, thus to choose the techniques in order to optimize the relationship between the utility of the knowledge acquired and the cost of resources needed for acquisition.

Chapter 6
eReadiness Assessment

Extensive literature has already been dedicated to the economic benefits of eGovernment and a wide consensus exists over what the key benefits are. A report commissioned by the Dutch presidency of the European Public Administration Network (EPAN), entitled *Does eGovernment pay off?* [41], identifies seven types of interconnected benefits:

- *Improved quality* of information and information supply.
- *Reduction of process time*.
- *Reduction of administrative burdens*, due to the availability, sharing, and reuse of electronic data, the digitization of key processes, and the elimination of unnecessary steps.
- *Cost savings*: eGovernment enables public sector agencies to increase their service processing and delivery capabilities, while requiring less time and fewer personnel.
- *Increased effectiveness*: a major benefit of eGovernment is the improved service level, more precisely in terms of increased flexibility (constant availability, multichannel delivery, etc.) and transparency of public e-services of new generation.
- *Increased efficiency*: eGovernment contributes to increasing the capability to convert resources and inputs into effects and impacts of public service delivery.
- *Increased customer satisfaction*.

eGovernment should be regarded as an alternative and complementary approach to government administration and service delivery, as well as a means to redefine the way it interacts with citizens and the private sector. In this sense *e* does not only mean electronic but also empowerment (ICTs can support increased interaction between citizens and their governments, for citizens to participate in the decision-making process and to also become more aware of their personal and community development) and economic and social development (the use of ICTs in government and in its interaction with the business community and citizens can create new businesses, attract investments, and generate employment). It should be clear, hence,

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This chapter is authored by Marcella Corsi, Andrea Gumina, Carlo D'Ippoliti, and Jordan C. Wood (Sects. 6.1, 6.3, and 6.4); Giorgio De Michelis, Michele Lembo, and Gianluca Misuraca (Sect. 6.2).

G. Viscusi et al., *Information Systems for eGovernment*,
DOI 10.1007/978-3-642-13571-2_6, © Springer-Verlag Berlin Heidelberg 2010

that eGovernment is something "more" than merely the use of ICT within public administrations. An analysis of the determinants of successful general eGovernment programs shows that the key factors are the countries' political will, the strength of their human capital, their telecommunications infrastructure, and the presence of administrative priorities.

In the following sections we discuss how the eG4M methodology deals with these issues, usually related to the concept of eReadiness which is introduced in Sect. 6.1. In Sect. 6.2 we introduce the social and organizational analysis framework and tools and we show their application to case studies and the running example. In Sect. 6.3 we describe the economic model for eReadiness assessment and we show its application to a case study. Finally, Sect. 6.4 discusses the implications for economic policy and public sector management of the modifications introduced by ICTs at the back-office level.

6.1 What Is eReadiness?

In our definition, *eReadiness* refers to the extent an organizational and social network is ready to accept the ICT-enabled innovation of processes it is involved in and how ready it is to take advantage of digitization. In other words, it determines how existing policies and practices and the institutional framework favor the implementation of a sustainable eGovernment system. In recent years, governments, businesses, and social organizations have considered how to best exploit the potential of information and communication technology for development. eReadiness assessment intends to guide development efforts by providing benchmarks for comparison and gauging progress. A considerable number of eReadiness initiatives have been launched to help developing countries in this field, and several eReadiness assessment tools have been generated and used by different groups, each concentrating on societal and economic aspects of ICT.

The *United Nations Global eGovernment Readiness Report* [60] develops and presents a synthetic "eGovernment Readiness index" that reflects and incorporates countries' official online presence, evaluates their telecommunications infrastructure, and assesses their human development capacity. In other words, the index reflects the "requisite conditions" that constitute an enabling environment for eGovernment.

Many of those studies [51, 72] propose methodologies that aim to investigate how a country is ready to face a more or less pervasive introduction of ICTs and at benchmarking this technological penetration across countries, without specifying any particular features for eReadiness itself or for ICT-driven development policies; through this, it should become easier for policy makers to apply these innovations to their own countries, by simply looking at comparisons and case studies across different areas in the world, eventually enhancing specific issues at the country level.

According to the World Bank [111], most of these approaches use Harvard's methodology [57] as a starting point. In doing so, they mostly look at physical

indexes, leaving apart almost every qualitative issue, such as the social and economic ones, which could represent an "added value" while trying to interpret the role and the effect of integrating technology-driven changes into citizens' and businesses' everyday life. At the same time, these models pay little attention to the role of eGovernment as a means of improving the general level of eReadiness, at least within the public sector; secondarily, to act as a catalyst for further development. As a matter of fact, therefore, it is quite clear how present-day eReadiness models have mostly worked as benchmarking methodologies among different areas and governments around the world, while the most advanced activities have succeeded in putting together some kind of meta-repository, in which many comparable indicators are contained (see, for example, [115]).

In this context, the need to build up a new eReadiness methodology, able to set eGovernment implementation initiatives in a model that embraces wider themes of development, is clear.

In the following we describe how eG4M addresses these issues both at the social – organizational level and at the economic level.

6.2 Social and Organizational Analysis

In order to be integrated into and be useful to the whole planning activity, the eReadiness assessment should

- encompass the relationship between the introduction of ICT-enabled innovations and the expected outcomes such as public value creation, increase efficiency, increase transparency and
- be founded on a micro-level of analysis.

eReadiness indicators derive from a complex map of a community's potential whose main factors are

- physical access to ICT (e.g., of the civil servants);
- appropriateness and affordability of ICT;
- use of ICT in business (i.e., suppliers);
- ICT capacity and training of civil servants;
- legal and regulatory environment for ICT use.

Here we propose an enrichment of the existing models of eReadiness. The proposed model also differs from the analysis carried out in the state reconstruction step (see Sect. 5.1.1), since it refers more closely to the community of users of the priority services selected at the end of the state reconstruction phase and involved in the eGovernment intervention's planning. For this reason, during the eReadiness assessment, besides secondary analysis, we propose methods for primary data collection and analysis, focusing on specific and direct investigations among the users and administrations, both through qualitative (e.g., interviews and participative observations) and quantitative (e.g., surveys) methods.

In order to be integrated into and be useful to the whole planning activity, the eReadiness assessment has to encompass the relationship between the introduction of ICT-enabled innovations and the expected outcomes such as public value creation, increase of efficiency, increase of transparency.

First, we consider the socio-economical composition of the users, starting from an analysis of the information collected in the state reconstruction step (see Chap. 5). In order to characterize the users' socio-economical relevant features, it is important at least to consider the following variables:

1. age, gender, and residency (e.g., urban/rural),
2. level of education and cultural capital,
3. socio-economic position (occupation, work activity/inactivity, income), and
4. family composition and the individual's position within the family (number of dependants, specified as number of children, elderly, not self-sufficient people).

The matrix in Fig. 6.1 shows that most of the people who ask for the change of residency are men and women in the opening and central part of their working and private life (they are between 20- and 35-year-old), who move mostly from rural to urban areas. Most of these users are unskilled workers who move with their young families: couples or couples with children.

A reading of these characters suggests linking the administrative service of change of residency to a social phenomenon, namely urbanization. This leads to paying special attention to the services related to the change of residency, because they could facilitate the integration process of the largest group of users into the new context.

In the running example, special attention should be paid to the users' registration at the new local health authority. Moreover, the provision of new services, related

Users/socio-economic feature (change of residency)	Age/gender	Type of residency	Socio-economic position	Family composition
1. Universe of users	All	All	All	All
2. Most relevant categories of users	·20–35 men and women	·Urban to rural population (internal migration)	·Working active people (working mobility) ·Unskilled workers (quantitative relevance) ·Highly skilled technicians and managers (qualitative relevance)	·Young families with/ without children

Fig. 6.1 An example of users' composition/socio-economic feature: change of residency

to the event "change of residency," should be taken into account. For instance, the organization of employment services and the provision of complementary educational services (full time, school-meal service, transport) play a central role in fostering the integration of unskilled workers' families into the new urban context.

Furthermore, the analysis of users' social composition reveals that there is also a smaller group of users, composed of highly skilled technicians and managers who transfer from city to city. This category could be of interest to the public decision makers and planners, since it may express different needs with regard to the services related to the change of residence. For instance, these urban users may only ask for their speeding-up and simplification, in order to have their time saved.

The matrix in Fig. 6.2 shows that the most important categories of users who request medical examination are elderly people (more than 60 years old), children and young people (under 14 years old), and women in the central part of their reproductive age (from 20 to 40 years old). Moreover, other categories of users are of special concern: low income users, since they mostly ask for public health-care services; rural and suburban population, who have a limited access to the health-care structures; and illiterate users, because they have difficulties in finding and managing information about the most adequate health structure for their needs. Thus, the analysis of the social composition of people who ask for medical examinations helps to more accurately define this area of intervention and suggests paying special attention to access issues (for urban and suburban users) and to information and communication issues (for illiterate users, for elderly users, and for women).

After the analysis of users' composition, the users' available resources and capabilities are taken into account, in order to evaluate their level of readiness for the innovation processes fostered by the eGovernment intervention. Thus, the following dimensions are explored: (i) social and cultural capital, (ii) level of access to ICT, (iii) orientations toward innovation and change. The indicators for the *social and cultural capital* concern the educational level and the urban/rural context. The

Users/socio-economic feature (medical exam)	Age/gender	Type of residency	Socio-economic position	Cultural capital
1. Universe of users	All	All	All	All
2. Most relevant categories of users	·<14 men and women ·> 60 men and women ·Women 20–40	·Urban population (quantitative relevance) ·Rural and suburban population (qualitative relevance)	·Low income segments (qualitative relevance)	· Illiterate people

Fig. 6.2 An example of users' composition/socio-economic feature: request of medical examination

indicators for infrastructural access to ICT and economic affordability are similar to the ones suggested in the state reconstruction step (see Chap. 5), but they refer to a lower scale and refer directly to users involved in the eGovernment intervention. The indicators for the ICT knowledge competence and usage are

- percentage of users with a basic ICT literacy level;
- level of competence in ICT (measured as percentage of users who can perform specific operations with a personal computer and ICT devices, such as editing a document, accessing and browsing the web);
- frequency and main purposes of Internet usage (e.g., professional, cultural and educational, leisure, information, social and communication);
- main location of Internet usage (at work, at home, at other access points).

The last dimension, namely *orientation toward innovation and change*, encompasses a wide range of attitudes, dispositions, and cultural orientations that can influence the global disposition of users toward the changes promoted by the eGovernment intervention. The following aspects should be explored:

- disposition toward technologies and especially the ICTs (e.g., perception of and trust in the technologies through which the PA's services are provided at present and technologies that are meant to support the provision of service after the eGovernment intervention);
- disposition toward the PA (trust in the information provided by the PA, general evaluation and level of satisfaction toward the PA);
- perception and attitude toward the PA's services (e.g., demand for changes in the service's contents and ways of provision).

As we said before, in this phase the above indicators should be analyzed and evaluated at the microlevel with reference to the users of services involved in the eGovernment intervention. In the following we detail the main tool adopted in the eG4M methodology for the eReadiness assessment.

6.2.1 The SECI Tool

The eReadiness assessment step in the eG4M methodology besides economic issues also considers social and cultural factors as standpoints to start from in order to understand the reality targeted for a potential intervention. In this vision, there is not a separated, self-sufficient section of the methodology dealing with social and cultural aspects per se, but these elements are taken into account whenever a new technological or organizational plan of action is considered. These aspects are a constant presence in the architectural background of the planning of projects and in the evaluation of their effectiveness. For these issues we now discuss the social and economic context indicators (SECI) tool adopted in the eReadiness assessment step. The tool aims to keep together the informative richness of the social world where

the eGovernment initiatives take place and the need for this information to be useful in a pragmatic, intervention-oriented sense.

The SECI tool is a heuristic device thought and built to be as flexible as possible, that is to say to preserve the capacity to read a context making visible under any given targeted context the connections and the contradictions among its various constituencies (social/occupational structure, system/s of values, general and professional cultures, organizational routines, potential and real access to services). It is composed of a set of indicators grouped into categories intended to be used in a modular way, with no need for a chronological order for the analysis. The indicators have a hybrid, social, and economic status; as an example we cite the activity rate among age and classes, the poverty rate in urban and rural contexts and among genders, and the unemployment rate. SECI is divided into two levels of analysis, namely

- Macro-scenery recognition
- Micro-field analysis

Furthermore, SECI is composed of five areas of investigation:

- Organizational units
- Socio-economic context
- ICT access and diffusion
- Analysis of the users
- Analysis of the services

The *organizational units* area concerns the public administration staff (executives, civil servants) chosen for the eGovernment intervention; the related questionnaire for organizational units is split into four subareas:

1. Informational level
2. Internal knowledge
3. Organizational structure and culture
4. e-Participation

The other areas are grouped into *socio-demographic questionnaire*, concerning samples of the population of the area selected for the intervention.

Within the context of eG4M, the SECI tool with its potential of evaluation of context resources and capabilities has been conceived to be used in both the state reconstruction and eReadiness assessment step.

During the state reconstruction step (see Chap. 5) the submission of socio-demographic questionnaire and secondary analysis of existing data accomplish the following tasks:

- representing the *socio-demographic context* (i.e., the ICT literacy rate of the total population and of the youth);
- relieving the *infrastructural access* (i.e., the percentage of population covered by mobile cellular telephony/with Internet at home or the percentage of schools equipped with PCs);

- detecting the *real access* (i.e., the cost of Internet access/mobile phone services, the percentage of people who can have access to the Internet at school, work, or other access points).

On the basis of the above investigations, it is possible to think of a structure for the future interventions which is sensitive to the strengths and weaknesses of the contexts and spreads itself on the most appropriate time horizons according to the gained knowledge, i.e., promoting articulated interventions, providing high interaction level services, on a well-established and well-known technology, while keeping it soft, step by step, on a less spread and accepted technology, so that users are not frightened but in the meantime they start to realize the potential of the mean they are offered.

Various methods are used among different parts of the SECI tool (statistics, ethnography, Likert scales) and the different levels of analysis it covers (a micro-level for PA organizational units; a macro-level for urban and rural contexts in the selected area). Thus the complexity of the real world is preserved and a synthesis is also provided through clusterizations driven by the key concepts exposed above. We point out that the proposed approach can ensure a picture of the local issues ready to be put in the context of a global scenery from which flexible solutions can be taken and modeled for the targeted areas.

Finally, the dynamic and modular nature of the SECI tool preserves it from the risks of rigidity, as it allows the researcher to learn from the context instead of trying to force it into abstract schemas: an everlasting process of gaining, selection, and use of data from the context, in order to really (positively) change the context itself by giving the people what they need and pushing them to actively engage in the processes of innovations rather than being mere unaffected spectators.

SECI facet/evaluation issue	Organizational structure	Human resources	Internal and external communication	ICT-related learning
Current situation	Hierarchical and centralized	Inequality of ICT know-how distribution	– Intradivision communication weak – Interdivision communication absent	Few courses for few people
Lack	Decision-making Processes too slow and without " in progress" controls	Same ICT expert staff overlooking large and diverse processes	An administrative task is at high risk of being slowed down	Civil servants have to ask "experts" for basic tasks
Best practice	– Diffusion of responsability – De-centralizations "in progress" monitoring	Each division must have an ICT expert staff specialized in the softwares used in that division	Intranet for every division: a common architecture for external communications	Continuous learning: courses must be more frequent and know how must be shared

Fig. 6.3 SECI facets and best practices

During the eG4M experimentations of the SECI tool in Tunisia and Morocco various indications have emerged concerning the social SECI facets.

Figure 6.3 shows the current lacks for the different SECI facets and a set of best practices to solve them based on the analysis carried out during the eG4M experimentations in Morocco and Tunisia.

In the following we describe some of the issues from the experimentation carried out at the Tangier municipality from June 2008 to April 2009.

6.2.2 SECI Field Analysis at the Tangier Municipality

In the case of the municipality of Tangier the goal of the application of the eG4M methodology is mainly to evaluate the eReadiness not only of the public organization under review (including civil servants) but also of the social context where eGovernment services have to be provided.

Due to these issues, only the assessment step has been developed. The eReadiness evaluation was designed in order to fulfill two macro-objectives of the municipality of Tangier, namely (i) to complete the analysis of the internal and external communication systems (in terms of information flows) and (ii) to provide requirements and guidelines for the development of an action plan for a new technological architecture for the internal and external communication (intranet, cooperative architecture, e-mail, etc.) including the development of an e-Participation platform to allow interaction with other administrations and citizens.

In this case eG4M has been applied under an action research perspective [18], where a customized eReadiness questionnaire, based on the SECI main questionnaires, has been produced in order to adapt the methodology tools for the requirements of the context. The questionnaire has been filled in by a sample of 20 public managers encompassing 13 chiefs of department of the municipality of Tangier. The chiefs of department were also involved in focus groups. The questionnaire investigated the current technological infrastructure degree of maturity, the skills of the public managers and of their employees, the investments on IT projects and on formal training for public managers and employees in the last 5 years, as well as the degree of access for citizens to the public administration services.

The analysis of questionnaires shows that investments aiming at improving computer literacy among the public managers have a lower priority besides the needs for effective tools and methodologies for enhancing the overall system of public governance. In fact, the lack of communication between different departments prevents an effective exploitation of current technological initiatives, leading to the risk of vertical projects not cooperating at the horizontal level (namely at the cross-functional level). Due to these issues, a weakly supported governance system results in a scarcely effective ICT integration which in turn can also create difficulties in the financial management of eGovernment initiatives for the municipality.

Furthermore, as stated by one of the managers attending the focus groups, the usefulness of the methodology was to create a cross-functional approach discussing current issues in the municipality of Tangier, such as common targets for ICT

investments and common formal training for managers and employees. In this case, the assessment step had a positive mediation effect among the personnel of the municipality of Tangier involved in the questionnaires related to activities and in focus groups. The outcome of the assessment points out the usefulness of the methodology as an instrument suitable to enable the mediation effect of organizational issues, such as learning, cross-functional communication, and process orientation on ICT investment effectiveness.

6.2.3 Running Example

In the running example (considering for the sake of brevity only the users who ask for a change of residency) users can be split into two categories, according to their urban/rural context of origin. Figure 6.4 shows some measures for the indicators of ICT access and use and for the attitude toward innovation.

Among all the users, mobile phones are the more diffused (43%) and used (for instance, 55% of users can send an sms) than Internet (18% of users have access to Internet and 14% can send an e-mail). This feature becomes particularly true when considering domestic access to Internet (just 2% of users, 0.8% of users from rural contexts); other kinds of Internet access (at work, school, or public and commercial points of access) are not widespread. The analysis shows that most of the users maintain an interest and a positive attitude toward ICT applications and channels (here mobile phone and Internet). Thus, users have a good attitude toward innovation and reasonable knowledge capabilities in ICT issues, but they have no easy access to Internet. On the other hand, they have fairly good access to mobile phones.

Indicator	Rural → urban users	Urban → urban users	All users
ICT access and usage			
% of users with mobile phone	30.0	62.5	43.0
% of users with Internet connection at home	0.8	3.8	2.0
% of users who have access to Internet outside home	13.0	25.5	18.0
% users with a basic ICT literacy level	16.7	37.5	25.0
% users who can send a mail with an attachment	10.0	20.0	14.0
% users who can send a message of text by mobile phone	40.0	77.5	55.0
Orientations toward innovation and change			
% users who declare a positive or high positive disposition toward technology: Internet	50.0	55.0	52.0
% users who declare a positive or high positive disposition toward technology: mobile phone	70.0	80.0	74.0
% users who declare to be high sensitive to ICT-related security and privacy issues	13.3	42.5	24.8
Total	60%	40%	100%

Fig. 6.4 eReadiness indicators: change of residency

This analysis may orient the reorganization of the services related to the change of residence toward multichannel solutions. It may also suggest supporting the re-engineering of administrative services with interventions among the main categories of users, in order to enhance their access capabilities. In the running example, public access points could provide access to users with a good attitude toward Internet, for those who cannot afford domestic access. It is important to note that these surveys should be conducted annually to monitor changes in the context of intervention.

6.3 The Microeconomic eReadiness Model

The principal idea of the approach taken here is that eGovernment acts on the economic environment as a catalyst of innovation: through it, the public sector is not only able to supply more effective services but also able to implement a better governance of itself and of external procedures, improve the quality and the effectiveness of bureaucracy, and, finally, offer its constituencies more sound opportunities. The methodology presented here intends to support public administrations (PAs) in developing a full comprehension of how and to what extent, through adoption and widespread promotion of ICTs, they should act as a development multiplier. Naturally, how far and how deep this process can go strictly depends on the *take-up* conditions, namely the influence of the general environment affecting eGovernment outcomes, possibly leading to a general reinforcement (or a worsening) of the final effects.

Concretely, the proposed strategic model, called MeRM (*micro-eReadiness model*), aims to pursue two main objectives:

- to outline and check ICT-driven development policies and projects in internal and external PA environment, on the basis of a labor productivity approach;
- to provide tools for monitoring and fine-tuning these policies/projects.

The purposes mentioned above cast light on the central meaning of the model: MeRM represents an approach for public administrations to fully understand the predicted/real outcomes/output of its ICT-driven policies, to design specific direct/indirect policies and solutions, to control their effective implementation while introducing fine-tuning activities. In this light, MeRM could not only be used as a tool to interpret ex post outcomes, but even for an ex ante and an ongoing evaluation phase. In other words, the model is a theoretical cornerstone that offers public sector agencies a valid mean to interpret the role, the strategies, and the outcome (both at a perspective and at a real level) of ICT-driven policies. Hence, from this point of view, it can serve both at an initial stage, to model and conceptualize eGovernment initiatives, and afterward, to advise policy and decision makers with ICT-driven policy and program suggestions (even at a fine-tuning level), that is to say, to act not only as a descriptive but also as a prescriptive tool in order to raise public administrations' awareness in choosing all the achievable/potential benefits of each ICT-driven policy

implementation and thus their consciousness of what they are actually "e-Ready" for.

The basic tenet of the model is that eGovernment programs result in improved labor productivity in the public sector and, as a consequence, contribute to a number of intermediate results (better services, cost savings, etc.), and to the growth of GDP. This is a complete about-face with respect to the orthodoxy of how economic theory considers the public sector contribution to overall economic development, i.e., mostly focusing on reducing its burden to unleash market forces. The model takes into account the objective of administrative burden reduction, but it goes one step further to estimate how the public sector, through ICT-driven innovations, can pro-actively increase its ability to generate a positive non-neutral impacts on general growth. The main assumption is simply that the goal of user-centered public administrations providing better services is achieved first of all through an increase in productivity enabled by reorganization, training, and ICTs, that is to say by eGovernment. The model takes into account the general contribution in monetary terms of the public sector to GDP. Actually, as shown in Fig. 6.5, by using the concept of public sector labor productivity, the contribution of the public sector to GDP can be estimated more accurately as being equal to the labor productivity of the public sector multiplied by the total number of public sector employees.

The productivity of the public sector must be estimated as a ratio between public sector output and the number of public sector employees involved in eGovernment projects (as eGovernment represents the focus of investigation, with a ceteris paribus assumption and only considering productivity increased due to the introduction of wider forms of eGovernment).

As already stated, the economic model starts by considering the value-drivers presented in a measurement framework model and the presence of *take-up* effects tied to the context, connecting both value drivers and take-up to a productivity estimation model. This model is derived by adjusting the productivity function developed by Sylos-Labini [207] for the private sector to the public sector. The proposed productivity function for the public sector is realized through the joint contribution of five different effects:

The Market Enlargement or "Smith's Effect": In the private context, Smith's effect takes into account how market/specific sector growth influences labor productivity. The resulting ratio is positive, i.e., the growth in market dimension increases productivity in two ways: (a) enterprises try to increase productivity to gain market share and (b) once they gain a large market share, productivity must improve in order to match the increased output volume. The adaptation of such an approach to the public sector presents several difficulties. The first problem is that public administrations do not have a market where they sell their products and services.

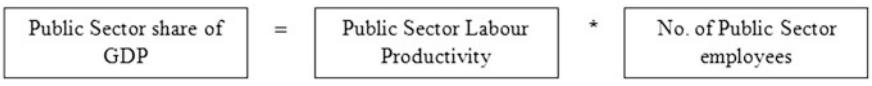


Fig. 6.5 The contribution of public sector to GDP

The second one is that the kinds of products and services they provide must be measured in monetary terms. A third consideration is that it is improper to talk about a "demand" for public sector: instead, the reference should be to the supply of public sector, namely public services, assuming that every service supplied is in demand. Therefore "Smith's effect" applied here corresponds to what happens in the private sector when market size increases, with the difference that in the public sector there is no real market. Therefore, estimation of this effect for the public sector will be made in monetary terms starting from the supply side and not from the demand side. In other words, the basic hypothesis is that the introduction of eGovernment increases the supply capacity of the public sector, which is considered equal to the market enlargement effect, based on the strong assumption that all services produced are also requested by users.

The Substitution or "Ricardo's Effect": In the private context, Ricardo's effect shows how an increase in the spread between wages and the price of technology (machines) boosts businesses to improve their productivity, often through a substitution process between technology and employees. This effect is due, alternatively or complementarily, to an increase in wages or a decrease in the price of technology, generally because of innovation. In the formalized model, the equation expressing the effects points out the existence of a time lag between when the event is recorded (the number of employees replaced by technology) and when its effect becomes tangible, since investment in machines to replace employees does not lead to an immediate increase in productivity. The assumption is that when the cost of innovation drops with respect to manpower, it may be profitable to substitute the latter.

Technically, in estimation model terms, the adaptation of this effect to the public sector is less problematic than Smith's effect. On the other hand, however, it is a bit more problematic politically, given the peculiarity of the public sector, where employees cannot be dismissed easily. Therefore, adaptation to the public sector implies a reformulation of the above assumption as follows: when the cost of innovation drops compared to that of manpower, it may be efficient to partially replace the latter and partially complement it with a wide implementation of eGovernment services.

The Back-Office Reorganization Effect: For the private sector, the model shows that firms will undertake a reorganization when the cost of making a product or delivering a service is disproportionately higher than its perceived value. If, for whatever reason, the product or the service cannot be discontinued, firms will be forced to reorganize production or service delivery thus influencing general productivity. Apart from the possible lack of an adequate incentive structure, from the organizational rationality point of view, this effect should be easily observed in the public sector too. From the point of view of the technical estimation of this effect, for the public sector, an approximate calculation will be required for the computation of the costs of reorganization.

The Investments in Innovation or "Schumpeter's Effect": The estimation of this effect does not present particular problems for the adaptation of the model within the context of public sector. The characteristic element of this component not only is the consideration of ICT investments, but also includes other related aspects:

consulting, training, hardware, software. The impact of such innovations (as new innovations replace older ones) generates increases in productivity, after a time lag. *The Take-Up Effect*: The take-up can be considered as an amplifier and an enabling condition for eGovernment. In particular, some aspects have to be considered:

- *The technological scenario*: Where there is an upward trend in delivery of ICT-based products and services, users should demand more ICT-based public services. This does impact not only the delivery channel but also the time of delivery;
- *The existence of private competitor services*: An increase in the delivery of some kinds of public services through e-GSP (eGovernment service providers) could induce an increase in the direct or indirect efforts of the public sector to provide better and quicker services;
- *The general education level*: With reference both to public sector staff and to the entire population, some links should appear between the general level of education and the will to provide more knowledge-based services via eGovernment programmes.

Thus, the more receptive the social environment is (because of a wide ICT diffusion, for instance, or because of a broad, deep-rooted use of e-services) the more the public sector productivity will increase. In particular, this happens for two reasons:

- the push toward innovation in the public sector exerted by the community (the more innovative processes are used in everyday life, the more they will be in demand);
- the high level of ICT literacy of civil servants, as well as of users, which boosts the use of advanced services.

Starting from these premises, the estimation model aims at showing the different ways in which eGovernment results in greater efficiency (see Fig. 6.6 for a representation of the model describing the economic impact of eGovernment). Particular emphasis is placed on productivity growth in the public sector, presumably one of the main reasons why single eGovernment projects are undertaken, which is tantamount to saying that public administrations grow more efficiently and public employees provide more goods and services. Given the large share of the public sector in European countries' gross domestic product (GDP), efficiency in the PAs is an objective per se and a major driver of international competitiveness and economic welfare (the first channel). Two other effects depart from the growth of PA's productivity. On the one hand, publicly provided goods and services contribute to welfare and are part of a country's GDP, hence their growth should be entered into national accounts (the second channel). Moreover, a more efficient public administration contributes directly to the efficiency of the economy as a whole and to the productivity of the private sector in particular and – at the macroeconomic level – stimulates innovation and the growth of the most competitive and innovative industries (the first, "indirect," part of the third channel). A more direct part of the third channel through which eGovernment contributes to GDP growth is its being part of aggregate demand, a particularly important part due to its technologically inno-

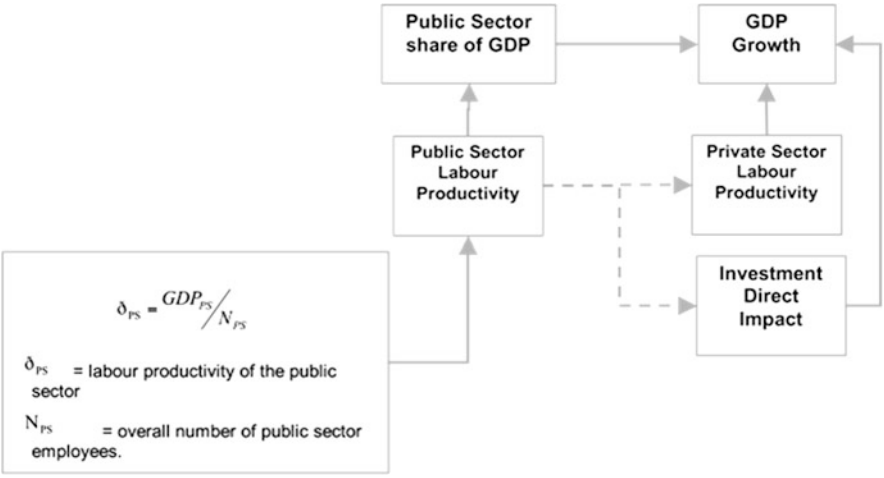


Fig. 6.6 The economic impact of eGovernment

vative content. In the model, this channel is labeled as "Investment Direct Impact," implying, at the macroeconomic level, that it could further extend to the multiplier and accelerator phenomena.

6.3.1 The Model and Reality

The model presented takes both microeconomic and macroeconomic phenomena jointly: analysis of the public sector productivity and most of the effects that eGovernment has on it (Smith, Ricardo, Back-Office, Schumpeter) are defined at the microeconomic level, in relation to an individual organizational unit within a PA. Other effects of the adoption of ICT in the supply of public services on the gross domestic product – for example, the indirect stimulus for productivity growth in the private sector and the direct impact of investments on the GDP – are, on the other hand, defined at the aggregate level, as are most of the possible effectiveness measures (based, for example, on social – economic development indicators including social inclusion and health).

From the empirical point of view this distinction takes on a certain significance since, although the aggregate measures derive at the level of construction from the summation notation of microeconomic variables, the macro-magnitudes thus obtained can rightly be said to differ quantitatively from the weighted mean of the observations obtainable ex ante at the disaggregated (micro) level; in fact, all the economic activities are (to one extent or another) in correlation among themselves and, indeed, a change within one organizational unit cannot occur without producing effects within another, associated unit (for example, if a public administration shows increased levels of efficiency the benefits deriving from it are also very likely to be absorbed in one way or another by the administrations interacting with it).

The operations to aggregate diverse magnitudes – in our case a miscellany of goods and services – imply the need to adopt a common unit of measurement: for the private sector the national accounting standards take reference from the market prices of goods and services, aggregating their value. However, the public sector has no market to sell its products and services, which makes measurement problematic, but above all public goods and services have no market value, and here the conceptual implications are indeed considerable.

With regard to the former type of problem, it is to be noted that many public administrations do not engage in the supply of services to the final users, interacting solely with other administrations (government-to-government): thus their place in the capitalist economy is only on the side of input acquisition; many administrations charge no price for the services supplied or charge only minimal sums in order to ration demand (thereby selecting from a great number of consumers those who really need the services in question) rather than covering, even if only partially, the costs borne.

Further problems of measurement arise in relation to the particular characteristics of certain public goods and services. For example, a number of public administrations have the precise of not supplying a certain service (for example, the PAs operating at the level of prevention of certain behaviors and actions on the part of citizens, for instance, or natural events, or even external threats). Furthermore, there is the issue of "public goods," as they are called – goods distinguished by collective and/or passive consumption (infrastructures, for example), consumption of which cannot be excluded for any individual user (as in the case of street lights or a dam), or in the case of inefficient use (of bridges or roads, for example): such goods are therefore generally provided without any charge.

No less significant is the lack of a clear and commonly accepted definition of the public sector output and of a value attributable to it. It is, indeed, precisely the many conceptual difficulties and problems of definition that make measurement such a complex task. The recent Atkinson report [8] has impressed on national statistical institutes worldwide the need to address the definition of common public sector output measurement criteria with all due commitment. The aim of national accounting systems is to estimate this magnitude through direct output measures, or in other words direct measurements of variations in the volume of output, without attributing monetary value. With regard to progress toward this goal, the Atkinson report emphasizes the pioneering position of the United Kingdom, with the estimation of about two-thirds of the total economic activities in the public sector applying direct output measures, while many OECD countries are lagging in the implementation of this methodology with all the consequent problems when it comes to comparing results.

In fact, the solution most often adopted involves classifying as *market activities*, aggregated on the basis of the payment made for the individual transactions, the supply of goods and services to final users when acquired at a price amounting to at least 50% of the unit production cost. Conversely, considered *non-market*, and thus valued at the cost of production, are all the remaining activities, and in particular those that do not imply individual transactions, or imply transactions only

among PAs, or for which the charge effectively paid is less than 50% of the average cost. Such practice proves in complete contrast with the main aim of the empirical analysis meant to be performed, in that imposing a condition of equality between costs borne and the value of output produced is tantamount to implicitly assuming constant average productivity (for example, a pay raise in certain PAs of the public sector is evaluated *sic et simpliciter* as a proportional increase in the respective production).

Finally, is the issue of unavailability of information or data. One way to help solve this problem is for PAs to introduce an analytical management accounting system (analytical balance sheet). In this way each internal unit/department within a ministry or PA manages to take out from their balance sheet information of paramount importance for the evaluation and measurement of performance related to eGovernment initiatives.

6.3.2 Case Study

The MeRM model has been put to use in order to investigate eGovernment initiatives by considering five case studies of large PAs in Morocco and Tunisia. The PAs were sent a questionnaire,[1] and they were helped throughout the process of filling in the questionnaire. Due to the confidentiality of some data, and in order to best investigate the explaining and predictive power of the model, the PAs' answers to the questionnaire were investigated in an aggregate form, i.e., with no specific reference to single PAs (though reference to single projects is helpful in a number of discussions). As previously described, average labor productivity (ALP) growth in the MeRM depends on a number of drivers.

From the point of view of ICT-enabled innovation, the most straightforwardly relevant driver of ALP growth is investments and the purchase of instrumental goods and services, what we previously referred to as the investment in innovation effect or Schumpeter's effect. While the traditional economic literature focuses on the substitution between capital and labor, the MeRM model highlights the complementarity between the two. Thus, new capital may increase workers' productivity because capital allows for a thorough reorganization of production (efficiency investments) or simply because new machinery is more efficient (replacement investments).

With specific reference to the investment in ICT, the questionnaire sent to the PAs distinguished four items of the Schumpeter's effect: investment in hardware, software, consultancy, and staff training. The PAs were asked to report the level and timing of their investments in these fields during the last 4 years, for each project. For hardware and software, they were also asked to distinguish to which degree the mentioned investment constituted a replacement of existing equipment. Finally, administrations were asked what further investment, complementary to the

[1] The questionnaire is available online at the companion web site of this book.

expenditure on ICT, they had undertaken in the same period for each eGovernment project.

In the MeRM model, innovation and investments are partly endogenous, and they are intertwined with the process of reorganization of PAs and of the public sector. This is analyzed by the parts of the model referring to the substitution effect and by the back-office reorganization effect. The model focuses on the substitutions and integration of capital and labor, because the latter is the major source of costs and the factor of production for most PAs. On the one hand, in order to analyze the determinants and the economic returns to investments and reorganization, investments and the price of ICT with labor costs are compared.

On the other hand, the impact of reorganization is considered, in both quantitative and qualitative terms (i.e., staff costs and staff composition). In order to avoid the narrow view that labor-saving technologies necessarily produce staff redundancy, PAs were asked to quantify the amount of labor that, as a consequence of ICT-driven reorganization, has been reallocated to other tasks or other PAs and the number of hired staff to meet the demand for new ICT-based skills. Besides the possible reduction of personnel and the re-qualification of employees, the model also considers the impact of reorganization for final users, i.e., citizens, firms, and other PAs. This impact is measured in terms of average waiting time and gains in the average delivery time.

Finally, the study takes into account static and dynamic economies of scale, or Smith's effect, by recognizing that the enlargement of the scale of activities of a PA generally allows for a more efficient use of its factors of production, and at times also makes the provision of some services possible, that would not be provided if the scale of activities was too small. While it is recognized that the increased efficiency leads to enlarged output only if there is also a corresponding demand, the model assumes that ICT-enabled innovations contribute to enlarging the demand of the services provided by the public administration involved.

The effect of eGovernment projects on the PAs' effectiveness and efficiency can produce four main impacts: it can save delivery time and consequently it can free the PA's resources for other activities and tasks, it can allow for a better management of financial flows or for the emergence of new financial sources, and thus it can improve the PA's capacity to acquire resources and to use them for further investments.

The first analysis that was carried on the questionnaires returned from the five PAs concerns the degree to which they were able and willing to provide the relevant information. All PAs were unable or unwilling to fill in some parts of the questionnaires. There are a number of reasons that concur to this situation; however, in general it appears to denote a potential lack of in-depth budgetary control of PAs or a lack of PAs' accountability toward society and their external environment. The PAs that were contacted voluntarily collaborated with the project, and thus there is a presumption that they were interested in disseminating relevant information and that they may constitute best practices of ICT-enabled innovation and of reorganization management. Thus, the partial filling in of the questionnaires provides a signal that

should be carefully considered by policy makers. Indeed, if it is excluded that PAs were unwilling to provide the data or that managerial shortcomings prevented their collection, still, a number of possible causes of the inability of PAs to gather all the necessary data emerge.

On the one hand, some of the projects considered were still ongoing at the time of filling in the questionnaire, and therefore part of the necessary information was not yet available. On the other hand, there is an objective difficulty in measuring output and productivity for several public administrations. First, the role of the public sector and of public policy is multidimensional, in the sense that it pursues a number of objectives simultaneously, and not all can always be considered. Second, it is often impossible to compare different public goods and services or different ways to provide them, as it may be infeasible to aggregate them in order to compute an overall measure of output.

Indeed, comparison and aggregation (either by summing or averaging) imply a common unit of measure for the different services. For the private sector, economic activities are aggregated on a market-value basis, that is, their quantity is multiplied by their *price* (say, average price during the year). Within the public sector these two operations may in many cases be impossible: as previously mentioned, many PAs do not serve final users (government-to-government activities), some do not charge a price for their supply, and others only receive a minimum compensation (e.g., a tax) which most of the time is a means for rationing demand (with the aim of selecting those who most need the service from potentially infinite consumers) rather than covering (even partially) costs. In a word, a major part of the public sector does not face a market.

Again, other problems arise due to the fact that some public services are actually designed without the objective of providing something specific (i.e., PAs operating toward prevention), some do not involve transactions (all so-called public goods, such as infrastructures, whose use is collective and/or their use from single consumers cannot be prevented). All these problems can be summed up by saying that there is often no clear definition of public service output and that this output is often lacking a univocally determined value (see also Chap. 1 for a discussion of public value). Finally, any correct measure of output volume cannot be lacking in adjustments for quality change. This problem has been neglected by the present analysis, but it certainly requires further investigation.

For an up-to-date review of the methodology for national accounting in the OECD countries, whose practice in this field appears to be the most advanced, we refer the reader to the final report of the review of the measurement of government output in the aforementioned Atkinson report [8].

In order to partially overcome these impediments, some of the questions were posed in qualitative terms or some answers were provided in qualitative terms even though the question required a quantitative measure. The answers provided by the five PAs in Morocco and Tunisia are summarized in the table shown in Fig. 6.7, with blanks denoting no answers, Y quantitative answers, and Q qualitative answers (when the survey encompasses several projects, a number is inserted together with the type of answer, thus pointing out the answers provided on the overall total).

	MENA				
Country	MR	TN	TN	TN	TN
PA	Social security agency (6 projects)	Ministry of the interior (5 projects)	Ministry of state domains	Ministry of the agriculture	Ministry of the environment
Smith effect					
Financial resources	6 Q	5 Q			
Saving on delivery time	6 Q	5 Q			
Cost saving	6 Q	5 Q			
Dynamic economies of scale					
Ricardo effect					
Staff composition			Y	Y	Y
Cost of staff				Y	Y
Cost of investment in ICT	6 Y	5Y	Y	Y	Y
Saving on cost of staff		5 Q			
Back-office effect					
Reallocation of human resources	6 Y	5Y			
Time efficiency	6 Q	5 Q			
Schumpeter effect					
Cost of hardware		3Y	Y	Y	Y
Cost of software		3Y	Y	Y	Y
Cost of consultancy		3Y	Y	Y	Y
Cost of training		3Y	Y	Y	Y

Fig. 6.7 Information provided for each case study: Middle East and North African (MENA) countries

The table shows that the PAs in Morocco and Tunisia clearly face some difficulties in quantifying the impact of eGovernment projects, in terms of efficiency and effectiveness. Indeed, the questionnaire section on the Smith's effect was not filled in by three PAs, whereas two PAs only provided qualitative information on all their projects. This pattern of limited information applies to the measurement of efficiency gains conveyed both by the employment of new technologies or by economies of scale (Smith's effect) and from PAs' reorganization (back-office effect).

Measures related to the use of labor input are more frequently provided by the Moroccan and Tunisian PAs, with the number and qualification of employees more easily known (or disclosed) than their cost. Finally, Tunisian PAs were able to provide almost all the necessary information concerning the cost and timing of investments in ICTs, whereas surprisingly the Moroccan case study was not.

Tunisia	
Service 1	128,550
Service 2	18,000
Service 3	187,500
Service 4	42,375
Service 5	1,778,400
Morocco	
Service 1	417,717
Service 2	278,478
Service 3	417,717
Service 4	626,575
Service 5	501,260
Service 6	313,288

Fig. 6.8 Value of eGovernment projects (US dollars)

6.3.3 The Investment in Innovation Effect

As shown in the table of Fig. 6.8, the information gathered within the present project concerns moderately different eGovernment programs, in terms of expenditure. In Morocco, the Régime Collectif d'Allocation de Retraite (RCAR, Collective Regime of Old-Age Pensions), the national institute of social security, provided information on six projects that range from an investment of $278,000 to $627,000. The Tunisian PAs contributed to this research by providing information on very small programs (with an expenditure of $18,000) and a large program (slightly below $1.8 million).

Total expenditure for the single projects exhibits a high variance both at the single project and at the PA levels. However, each program considered constitutes only a small fraction of the PAs' total expenditure for eGovernment. Thus, the analysis at the project level appears to isolate the PAs' reorganization specifically related to the adoption of the single ICT-enabled project, rather than being substantially affected by overall reorganization at the PA level (as it would be the case if we had considered very large projects, involving the whole or a large part of the PA).

The table in Fig. 6.9 displays the composition and timing of PAs' expenditure for eGovernment projects, for the PAs for which information was available. As summarized in Fig. 6.10, costs of hardware tend to absorb almost one-half of the expenditure for ICT. The investment in software follows, with a share close to one-third of the expenditure, while roughly 15% of the budget is allocated to costs for consultancy.

However, this overall pattern may be a consequence of the early stage of development of the projects considered. Indeed, the costs for hardware tend to be very large at the beginning of eGovernment programs, and they even increase after the initial launch, up to almost 80% of all costs for ICTs, on average.

However, they then tend to rapidly reduce (hypothetically to a level of only investments for replacement), as do costs for software. Thus, a larger share of the expenditure on ICT is allocated to consultancy and staff training once the equipment

	Year 1	Year 2	Year 3	Year 4	Total
Ministry of state domains					
Total					
Hardware	134,160	146,055	18,698		
Software					
Consultancy					
Training	10	8	7	3000	
Ministry of agriculture					
Total					
Hardware	124	98	64	120	
Software	394	161	101	86	
Consultancy	11	11	14	34	
Training					
Ministry of environment					
Total					
Hardware	244	172	190	126	
Software	169	0	5	19	
Consultancy					
Training	4	0	4	4	

Fig. 6.9 PAs' expenditure for eGovernment, last 4 years (thousands of US dollars)

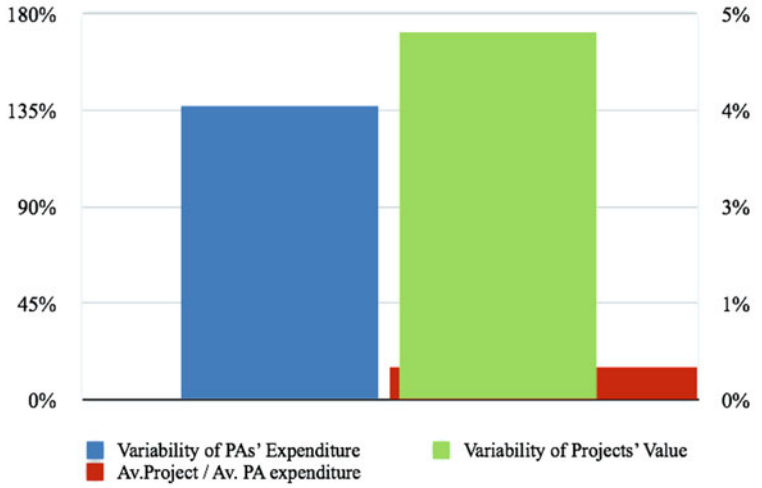


Fig. 6.10 eGovernment initiatives: coefficient of variation for projects ($n = 11$) and PAs ($n = 3$)

has been acquired, starting from the third year on average for consultancy and the fourth year for training. It should nonetheless be noted that the overall expenditure itself tends to be significantly lower at the later stages of eGovernment programs and consequentially expenditure for training and consultancy never reaches the values of the other two forms of expenditure (see Fig. 6.9).

6.3.4 The Substitution/Integration and Back-Office Reorganization Effects

As mentioned previously, the questionnaire sections on the impact of PAs' reorganization and on labor costs provide less information than the section on costs for ICT. Specifically, the scant evidence collected, on labor costs and the composition of personnel qualifications, prevents the analysis of these aspects in detail. Again, these are the reasons behind the lack of control over the information on the side of

		Year 1	Year 2	Year 3	Year 4	Total
Tunisia						
Service 1	*Net variation*	*4*	*4*	*6*	*7*	*21*
	Hired Personnel	4	4	6	7	*21*
	Personnel Reduction	0	0	0	0	*0*
Service 2	*Net variation*	*2*	*2*	*2*	*2*	*8*
	Hired Personnel	2	2	2	2	*8*
	Personnel Reduction	0	0	0	0	*0*
Service 3	*Net variation*	*-1*	*0*	*0*	*0*	*-1*
	Hired Personnel	0	0	0	0	*0*
	Personnel Reduction	1	0	0	0	*1*
Morocco						
Service 1	*Net variation*	*0*	*-1*	*-2*	*0*	*-3*
	Hired Personnel	0	0	0	0	*0*
	Personnel Reduction	0	1	2	0	*3*
Service 2	*Net variation*	*0*	*0*	*-2*	*0*	*-2*
	Hired Personnel	0	0	0	0	*0*
	Personnel Reduction	0	0	2	0	*2*
Service 3	*Net variation*	*0*	*0*	*-1*	*0*	*-1*
	Hired Personnel	0	0	0	0	*0*

Fig. 6.11 eGovernment projects: impact on PAs' labor force

PAs' management. However, this was found to be a widespread phenomenon, not limited to the specific PAs considered in this study.

The table in Fig. 6.11 shows the impact of eGovernment projects in terms of staff hiring and reduction, for the projects for which information was available. Contrary to what may be expected, in the PAs considered by the present study eGovernment projects tended to correspond to increases rather than reductions of the number of employees.

As is shown, new personnel tend to be hired toward the later stages of eGovernment projects, while existing personnel tend to be allocated to other tasks or other PAs during the intermediate stages. The overall net variation is positive, although it should be highlighted that this result is strongly affected by one or two single projects (in Tunisia) that implied a relatively large number of hiring at all phases of the program. Even though excluding the larger project would lead to a small net reduction in the average number of staff, this piece of evidence shows that innovation and reorganization projects can lead to both personnel reductions or increases, depending on the specific nature of the project and the level of substitution or integration between labor and capital that it implies.

6.4 Implications for Economic Policy and Public Sector Management

At the social and political levels, the reorganization of public administrations prompted by the adoption of ICT promises to increase the production and diffusion of information, making them more transparent and responsible toward citizens and policy makers, reducing the scope for corruption and enhancing opportunities for all citizens and firms, while increasing the competitiveness of many markets upstream and downstream from the public sector. From the strictly economic point of view, no less potential is shown by the eGovernment initiatives: indeed, eGovernment represents an opportunity for a radical transformation of PAs, both in terms of goods and services supplied to citizens and the capacity to satisfy needs not adequately met by the market (public sector effectiveness) and in terms of efficiency in the supply of these services and in support for the services supplied by the market (where the public sector constitutes a factor of production). For what concerns the impact of eGovernment on public sector productivity and the results in terms of GDP growth, the analysis appears to have yielded some encouraging preliminary findings. The results should offer ideas and directions on which public sectors should base policies for successful eGovernment initiatives. In order to exploit the potential of ICT in PAs – along the lines of the proposed model – it is necessary to concentrate efforts on three general development paths:

- increase both the efficiency and the effectiveness of eGovernment inside public administrations with reference to their main stakeholders;
- promote the dissemination of specific tools to measure performance, together with a favorable cultural background;

- set up a number of complementary policies, in order to foster the "take up" effect, and finally promote productivity and growth.

Concretely, we refer to the effect that such policies should have on how to achieve a better, more efficient and effective eGovernment, explicating the links with our economic model. Therefore, policies to be implemented refer to the following:

- *The promotion of a horizontal eGovernment*: This approach is best suited to make a thorough reorganization of the public sector possible in the medium term. It implies global intervention on PAs, aiming at transforming the entire set of ICT-enabled public services, in line with the back-office reorganization effect to which we referred above. A higher degree of efficiency should also be pursued through benchmarking processes and the diffusion of the best technological, organizational, and training solutions, as well as through a strong commitment to interoperability among organizational units.
- *A review of eGovernment vertical policies*: The approach adopted in the last few years, aimed at promoting high efficiency and effectiveness standards with reference to single services at the country level, should be partially reviewed and integrated. In particular, greater attention should be paid to finding solutions that could have an impact on productivity and growth, according to the proposed economic model.
- *Specific principles, linked to technical features*: Apart from general W3C compliance, policies should be promoted to reach a complete and effective current e-services main features knowledge management, not looking at software solutions alone, but rather at organizational topics and gained results as well. This should lead to the creation of data warehouse/databases of these elements. The use of open-source software, in addition to a strong commitment to "solution reusing" should foster this.
- *The promotion of both a user-centered and a locally aimed eGovernment*: Due to budget constraints, eGovernment policies should not be oriented only to local growth, but should also take into account user needs. Consequentially, further implementation should be based upon a number of subjective and objective priorities, combining the need to satisfy user needs and the opportunity of realizing programs which refer to the true needs and potential of local areas, such as macroeconomic entities. This would lead to a progressive deployment of eGovernment projects, following different priorities in different areas, maybe not homogeneous, thus giving measurement, monitoring, and fine-tuning activities a sharper and more effective meaning, in light of promoting sustainable and lasting local growth.
- *The promotion of specialization within the public sector*: Horizontal and pervasive eGovernment should benefit from a higher degree of local specialization within different branches of the public administration (if accompanied by interoperability), rather than from an indiscriminate upgrade of organizational issues within the entire public sector. However, in general, the size of single administrations matters; while a region, a central department, or even a large municipality may find it more useful to identify and promote such economies internally,

smaller administrations may find outsourcing to be a smarter and more suitable solution.

- *Fostering the adoption of reforms that encourage performance measurement*: Such a framework requires regulatory and legislative ad hoc reform promotion: this refers, for instance, not only to the above-mentioned "prize and penalty" mechanism but also to guaranteeing mandatory performance measurement and linking legitimization of policy makers' decisions to e-democracy tools. In this respect, further research ought to look into which reforms should be put into place, to what extent, and to what degree of homogeneity. All these policies should generate effects on Smiths', back-office, and Schumpeter's effects. With reference to the first one, more performing organizational units should lead to more efficient and effective e-services; at the same time, more productive units should generate positive effects also at the back-office effect level, lowering the cost of labor through a rise in productivity. Finally, Schumpeter's effect should also be affected, thanks to pressure for more productive investments, which could stem from a performance-friendly environment.
- *Accelerating the shift from evaluation to performance rewarding*: Together with a mandatory measurement approach, performance should be linked to a "prizes and penalties" mechanism. Public administrations do not have strong incentives to set particularly ambitious objectives and to try to achieve them. This could lead to vicious circles: an adverse selection mechanism could take place, where establishing goals that are too ambitious could mean risking not reaching them. The only way to break these vicious circles is to ensure strong financial and career incentives linked to performance for both personnel and public managers.
- *Working against motivational crowding out*: Motivational crowding out, which could appear as a consequence of the introduction of ICT, can lead to the failure of any eGovernment-related reorganization policy. Our model predicts that successful "internal" policies will have substantial "external" implications (in terms of productivity and growth): that is why decision makers should pay a lot of attention to clearly defining and sharing eGovernment-related objectives at all levels, as well as to provide support tools. The more local representatives are informed of prospective goals and local "returns" from eGovernment, the more the risk of motivational crowding out will fade away.

These policies have an effect on the proposed model at various levels. Promoting horizontal eGovernment in particular means fostering the re-organization of the units involved in the back-office process, at both inter- and intra-administration levels, thus impacting the back-office effect. In addition, horizontal eGovernment should lead to integrated services, thus affecting the efficiency and the effectiveness of the public sector (via Smith's effect), generating not only cost savings but also new revenues.

At the same time, reviewing eGovernment vertical policies should generate an impact on Ricardo's effect, since by developing high-quality, known solutions, it could at first lower the cost of building up the same solutions in a different con-

text, while shifting investments to more productive goals, thus also multiplying the Schumpeter's effect and, possibly, even impacting take-up.

Affecting the setup of an effective knowledge management system and promoting the creation of a data warehouse of solutions for reuse should also put pressure on Ricardo's effect, lowering the cost of accessing eGovernment solutions. Meanwhile, this should generate an impact on the Schumpeter's effect by favoring more productive investments and on the back-office effect by generating pressure in favor of more effective reorganization models. User-centered and locally aimed eGovernment should generate results in terms of Smith's effect, as services specifically focused on local and user needs should become more effective: this should also produce effects on the ability of public administration to generate new revenues, going so far as applying different fees to different kinds of constituencies. The back-office level should also be affected, and pressure in favor of reorganizing should be another result of this policy. Finally, more "fitting" eGovernment could translate into positive effects on the scenario variables, thus fostering positive circular and cumulative effects on take-up.

6.5 Summary

In this chapter we have discussed the eReadiness assessment framework for both socio-economic and organizational facets of the context of intervention. Besides the framework itself, we have described the tools supporting the analysis and, in particular, the social and economic context indicators (SECI) tool adopted in the eReadiness assessment step. The tool aims to keep together the informative richness of the social world where the eGovernment initiatives take place and the need for this information to be useful in a pragmatic, intervention-oriented sense. Finally, we have shown through how the framework and tool have been applied to real case studies and experiences related to the running example.

Chapter 7
Quality Assessment

Quality is a first-class citizen in eG4M. Users of services do not want to lose time in their interactions with administrations, they do not want to suffer to provide information which is already present in public administration databases and they do not want to be bothered by inefficiencies and errors in administrative processes. Figures say that the time period a company has to wait in Italy to be registered in the official public registry and start to operate is ten times the time needed in Great Britain and France. Yet, time is money, and such inefficiencies deeply influence business development. The same for citizens, who greatly appreciate fast, efficient, proactive and transparent administrations. All the previous aspects are captured by the concept of *quality*. In eG4M the quality assessment phase aims to identify and measure the most relevant qualities of the different eG4M layers defined in Figure 5.1. Among them, the most important ones are service qualities. Considering only service qualities in the planning activity hides issues that may deeply influence the nature of new projects, since services are produced by processes, that are performed in administrations, whose functions are defined by laws.

In Sect. 7.1 we define the concepts related to quality and introduce typical methods existing in the literature to observe and measure service-related qualities. In Sect. 7.2 we describe the eG4M quality registry that represents and defines qualities for all the layers discussed before. Such qualities pertain to the categories of efficiency, effectiveness, accessibility, and accountability. Section 7.3 investigates the correlations defined among qualities to represent qualities as a system of related issues. Section 7.4 recapitulates all the concepts introduced in previous sections providing a practical methodology to perform quality assessment. Finally Sect. 7.5 applies the methodology to the running example.

7.1 Introduction to Quality

According to the ISO [113], a *quality* of an artifact, a product or a service is the degree to which a set of inherent characteristics of the artifact, process, or service fulfills requirements. Qualities can be classified in terms of *characteristics* and *sub-*

This chapter is authored by Carlo Batini and Gianluigi Viscusi.

G. Viscusi et al., *Information Systems for eGovernment*,
DOI 10.1007/978-3-642-13571-2_7, © Springer-Verlag Berlin Heidelberg 2010

characteristics; instead of characteristics/sub-characteristics, we will use the general term *quality dimensions* or, simply, *dimensions*. Two modalities are used to assign a value to quality dimensions, namely

- a *measure*, performed with a *measurement procedure* that results in a *metric*, namely a value in a domain and
- the *evaluation* of *perception of users* with questionnaires and focus groups.

According to the first modality, a *measurement procedure* consists in a sequence of steps that leads to measuring a value for the dimension in a specific domain. For instance, an efficiency dimension for services is *temporal efficiency*, which corresponds to the time related to service provision. A first possible metric for temporal efficiency is the user time, namely, the time the user has to spend in (i) service request, (ii) possible further interactions with the administration, and (iii) service acquisition. Another metric for temporal efficiency is the service provision time, the time passed from the time stamp of the request to the time stamp of the delivery. This interval of time can be measured easily and with low cost if the administration involved in service provision manages a workflow procedure that captures the request time and the delivery time. In case the macro-process involved in service provision crosses more than one administration, it is also necessary to identify the inputs and outputs associated with the different processes, in such a way that they can be univocally associated with the service request.

Notice that temporal efficiency can also be evaluated through user perception. In this case we are looking for an average perception, since we can find intolerant users and patient users, so the user's sample has to be chosen in such a way to be representative of the universe of users. For methods related to the choice of samples and segmentation of users, see [81, 135]. Not all perceived dimensions can be measured with a measurement procedure, e.g., the kindness of the front-office personnel of an administration cannot be measured, it can only be evaluated through the perception of users or else of a third-party human observer.

The literature on quality is characterized by many proposals on how to model and assess the quality of services. One of the most popular proposals referring to the user's perception concerns Parasuraman [168, 235]. In the approach of Parasuraman (see Fig. 7.1) user's service expectations are compared to user's service perceptions; this is done using questionnaires whose questions refer to a set of quality dimensions. In the original approach such dimensions pertain to the following categories:

- *Tangibles*, namely the appearance of physical facilities, equipment, personnel, and communication materials.
- *Reliability*, the ability to perform the promised service dependably and accurately.
- *Responsiveness*, the willingness to help customers and provide prompt service.
- *Assurance*, the knowledge and courtesy of employees and their ability to inspire trust and confidence.
- *Empathy*, that is, caring, individualized attention the firm provides its customers.

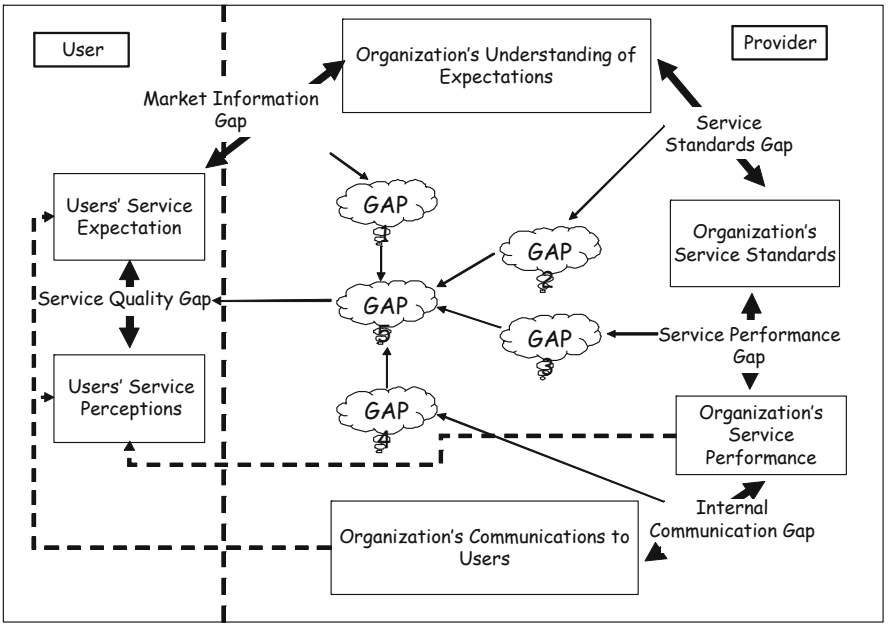


Fig. 7.1 The gap model of the methodology adapted from [167]

Quality	Description
Reliability	The correct technical functioning of the site and the accuracy of service promises
Responsiveness	How quick is the response and the ability to get help if there is a problem or question
Access	The ability to get on the service quickly and to reach the company when needed
Flexibility	The choice of ways to pay, ship, buy, search for, and return items
Ease of navigation	Site delivering the service contains functions that help customers find what they need without difficulty, has good search functionality, and allows the customer to maneuver easily and quickly back and forth through the pages
Efficiency	The site delivering the service is simple to use, structured properly, and requires a minimum of information to be input by the customer
Assurance/trust	Confidence the customer feels in dealing with the site and is due to the reputation of the site and the products or services it sells, as well as clear and truthful information presented
Security/privacy	The degree to which the customer believes the site delivering the service is safe from intrusion and personal information is protected
Price knowledge	The extent to which the customer can determine shipping price, total price, and comparative prices during the shopping process
Site aesthetics	Appearance of the site delivering the service
Customization/ personalization	How much and how easily the site delivering the service can be tailored to individual customer's preferences, histories, and ways of shopping

Fig. 7.2 quality dimensions considered in the gap model adapted from [169]

The gap between perceptions and expectations is the input to a process performed by the organization delivering the services, which analyzes such a gap in order to understand how to react by improving the organization's service standards and performance. Such an effort of improvement has to be communicated to users, thus closing the life cycle of the quality measurement and improvement activity.

A more recent classification of service quality is provided in [167], where the focus is on the quality of the web site that manages requests of users and delivery of services. The different quality dimensions of web site quality are defined in Fig. 7.2.

Although the approach of Parasuraman is quite popular, in this book we prefer to propose a different approach where the quality of services is seen as intrinsically related to the quality of administrative processes, the quality of public administration organization, the quality of laws and norms, and, finally, the quality of ICT support framework. In the following we discuss this approach.

7.2 The eG4M Quality Registry

In this section we introduce and define all the quality dimensions considered in eG4M. Since administrative processes and the organization of the public administration are strictly related, we will refer generically to qualities of organization/processes. All the quality dimensions considered are represented in the eG4M *quality registry*, see Fig. 7.3, clustered in terms of the eG4M layers considered relevant in an eGovernment planning activity.

Dimensions belong to four general categories:

1. *Efficiency*: the amount of resources (including time) needed for service provision.
2. *Effectiveness*: how close is the service provided to user's expectations.
3. *Accessibility*: how easy and feasible it is for the user to request the service, in terms of technological resources available and friendliness of the interactions.
4. *Accountability*: the assumption of responsibility for actions, products, decisions, and policies of the administration. It includes the obligation to report, explain and be answerable for resulting consequences of service provision.

All of the above categories are meaningful for all eG4M layers. Each one of the above categories is refined in the following for each layer in terms of dimensions and in some cases in terms of metrics.

7.2.1 Efficiency

7.2.1.1 Legal Framework Efficiency

Legal framework efficiency is achieved when the legal framework is produced with a limited use of resources [112]; such resources can be human, financial, or temporal resources. A sub-dimension of legal framework efficiency is *redundancy*: a legal framework is not redundant when the set of laws is minimal, namely, each issue dealt with in the legal framework is regulated by one and only one law (or part

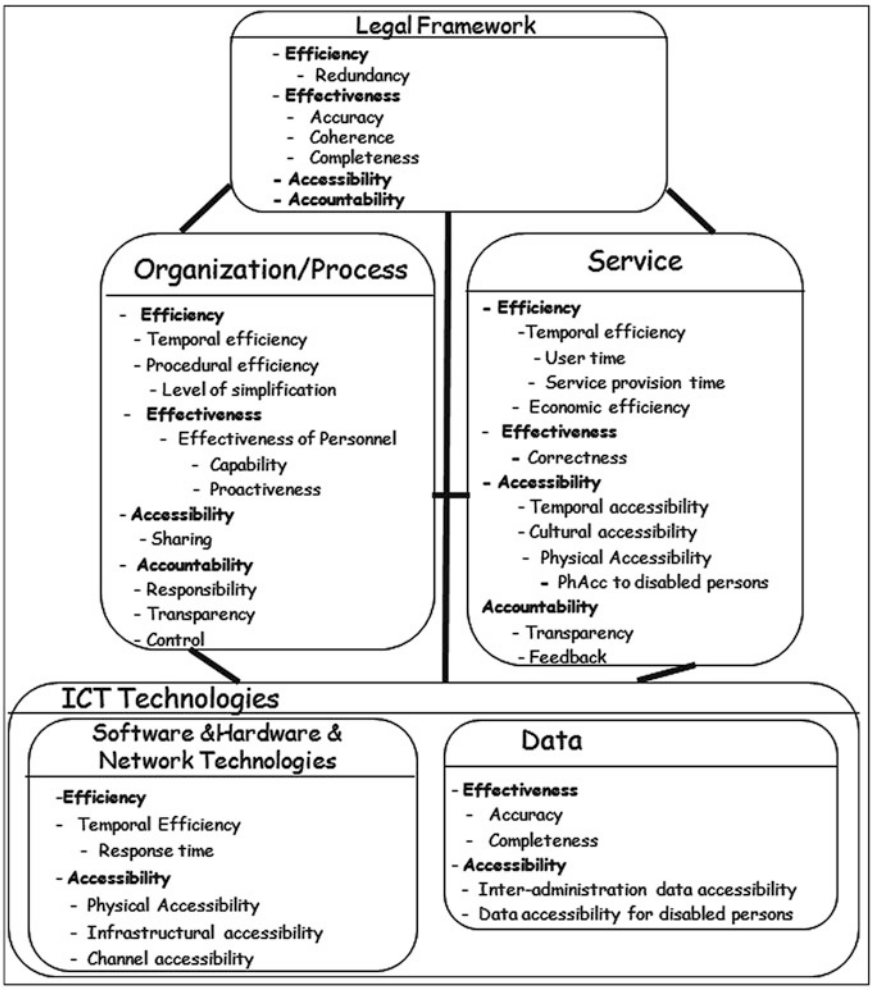


Fig. 7.3 The eG4M quality registry

of law) [73]. Besides the whole legal framework, these qualities can be defined for specific laws, parts of laws, or for a set of laws related to a specific domain. For what concerns the level of enforcement of quality dimensions, it is important to note the difference between *legal technique* (singular), pertaining to the correct production of the text of a law, and *legal techniques* (plural), these latter encompassing the analysis of administrative procedures and the appropriateness of a law [112].

7.2.1.2 Service Efficiency

Service temporal efficiency refers to efficient use of time in service production and provision. As anticipated in Sect. 7.1, it can be expressed in terms of two metrics:

- The *user time*: the average time spent by users to obtain the service.
- The *service provision time*: the average time spent by organizational units to produce the service.

To measure the user time for services provided with a traditional desk, we have to add

1. the time required to go to the desk;
2. the waiting time in line;
3. the service time at the desk.

In case of services which request citizens to collect information, such as certificates from other administrations, we have to also consider the time spent by users in obtaining this information.

The *service economic efficiency* concerns the costs sustained for service provision and their trends in time. This economic dimension can be specialized by relating the cost to the output which the service produces, e.g., for services that produce one or more documents in output, we can specify the service economic efficiency by means of a metric expressed as cost/output.

7.2.1.3 Organization/Process Efficiency

Organization/process temporal efficiency corresponds to time execution of the macro-process which provides the service. The *organization/process procedural efficiency* concerns the level of bureaucratic simplification. Procedural efficiency refers to obligations and constraints that laws impose on the administrative processes and on the interactions between administrations and external users. We associate a sub-dimension with the procedural efficiency, consisting in the *level of simplification*, and a metric, the number of interactions required by users to provide useful information in order to complete the service.

7.2.1.4 ICT Infrastructure Efficiency

ICT infrastructure temporal efficiency can be measured by means of the *response time*, the usual metrics considered for ICT infrastructures; the measure is simply the time interval that the ICT resources need to execute transactions and/or queries; it can be expressed referring to an application load expressed in terms of several benchmarks; see also [211] for a full introduction to this issue.

7.2.2 Effectiveness

Effectiveness concerns the closeness to user needs and expectations. Sometimes, it is not easy to distinguish between efficiency and effectiveness. Furthermore, to evaluate efficiency we can ignore user expectations and focus on the output produced

by the service and the resources used. To evaluate effectiveness, we have to know precisely the user's expectations. We can say that effectiveness tends to "do the right things" while efficiency has the objective of "doing things right."

7.2.2.1 Legal Framework Effectiveness

Effectiveness of the legal framework is achieved when the legal framework has been conceived so that its concrete enforcement produces the results and outcomes initially planned [53]. Sub-dimensions of legal framework effectiveness are as follows:

- *Accuracy*: laws address precisely and non-ambiguously the domain of interest and do not give rise to misleading applications in the domain [134].
- *Coherence*: laws enacted over time are not contradictory to each other and the legal terms used within different legislative domains of intervention refer to a common coherent lexicon [32].
- *Completeness*: the legal framework addresses all the issues relevant for the considered domain of enforcement [32, 85], in our case the eGovernment plan.

7.2.2.2 Service Effectiveness

Service effectiveness expresses the property that the service achieves users' expectations. Proper metrics of effectiveness can be the figures of complaints, and the users' perception of the usefulness and reliability of the provision of the service [168]. A sub-dimension associated with service effectiveness is *service correctness*, namely the coherence of the service behavior with the requirements.

7.2.2.3 Organization/Process Effectiveness

At this level we are interested in effectiveness of personnel, which results in capability to face and proactiveness. *Capability to face* is the ability of personnel in the relationship with the user and in the resolution of all types of problems arising in process execution. *Proactiveness* corresponds to the ability to foresee and anticipate events and act in advance to deal with an expected difficulty.

7.2.2.4 ICT Effectiveness

At the data layer, effectiveness results in several dimensions, which we have examined in Chap. 2. Due to the relevance of the data resource in administrative activities, we discuss in detail possible metrics for accuracy and completeness.

Two kinds of accuracy can be identified, namely a syntactic accuracy and a semantic accuracy. *Semantic accuracy* of a value v is the closeness between v and the correct value v' that v aims to represent. In the following we do not address semantic accuracy; the interested reader can find further details in [23].

Syntactic accuracy is the closeness of a value v to the elements of the corresponding definition domain D. In syntactic accuracy we are not interested in comparing v with the true value v′; rather, we are interested in checking whether v is any one of the values in D, whatever it is. So, if v = Jack, even if v′ = John, v is considered syntactically correct, as Jack is an admissible value in the domain of persons' names.

Syntactic accuracy is measured and achieved by means of functions, called *comparison functions*, which evaluate the distance between v and the values in D. Edit distance is a simple example of a comparison function, taking into account the minimum number of character insertions, deletions, and replacements to convert a string s to a string s′. More complex comparison functions exist, for instance, taking into account similar sounds or character transpositions. So, given a comparison function C, we may define a measure of syntactic accuracy of a value v with respect to a definition domain D, as [1 − mindistance/n] where *mindistance* is the minimum value of C, when comparing v with all the values in D and n is the maximum possible value that the comparison function may have.

Notice that the definition of syntactic accuracy can be used, besides measuring the degree of accuracy, also for correction of inaccurate values, which can be changed into the closest value in the definition domain D.

Concerning *completeness*, we introduce a simple metric for tables, the typical data structures adopted in the relational data model. We assume that null values, namely, values that exist in the real world but for some reason are not available, denote the presence of an incompleteness. Thus, the measure of completeness of a table is [1 − nv/n] where nv = the total number of null values in the table and n = the total number of values in the table]. A more extensive discussion on metrics for completeness can be found in [23].

As an example of evaluation of accuracy and completeness, let us consider the relation Movies introduced in Chap. 2 (see Fig. 7.4).

The value Rman Holiday in movie 3 for Title is syntactically inaccurate, since it does not correspond to any title of a movie. The accuracy of the term *Rman Holiday* is equal to 1 − 1/15 = 0.9, since the closest movie title is *Roman Holiday*, and 15 is the maximal length of items in the table. The completeness value of the table is 3/24, namely, 0.13.

Id	Title	Director	Year	#Remake	Last Remake Year
1	Casablanca	Weir	1942	3	1940
2	Dead poets society	Curtiz	1989	0	NULL
3	Rman Holiday	Wylder	1953	0	NULL
4	Sabrina	NULL	1964	0	1985

Fig. 7.4 A relation Movies

7.2.3 Accessibility

Dimensions associated with *accessibility* take into account all the issues related to the existing service access barriers for different kinds of users, such as elderly or disabled people, rural or suburban population, illiterate people, linguistic minorities, people without a sufficient level of technological skills; furthermore, accessibility also refers to technological barriers related to ICT networks and infrastructures needed to connect with the system providing the service.

7.2.3.1 Legal Framework Accessibility

The *legal framework accessibility* is achieved when the users of the legal framework can easily access the whole set of norms related to their rights, duties, and obligations [85]. The legal framework of a state is the result of years and years of enacting of new laws that are added to previous bodies of law. The new law usually expresses the abrogations and updates to previous laws with explicit references such as "law 325/98 is abrogated" "articles 1 and 2 of law 325/98 are abrogated" or else with implicit references such as "all laws referring to cattle raiding are abrogated." Notice that in both cases it is not easy to deduct the consequences of abrogation or update. It is also evident that the more the legal framework is updated with new laws, the higher the risk is for the legal framework to have a "spaghetti style." A possible metric for the legal framework accessibility is the complexity of the legal framework, measured by the number of implicit and explicit references divided by the number of different topics addressed, where the implicit references have a higher weight w.r.t. explicit ones. Other measures can be obtained using questionnaires to be filled by a sample of users, especially judges, legal offices of public administrations, and lawyers.

7.2.3.2 Service Accessibility

Service temporal accessibility, defined at the service layer, expresses the interval of time, usually in a day or in a week, during which the service can be requested. Focusing on a traditional service desk, it can be measured through the amount of business/opening hours of the desks. *Service cultural accessibility* concerns the diffusion among users of skills and capabilities required for an autonomous usage of service and the attitudes, preferences, and perception (e.g., trust, ease of use) expressed by users toward the usage of different technological channels which support the provision of service. A number of metrics can be used to measure this dimension, such as

- the percentage of words whose meanings can be understood by an average user;
- the number of languages in which the service is provided;
- the media richness of the channels [57]; and
- the perceived usefulness and perceived ease of use of the access channels [1, 59, 198].

Service physical accessibility measures the ability of the user to access the service from his/her physical status/functions. Particularly important in the social domain is *physical accessibility for disabled persons*. Metrics and guidelines for physical accessibility have been proposed, among others, by the World Wide Web Consortium [218] that defines the individuals with disabilities as subjects who

1. may not be able to see, hear, move, or process some types of information easily or at all;
2. may have difficulty reading or comprehending text;
3. may not have to or be able to use a keyboard or mouse;
4. may have a text-only screen, a small screen, or a slow Internet connection; and
5. may not speak or understand a natural language fluently.

An example of metrics for blind persons is the presence/absence of equivalent alternatives to visual content in a web site or an application used to access the service; such alternative is a *text equivalent content*. In order for a text equivalent content to make, e.g., an image accessible, it can be presented to the user as synthesized speech, braille, and visually displayed text. Each of these three mechanisms uses a different sense, making the information accessible to groups affected by a variety of sensory and other disabilities. In order to be useful the text must convey the same function or purpose as the image. For example, consider a text equivalent for a photographic image of the continent of Africa as seen from a satellite. If the purpose of the image is mostly that of decoration, then the text "Photograph of Africa as seen from a satellite" might fulfill the necessary function. If the purpose of the photograph is to illustrate specific information about African geography, such as its organization and subdivision into states, then the text equivalent should convey that information with more articulate and informative text. If the photograph has been designed to allow the user to select the image or part of it (e.g., by clicking on it) for information about Africa, equivalent text could be "Information about Africa," with a list of items describing the parts that can be selected.

7.2.3.3 ICT Accessibility

Infrastructural accessibility, defined at the technological layer, concerns the diffusion of the infrastructure and technologies which support the service provision: proper measures are the number of territorial desks per inhabitant and the average distance from the territorial desk for different kinds of users. *Channel accessibility* focuses on the existence of different channels for service access and delivery, such as the desktop, cell phone, TV. Channel accessibility can be measured in terms of the number of available access channels for the service considered. *Data accessibility* refers to the possibility of access data involved in the service. Sub-dimensions of *data accessibility* are inter-administration data accessibility and data accessibility for disabled persons.

Inter-administration data accessibility corresponds to the possibility for administrations to access data involved in service provision and managed by a different administration by means of an inter-administration back-office. *Data accessibility*

for disabled persons can also be seen as a particular case of service physical accessibility to which we address the reader.

7.2.4 Accountability

With regard to accountability, *legal framework accountability* is achieved when the legal framework provides rules which govern the clear responsibility and transparency to be provided when a law is enforced [32]. At the organization/process level we define three sub-dimensions: responsibility, transparency, and control. *Responsibility* is the obligation of the organization to make decisions and take actions which will enhance the interests of internal and external users.

At the process level, *transparency* evaluates the availability of information on the state of the administrative macro-process when the user asks for it. A feasible metrics for transparency is the percentage of processes on which there is information available for users. *Control* is the attitude of the organization to govern all events related to the correct and efficient functioning of the process.

Dimensions referring to accountability, defined at the service level, are transparency and feedback. *Transparency* concerns the volume of information that the PAs provide to users on the characteristics of the service and on what they could expect or claim using the service. *Feedback* refers to the effective level to which users' opinions reach the PAs in charge of the service and influence the provision [2]. Metrics for this dimension are

1. the percentage of offices for which users can make a formal complaint in case of error or failure of the service;
2. the presence of two-way interaction channels between users and PA (the so-called public relation offices);
3. the percentage of responses to complaints;
4. the average response time to complaints.

7.3 Dependencies Among Dimensions

Quality is a multifaceted concept; dimensions/metrics introduced above provide different points of view on quality characterization and evaluation. While focusing on different aspects, quality dimensions are not always independent of each other and are related by reciprocal *dependencies*. Such dependencies may be *positive*, when an increase in the value of a dimension d1 results in an increase in the value of a second dimension d2, or *negative*, when the opposite occurs. Furthermore, dependencies may be *inter-layers*, when they concern different layers, *intra-layer* otherwise. The most relevant dependencies among dimensions in the quality registry are shown in Fig. 7.5.

The user time is positively influenced by the channel accessibility (inter-layer dependency), since the availability of channels reduces the time needed to reach

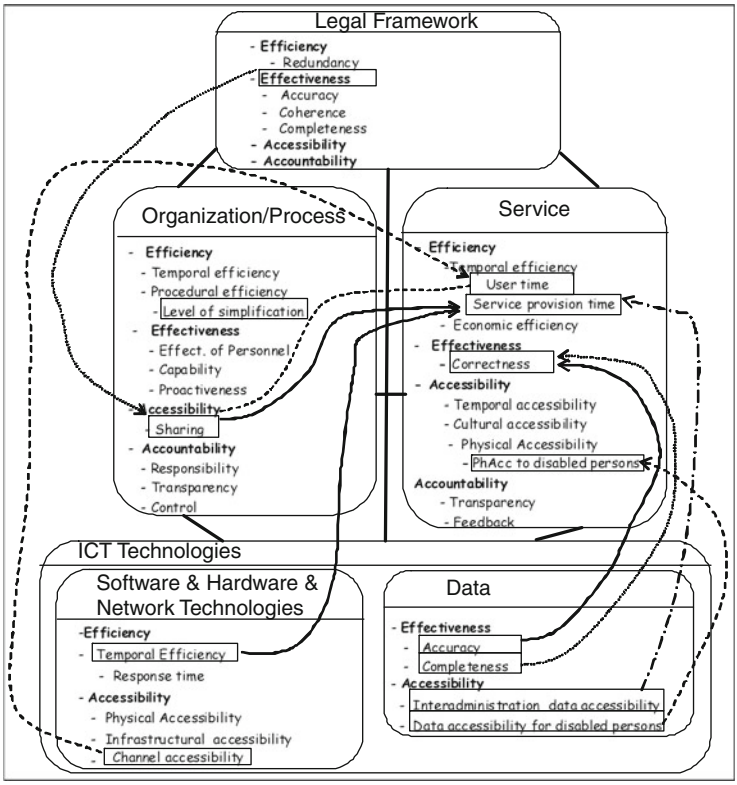


Fig. 7.5 Inter- and intra-layer dependencies among dimensions

traditional service desks. It is also influenced by the level of simplification, since a higher level of simplification reduces the need for interactions. Finally, it is positively influenced by the inter-administration data accessibility, which impacts on query performance in the back-office.

The service provision time is positively influenced by the level of simplification and by the accuracy of data. Service provision time is also dependent on the level of simplification, the inter-administration data accessibility, and the response time of the ICT infrastructure. Completeness also influences service provision time, since in most administrative activities incomplete data force time-consuming investigations to complete them. Service effectiveness correctness is influenced by data accuracy, since inaccurate data result in user dissatisfaction. Physical accessibility of a service by disabled persons is positively related to the existence of an alternative text.

Knowledge on dependencies can improve the efficiency and effectiveness of the planning methodology, since the effort needed to improve actual metrics into target ones is lower than in the "independence of dimensions" assumption, e.g., considering again the accuracy and completeness at the data layer, the relevance of the data

layer for the effective service provision is often disregarded and seen as a purely technological issue, concerning the efficiency of query management. On the contrary, since data are the major resource used in most organizations, an improvement of process/service qualities can often be effectively achieved only acting on data quality.

7.4 A Methodology for the Assessment Activity

The eG4M methodology for the quality assessment step is shown in Fig. 7.6.

In the first step we have to extract the dimensions related to knowledge collected in the state reconstruction step from the quality registry. In this extraction we need to be selective and focus on the most critical issues, e.g., if a service has turned out as very frequently used and at the same time is provided in a context with low technological eReadiness, we may focus on user time, service delivery time, and channel availability. As a second example, for administrative processes with a high number of administration offices involved and a high number of related services, we may focus on legal framework efficiency and organization – process procedural efficiency. At this stage we can also entrust a panel of users and ask them for most relevant service qualities.

Note that in this activity we could need to extend the quality registry with new dimensions, e.g., in order to measure the quality of a list of taxpayers, we could reach the conclusion that besides accuracy and completeness, we have to measure the currency dimension, which we defined in Chap. 2. *Currency* can be measured with respect to *last update* metadata, which correspond to the last time the specific data were updated. Another typical measure of currency is the time interval between the acquisition of data in the organizational system and the update of data in the database. We can also add weights to dimensions, associating major importance, say, to user time than to service delivery time. The output of activity 1 is a list of quality dimensions and related service, organization/processes, ICTs the dimensions refer to, plus, in case, weights to highlight the relevance of each dimension.

Activity 2 focuses on metrics. Evaluating metrics has a cost, and this cost should not be overcharged with respect to the value of the information we obtain on quality,

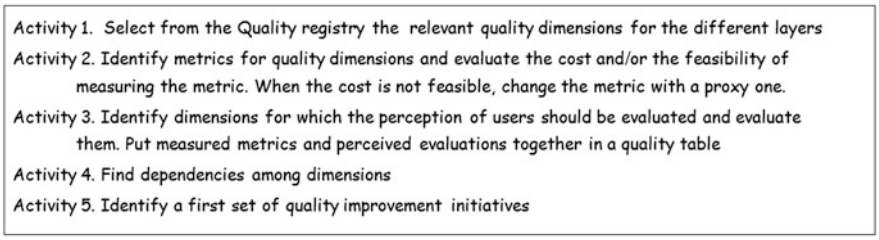


Fig. 7.6 A methodology for the assessment step

e.g., the service delivery time of a service can be measured through a sophisticated realization of a workflow system that observes all the phases of service production and delivery. This means that all offices involved have to be equipped with a software application which traces the activities related to the process and measure the time interval needed to complete the activity. With such a workflow application we obtain precise measures of the average service delivery time, its distribution among offices and among time intervals such as the working hours of the day and the days of the week. However, the cost could be prohibitive; so we may reach the conclusion that it is worthwhile to be less precise, while at the same time obtaining a good approximation. As an example, we could trace service delivery time as a black box, measuring for each service the time stamp of the request and the time stamp of the delivery. In this case, in order to be able to recognize the service in input to the black box and the service in output we have to mark the service with its identifying information. As further approximation, we could focus on a sample of services delivered and measure time intervals by hand.

Activity 3 considers perceived evaluation of users, e.g., if the service delivery time is considered as the most relevant dimension, one could ask users to perceive their level of satisfaction w.r.t service delivery time choosing from several levels such as [very low, low, neutral, high, very high]. At the end of activity 3 we have to refer to a common scale of numerical values of metrics obtained in activity 2 and qualitative values obtained in activity 3; we can do so by associating each one of the values [very low, low, neutral, high, very high] with a value in the [0,. . .,1] numerical interval used for numerical values.

Activity 4 considers dependencies among dimensions. The dependency graph has to be simplified, considering only dependencies that relate dimensions selected in previous steps. Notice that a deeper analysis of the system considered could result in adding new dependencies, e.g., a project focused on improving the responsibility of public administration employees could investigate the influence of transparency and feedback at the service level on responsibility.

Activity 5 exploits the fact that at this stage we obtain a vivid image of the system around services and causes of low quality; thus, this phase of planning process is the right moment to define a first set of improvement initiatives, e.g., we could have discovered that the completeness of the registry of taxpayers is very low or else that the average currency is equal to, say, 6 months. It is not necessary to proceed to further phases of the methodology to reach the conclusion that a project leading to the digital transmission of tax declarations has to be set up.

7.5 Running Example

At the end of the chapter, we apply the methodology to the running example. For the sake of clarity, in the example we distinguish between service issues (and other service-related eG4M layers) and legal framework issues.

Quality dimensions for services (activity 1) can be selected in this case entrusting a panel of users and asking them which are the most relevant quality dimensions to be considered. The users may conclude that the most relevant dimensions and corresponding layers are

1. at the service layer, temporal accessibility, user time, and service provision time;
2. at the organization/process layer, the level of simplification; and
3. at the ICT layer, channel accessibility.

We may also conclude that such dimensions are considered relevant for all the services considered. At this point (activity 2), we have to identify metrics for selected quality dimensions and evaluate the cost of measuring the metric. We can draw the following conclusions:

1. Assuming that only physical desks are available, temporal accessibility can be measured in terms of hours per week the offices are open, this measure has a low cost.
2. User time can be measured according to the metrics proposed above by means of interviews given to a sample of users. To obtain an accurate value, we need a sufficiently large and differentiated sample; in order to restrain costs telephone interviews are needed.
3. Service provision time can be calculated with the black-box method described above, leading to reasonable costs.
4. At the organization/process layer the level of simplification can be evaluated with interviews to users, the same carried out for the user time. Another possibility is to make an analysis performed on service/process and process/organization matrices described in Chap. 5;
5. At the ICT layer, channel accessibility can be evaluated by means of the same interviews performed for user time and level of simplification, leading to further savings due to a unique interview instead of three.

We may now (activity 3) measure the values of quality dimensions, leading to the table shown in Fig. 7.7.

With regard to the legal framework, we may focus on completeness and accountability. With reference to completeness, we may decide to involve domain experts having juridical background and entrust them in the evaluation of completeness level. We may assume that the juridical team assigns on a scale [very low, low, good, very good] a “low” level to the legal framework, due to the scarcity in the definition of rules for digital signature, which has been considered in Chap. 4 as a leading technology to be adopted. Furthermore, we also assume a “low” level for accountability, since the considered law 59/97 and the decree with the force of law 396/2000 do not define the public administration(s) or the agencies that have responsibility on the control of legal requirements, the validity of information flows and of the data/documents exchanged.

Layer	Quality dimension	Service	Current value
Service	Temporal accessibility	Comm. of change of residency to the new mun.	30 h a week
		Comm. of change of residency to the old mun.	30 h a week
		Change of residency in the driving licence	20 h a week
		Change of residency in the health card	25 h a week
		Reservation for medical examination	15 h a week
Service	User time	Comm. of change of residency to the new mun.	3 h
		Comm. of change of residency to the old mun.	6 h
		Change of residency in the driving licence	6 h
		Change of residency in the health card	6 h
		Reservation for medical examination	24 h a year
Service	Service provision time	Comm. of change of residency to the new mun.	1 week
		Comm. of change of residency to the old mun.	1 week
		Change of residency in the driving licence	1 month
		Change of residency in the health card	1 month
		Reservation for medical examination	3 days
Organization/ process	Level of simplification	Comm. of change of residency to the new mun.	2 interactions
		Comm. of change of residency to the old mun.	2 interactions
		Change of residency in the driving licence	2 interactions
		Change of residency in the health card	2 interactions
		Reservation for medical examination	2 interactions
ICT infrastructure (channel)	Channel accessibility	Comm. of change of residency to the new mun.	Only desk
		Comm. of change of residency to the old mun.	Only desk
		Change of residency in the driving licence	Only desk
		Change of residency in the health card	Only desk
		Reservation for medical examination	Only desk

Fig. 7.7 Layers, qualities, values

We have now (activity 4) to find dependencies among dimensions. Only a subset of dependencies in Fig. 7.5 has to be considered; by deleting dependencies between quality dimensions not involved among those selected, we obtain the quality registry of Fig. 7.8. Looking at the dependencies, due to the relevance of user time and the presence of channel accessibility among the dimensions considered, we can extend the channels available to request the service, thus influencing two different dimensions.

Finally (activity 5) we proceed to identify a first set of quality improvement initiatives. Here we focus on initiatives related to the legal framework, see Fig. 7.9. The level of completeness of the legal framework can be improved by enriching it with

1. a law which introduces the legal validity of electronic documents with legal signature;
2. a law which defines rules and guidelines for the digital signature;
3. a decree with the force of law that introduces the obligation for local public administrations to exchange data in electronic format through the network by adopting the digital signature.

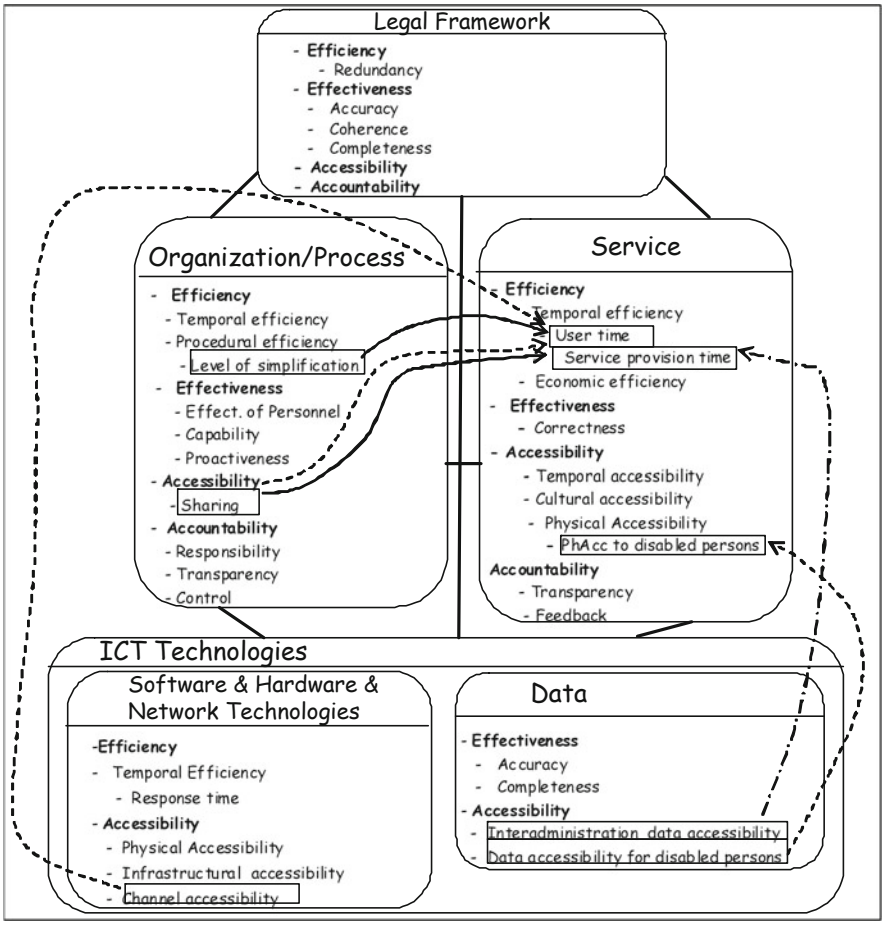


Fig. 7.8 Dependencies in the running example

Higher levels of legal framework accountability can be achieved, e.g., by assigning the responsibility for the enforcement of the laws for data exchange to a central agency which governs the legal validity of electronic documents and the digital signature, also providing the standard requirements for the adoption of the digital signature by public administrations. Figure 7.9 shows how the legal framework can be improved by introducing general rules on digital signature and certification services; the new rules must be enacted with new technical rules defining the guidelines for their enforcement. The new technical rules substitute and complete previous ones. Indeed, the improvement of legal framework enabled by the adoption of digital signature allows the innovation at the technological and organizational levels in initiatives such as the redesign of the office processes of records.

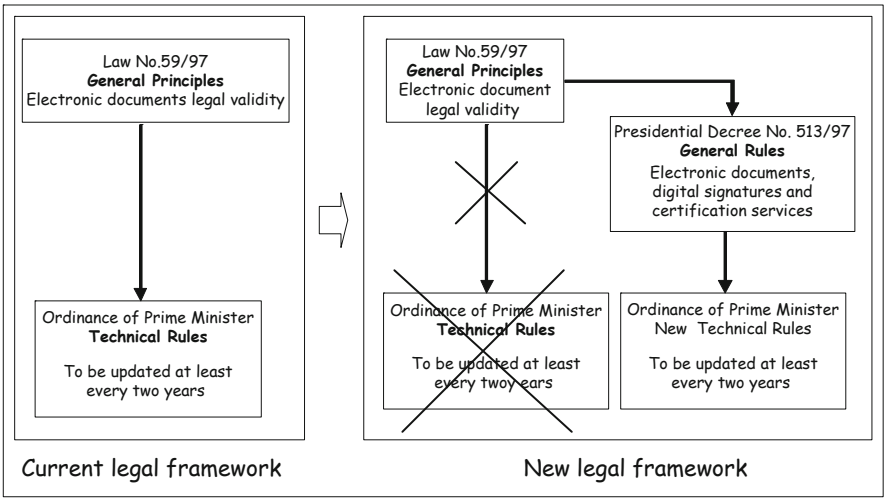


Fig. 7.9 Initiatives for improving the legal framework

7.6 Summary

The eG4M quality registry introduced in this chapter and all the mechanisms in terms of the categories of quality, dimensions, metrics, dependencies defined for the different eG4M layers are to be seen as powerful yet adaptable means of assessing the current state of service provision and of all the service-related eG4M layers. Such mechanisms have to be chosen carefully, paying attention to costs and focusing on the most relevant issues. At the same time, it may happen that during the assessment activity new dimensions and metrics not considered before have to be investigated; the openness and the extensibility of the eG4M methodology guarantee flexibility and adaptability to unforeseen situations.

Part III
Operational Planning

Chapter 8
Definition of Priority Services and Value Targets

In this chapter we discuss the step of the methodology which supports the definition of priority services and their quality value targets. As for the overall methodology, the general idea is that the choice should be driven by a clear understanding of

- the strategic/political objectives from the different layers involved (see Chap. 3);
- the elements composing the service as part of a complex system of values, impacting both the inner and outer context of intervention (see again Chap. 3); and
- the related qualities.

According to such an analysis, the planning activity results in a set of priority services based on the results of eGovernment vision elicitation (see Chap. 4) defining the macro – micro-objectives which develop them.

As shown in Fig. 8.1, macro- and micro-objectives depend, respectively, on the final intentions and associated strategies, resulting from eGovernment vision elicitation step; in the running example provided in Sect. 4.3 a macro-objective is defined on the basis of final intention *Achieve internal effectiveness*, while the micro-objectives are defined on the basis of strategies *improving administrative processes* and *improving information management and coordination by means of laws or ICT*.

For example, *to improve registry services* is a macro objective to *achieve internal effectiveness* that can be implemented through the achievement of a set of micro-objectives such as

(i) *to simplify administrative procedures for registry services* (specifying the *improving administrative processes* strategy);
(ii) *to deploy new proactive services* which asks for innovation at the legal and technological levels (specifying the *improving information management and coordination by means of laws or ICT* strategy);
(iii) *to deploy services accessible with multiple channels* as implementation of the macro-objective *use innovative ICTs*.

This chapter is authored by Gianluigi Viscusi.

G. Viscusi et al., *Information Systems for eGovernment*,
DOI 10.1007/978-3-642-13571-2_8, © Springer-Verlag Berlin Heidelberg 2010

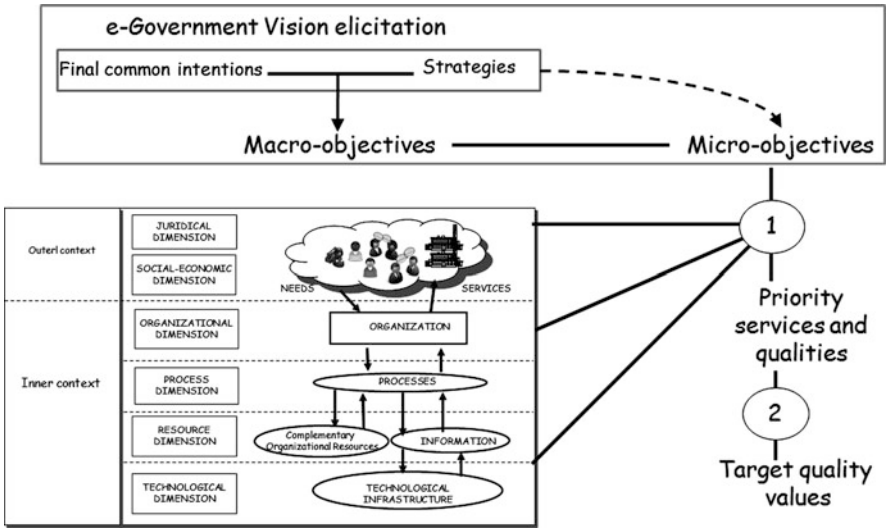


Fig. 8.1 Relationships between eGovernment vision elicitation, macro – micro-objectives, and activities of the step

The chosen set of priority services and their related qualities should better fit the achievement of the new quality target values.

In this step we exploit the results of the previous steps of the eG4M methodology, namely the eGovernment vision elicitation, state reconstruction, eReadiness, and quality assessment steps.

These three steps provide the information supporting the choice of the services which are more relevant for the context of intervention for both what concerns the back office and the front office of the involved public administrations. In particular, we point out the following issues:

- The outputs of the eGovernment vision elicitation step are used to choose the appropriate macro- and micro-objectives.
- The outputs of the eReadiness assessment and state reconstruction steps are used to find the most appropriate services or cluster of services for the chosen macro- and micro-objectives.
- The outputs of quality assessment are used to define the relevant qualities and related values for services and other facets of the context of intervention.

As shown in Fig. 8.2, the step is composed of three activities:

- *Definition of priority macro/micro-objectives*, where for each macro – micro-objective identified in the eGovernment vision elicitation step, we define the priority ones on the basis of the results of state reconstruction and eReadiness assessment steps.

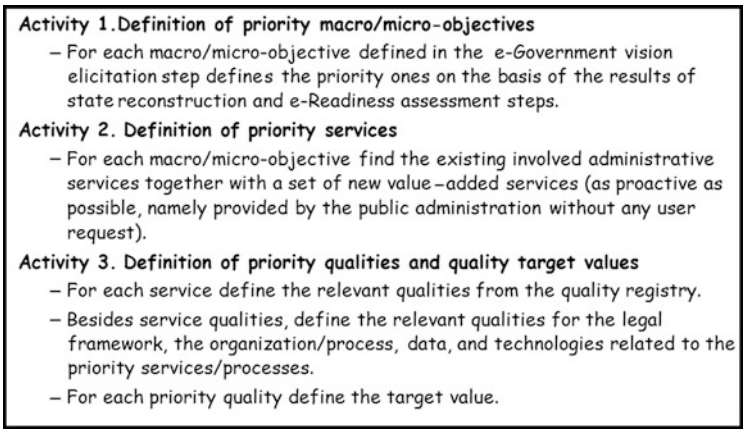


Fig. 8.2 Activities for the definition of priority services and target quality values

- *Definition of priority services* where the *service package* is defined on the basis of macro- and micro-objectives. The service package [94] discussed in Chap. 1 in other methodologies is usually composed of *core services* and *support services*; in our case, using the concepts proposed in [164], the service package is seen as composed of *administrative services* (the basic functionalities and resources offered) and *value-added services* (the functionalities and resources considered of value for the user).
- *Definition of priority qualities and quality target values* where priority quality dimensions for the chosen services are identified and the target values to be achieved in the time horizon of the plan are defined.

In the following we describe the activities leading to the choice of services and we refer to the running example. In Sect. 8.1 we discuss the definition of priority macro/micro-objectives, leading to the choice priority services described in Sect. 8.2. Finally, in Sect. 8.3 we detail the activity of selection of priority qualities for services and the definition of their target values.

8.1 Definition of Priority Macro/Micro-objectives

In Chap. 4 we have defined a preliminary set of macro- and micro-objectives for the running example. We now define their priorities on the basis of the results of state reconstruction and eReadiness assessment steps. We now briefly review the preliminary macro/micro-objectives identified in the eGovernment vision elicitation step:

- for what concerns the organizational and legal facets we have identified *to simplify administrative procedures for registry services* (MIO1 in the following) as

a common micro-objective for the macro-objective *effectiveness and the simplification of administrative activities macro-objectives* (MAO1 in the following);
- for what concerns the service facet we have identified *deploy new proactive registry services* (MIO2 in the following) as a micro-objective of the macro-objective *improve registry services as macro-objective* (MAO2 in the following);
- for what concerns the technological facet we have identified the *use of innovative ICTs* (MAO3 in the following) as a macro-objective in order to provide *services accessible with multiple channels* as micro-objective (MIO3 in the following).

As shown in Fig. 8.3 improving registry services is important in order to satisfy the need for choosing services oriented toward user local needs. In particular, the high number of yearly requests in the running example and the high number of potential users are related to the critical phenomenon of urbanization of the rural population. In order to provide new proactive registry services, a huge back-office intervention is required at the organizational and legal levels in terms of

- roles defined by the law for different central and local public administrations involved in the service provision;
- reduction of hierarchical levels and distribution of responsibilities inside the public administration organization;
- improvement of the internal communication between organizational units of the same or cooperating public administrations.

Macro-objective	Micro-objective	Facet	State reconstruction	eReadiness
Improve registry services	Deployment of new proactive registry services	Service	Relevance of the services related to change of address (5,000,000 of potential users at the national level and 1,000,000 of requests each year)	– Need for services oriented toward user local needs
Effectiveness of administrative activity Simplification of administrative activities	Simplification of administrative procedures for registry services	Organization–legal framework	–Different organizations involved at both central and local levels –Different roles by law for the ministries involved in service provision: (a) the ministry of finance certifies information both for residency and for health card provision, and co-governs with the ministry of health the health card provision information flow (b) Ministry of interior is the owner of registry office	– Need for horizontal projects and back-office reorganization – Hierarchical and centralized organization – Lack of internal communication
Use innovative ICTs	Provision of services accessible with multiple channels	Service /technology	– Widespread use of mobile phone (45% of the total population) – High cost of Internet access – Low diffusion of Internet access (20 % of the total population have Internet access)	– Not homogeneous distribution of ICT knowledge

Fig. 8.3 Specifications for the macro/micro-objectives from the state reconstruction and assessment steps

Finally, the widespread use of mobile phones, the high cost, and the low diffusion of Internet access decline the macro-objective of using innovative ICTs in terms of deployment of a technological infrastructure, supporting both a multichannel service provision and the public administration's internal communication.

The information collected in the state reconstruction and eReadiness assessment steps allows to define the appropriate specifications for macro-objectives impacting on different facets of the context of intervention. It is important to note that at this level the different facets are considered as separated and self-referential from a system perspective. In this sense, micro-objectives are the real bridge toward the outer context or environment, and we can define dependencies and priorities between them.

As shown in Fig. 8.4 the deployment of new proactive registry services (MIO2) asks for a selection of value-added services besides administrative services. Nevertheless, value-added services cannot be deployed without an efficient and agile back office dedicated to the provision of core administrative services (see arrow 1 in Fig. 8.4), as outcome of the implementation of the micro-objective aiming at the simplification of administrative procedures for registry services (MIO1). Finally, the technological infrastructure supports the provision of services accessible with multiple channels (MIO3) for a back-office and an organization (see arrow 2 in Fig. 8.4) which should be made efficient and agile for MIO2 as a final micro-objective (see arrow 3 in Fig. 8.4).

In conclusion, the type of services chosen is strictly related to the requirements of the micro-objectives, namely (i) value-added services in terms of proactiveness for the final user are associated with MIO1, (ii) administrative services are related to MIO2; and (iii) value-added services considered at technological level as mobile and multimedia services are associated with MIO3.

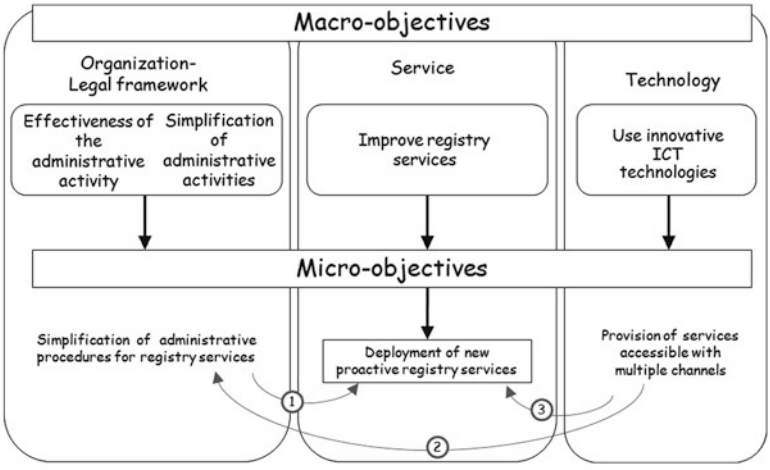


Fig. 8.4 Dependencies and priorities between macro- and micro-objectives

8.2 Define the Priority Services

For each macro/micro-objective we now identify the existing available services. This activity is carried out with the support of the repository of services described in Sect. 5.1.2, using information retrieved during the state reconstruction step.

Administrations provide many services to citizens. At this stage, we will consider services in the repository classified by events of life; in particular, as shown in Fig. 8.5, we focus on the services related to the change of residency. In the running example the services retrieved from the repository have to be associated with the micro-objectives and classified on the basis of their function (see Sect. 5.1.2) and their type (administrative or value-added services). It is important to note that the available services are mainly administrative and related to the MIO1 micro-objective, while value-added services related to other micro-objectives are provided by other public administrations in the repository (see column `owner` in Fig. 8.5).

Indeed, the preliminary analysis of the services retrieved from the repository suggests two different choices in terms of priority; investments for (i) the improvement of available administrative services and (ii) the reuse of existing value-added

Service	Type	Micro-objective	Functional class	Owner
Report the change of residency to the old municipality and request of certificate	Administrative	Simplification of administrative procedures for registry services	Certification	The considered public administration
Report the change of residency to new municipality and request of certificate	Administrative	Simplification of administrative procedures for registry services	Certification	The considered public administration
Report the change of residency to the ministry of transport and update the driving licence	Administrative	Simplification of administrative procedures for registry services	Certification	The considered public administration
Report the change of residency to the change to the health local agency and update the health card	Administrative	Simplification of administrative procedures for registry services	Certification	The considered public administration
Reservation for medical examination	Administrative	Provision of services accessible with multiple channels	Registration	The considered public administration
Information on how to change the utilities (gas, electricity, etc.).	Value added	Deployment of new proactive registry services	Suupporting knowledge	The considered public administration
Family information on where schools or kindergartens are with all the features needed for choosing	Value added	Deployment of new proactive registry services	Suupporting knowledge	Other public administrations in the repository
Call center for information on the change of residency process	Value added	Provision of services accessible with multiple channels	Suupporting knowledge	Other public administrations in the repository
Information on the state of the case (by sms,e-mail, or text-based posts)	Value added	Provision of services accessible with multiple channels	Suupporting knowledge	Other public administrations in the repository

Fig. 8.5 Services in the repository for the change of residency

services provided by other public administrations. Nevertheless, in order to properly choose priority services a further evaluation is required.

In order to evaluate the relevance of the services for citizens, we consider for each service the information resulting from the state reconstruction step. The evaluation in Fig. 8.6 considers the following properties:

- the number of potential `users`;
- the `yearly frequency`, namely the number of single requests of the services in a year;
- the public value (see Sect. 4.1) related to the realization of macro- and micro-objectives implementing the political vision;
- the level of interaction of the available services;
- the costs related to the number of interactions between organizational units and public administrations involved by the law;
- the technological infrastructure required.

Figure 8.6 shows that the priority services are the administrative ones related to the micro-objective "simplification of administrative procedures for registry services" in Fig. 8.5. This latter is related to macro-objectives impacting mainly at the organizational and legal levels (see Sect. 4.4), confirming their role in enabling the main macro-objective of "improving registry services."

Service/ properties	Users	Yearly frequency	Public value	Level of interaction	Cost	Relevance
Report the change of residency to the old municipality and request of certificate	5,000,000	1,000,000	High	Information	High	Very high
Report the change of residency to new municipality and request of certificate	5,000,000	1,000,000	High	Information	High	Very high
Report the change of residency to the ministry of transport and update the driving licence	2,000,000	500,000	High	Information	High	Very high
Report the change of residency to the change to the health local agency and update the health card	5,000,000	1,000,000	High	Information	High	Very high
Reservation for medical examination	5,000,000	10,000,000	Very High	Information	High	Very high
Information on how to change the utilities (gas, electricity, etc.).	5,000,000	10,000,000	Medium	Information	Low	Medium
Family information on where schools or kindergartens are with all the features needed for choosing	Nd	Nd	Medium	Information	Low	Medium
Call center for information on the change of residency process	Nd	Nd	High	Two-way interaction	High	High
Information on the state of the case (by sms, e-mail, or text-based posts	Nd	Nd	High	One-way service	High	High

Fig. 8.6 Relevance of the services chosen as the priority ones

Indeed, the administrative services for the change of residency are support services having public value when provided in a coordinated way and at the same level of interaction. This objective can be reached only with an efficient back-office leading to high organizational costs besides the technological costs related to the evolution of the actual infrastructure. The intervention will also provide the support required for the reservation of medical examination service, an administrative service related to the provision of services accessible with multiple channels (MIO3 of the macro-objective "use innovative ICTs").

For what concerns value-added services (see the two priority services highlighted at the bottom of Fig. 8.6), they have a second-order priority and their potential reuse of available ICT solutions have relevant costs, mainly in terms of governance between involved public administrations.

Nevertheless, a potential service package can be designed by integrating the "reservation for medical examination" administrative service with value-added services from other public administrations (see arrows in Fig. 8.6), such as the call center for information on the change of residency process and an information service on the state of the case (by sms, e-mail, or text-based posts).

The other value-added services have low priority for the following reasons. The service providing information on how to change the utilities (gas, electricity, etc.) even if characterized by high volumes of users and yearly requests is not a priority because of its interaction level which needs a routine activity of update and alignment of the service-related information. Finally, the service providing family information on where schools or kindergartens are located is relevant but with a second-order priority too because of the actual level of administrative service provision asking for higher investment priority.

In this activity our service-oriented methodology has supported the choice of a set of priority services, which are mainly administrative in the running example. In the following, we define priority qualities for the different facets involved in service provision.

8.3 Definition of Priority Qualities and Target Values

This activity is based on the data available in the registry of qualities (see Chap. 7), resulting from the quality assessment step and new survey carried out by the service users. It is important to note that besides service qualities, we also define the relevant qualities for the legal framework, organization, data, and technologies related to the priority services. In order to support the reader, we reproduce in Fig. 8.7 (which was already discussed in Chap. 7) the qualities identified for the administrative services with their current values.

Besides Fig. 8.7, we consider Fig. 8.8 which shows the qualities and their current value for the macro- and micro-objectives related to the use of innovative ICTs for the improvement of temporal accessibility by means of multichannel access to services. As discussed in previous sections and shown in Fig. 8.3 these macro- and

Layer	Quality dimension	Service	Current value
Service	Temporal accessibility	Report the change of residency to the new mun.	30 h a week
		Report the change of residency to the old mun.	30 h a week
		Report change of residency and update the driving licence	20 h a week
		Report change of residency and update the health card	25 h a week
		Reservation for medical examination	15 h a week
Service	User time	Report the change of residency to the new mun.	3 h
		Report the change of residency to the old mun.	6 h
		Report change of residency and update the driving licence	6 h
		Report change of residency and update the health card	6 h
		Reservation for medical examination	24 h a year
Service	Service provision time	Report the change of residency to the new mun.	1 week
		Report the change of residency to the old mun.	1 week
		Report change of residency and update the driving licence	1 month
		Report change of residency and update the health card	1 month
		Reservation for medical examination	3 days
Organization/ process	Level of simplification	Report the change of residency to the new mun.	2 interactions
		Report the change of residency to the old mun.	2 interactions
		Report change of residency and update the driving licence	2 interactions
		Report change of residency and update the health card	2 interactions
		Reservation for medical examination	2 interactions
ICT infrastructure (channel)	Channel accessibility	Report the change of residency to the new mun.	Only desk
		Report the change of residency to the old mun.	Only desk
		Report change of residency and update the driving licence	Only desk
		Report change of residency and update the health card	Only desk
		Reservation for medical examination	Only desk

Fig. 8.7 Current values for administrative services in the running example

Macro-objective	Micro-objective	Layer	Quality	Dimension	Current value
Use innovative ICTs	Services accessible with multiple channels	Service	Accessibility	Temporal accessibility	30 h a week
Use innovative ICTs	Services accessible with multiple channels	ICTs	Accessibility	Channel accessibility	Physical desk for 99% of services

Fig. 8.8 Current values for value-added services in the running example

micro-objectives have been considered in the running example as mainly related to the service and technological facets of the context of intervention.

In this context, indeed, accessibility is strictly related to value-added services, asking for a high cost of intervention due to its actual low values, namely the physical desk for 99% of services and only 2% of sites physically accessible (see Fig. 8.8), and the availability of technological services only from other administrations.

In order to identify the priority dimensions to be considered for the definition of final eGovernment projects on the basis of available information, we now produce a qualitative evaluation of the impact of quality dimensions on macro-objectives. In Fig. 8.9 we first report the relevance of the quality dimensions for the macro-objectives considered in the running example by adopting a five-point scale from no

Macro-objectives	Facets	Quality dimensions				
		Temporal accessibility	User time	Service provision time	Level of simplification	Channel accessibility
Improve registry services	Service	Low	High	High	NO	High
Effectiveness of the administrative activity	Organization	Low	NO	NO	High	High
Simplification of administrative activities	Legal framework	NO	High	Low	High	NO
Use innovative ICTs	Technology	High	Low	NO	Low	High

Fig. 8.9 Relationships between political objectives and quality dimensions in the running example

when there is no relevance at all to `yes` for a full relevance; intermediate values are `Low`, `Medium`, and `High`.

We now consider the results of Fig. 8.9 and in particular the quality dimensions with high relevance for a given facet of the context of intervention. Figure 8.10 shows each quality related to its main quality dimension and facet: in the running example the resulting characteristics are efficiency and accessibility. In Figure 8.10 arrows represent dependencies between qualities for different facets as a priority path.

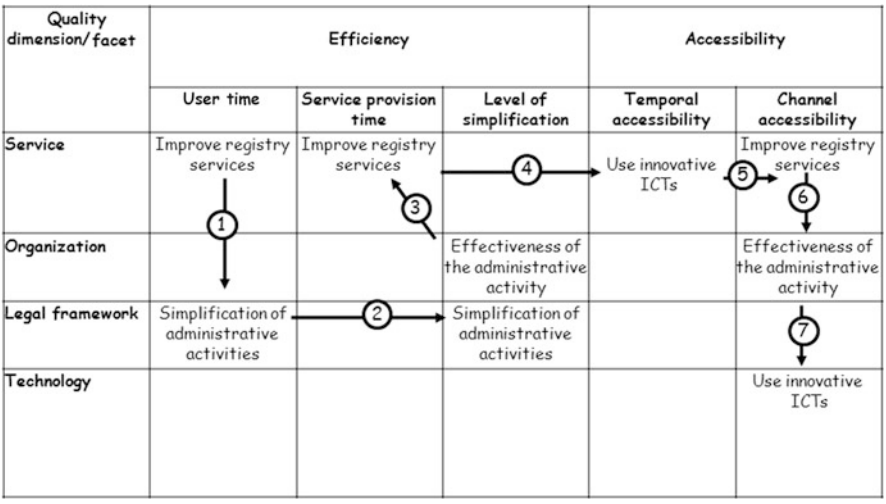


Fig. 8.10 A priority path for qualities

The first quality to be considered is the *user time* at the service level in order to improve registry services (see arrow 1 in Fig. 8.10). This improvement is strictly related to a simplification at both the front office (e.g., by unifying the request points) and back office (e.g., by reducing the administrative procedures and organizational units involved by law). Nevertheless, as we have seen in the quality assessment step the simplification of administrative activities is constrained by the low level of accountability and completeness of the legal framework.

Due to these issues, user time has a priority in terms of improvement of the quality of legal framework for MAO1 aiming for the simplification of administrative activities (see arrow 2 in Fig. 8.10).

As seen above, this simplification in the eGovernment vision is strictly related also to the second facet of MAO1 aiming to improve the effectiveness of the administrative activity at the organizational level. The high relevance of the *level of simplification* for both the facets of MAO1 makes this quality the third to be considered in order to improve *service provision time* at the service level (see arrow 3 in Fig. 8.10).

A comment on Fig. 8.10 points out the resulting priority of efficiency for administrative services, and in particular of efficiency-related qualities impacting at the organizational and legal levels. Indeed, the service-oriented approach of the eG4M methodology allows to identify quality priority not related to technology as preliminary requirements for a technological initiative.

Taking these issues into account, the priority path in Fig. 8.10 shows how in the running example *temporal and channel accessibility* for the improvement of service provision time (see arrow 4 in Fig. 8.10) depends once again on the effectiveness of the administrative activity at the organizational level (see arrow 5 in Fig. 8.10), which can suggest a horizontal initiative based on MIO1 at both the legal and organizational levels (see Fig. 8.3).

In the considered priority path, channel accessibility at the technological level has the lowest priority but a relevant role in enacting the results of initiatives related to higher priority qualities (see arrows 6 and 7 in Fig. 8.10). The path described in Fig. 8.10 allows to rank the priority of the considered qualities as follows:

1. user time (efficiency);
2. level of simplification (efficiency);
3. service provision time (efficiency);
4. temporal accessibility (accessibility);
5. channel accessibility (accessibility).

As final activity, we fix the target values of quality dimensions to be achieved in the time horizon of the plan. These values are influenced by (1) the length of the projects, (2) the political vision and macro – micro-objectives, and (3) the available budget, which may force the delay of costly projects.

Figure 8.11 describes the current and expected values for the quality dimensions in the running example classified on the basis of their resulting priority.

Note that we have expressed a unique global target value for the level of simplification of the four services related to the change of residency. The reason is that we

Priority	Layer	Quality dimension	Service	Current value	Expected value
1	Service	User time	Report the change of residency to the new mun.	3 h	10 min
			Report the change of residency to the old mun.	6 h	10 min
			Report change of residency and update the driving licence	6 h	10 min
			Report change of residency and update the health card	6 h	10 min
			Reservation for medical examination	24 h a year	5 min
2	Organization/ Process/law	Level of simplification	Report the change of residency to the new mun.	2 interactions	1 interaction
			Report the change of residency to the old mun.	2 interactions	
			Report change of residency and update the driving licence	2 interactions	
			Report change of residency and update the health card	2 interactions	
			Reservation for medical examination	2 interactions	
3	Service	Service provision time	Report the change of residency to the new mun.	1 week	2 days
			Report the change of residency to the old mun.	1 week	10 min
			Report change of residency and update the driving licence	1 month	3 days
			Report change of residency and update the health card	1 month	3 days
			Reservation for medical examination	3 days	10 min
4	Service	Temporal accessibility	Report the change of residency to the new mun.	30 h a week	72 h a week
			Report the change of residency to the old mun.	30 h a week	72 h a week
			Report change of residency and update the driving licence	20 h a week	72 h a week
			Report change of residency and update the health card	25 h a week	72 h a week
			Reservation for medical examination	15 h a week	Always open
5	ICT infrastructure (channel)	Channel accessibility	Report the change of residency to the new mun.	Only desk	Desk, Internet, mobile phone
			Report the change of residency to the old mun.	Only desk	Desk, Internet, mobile phone
			Report change of residency and update the driving licence	Only desk	Desk, Internet, mobile phone
			Report change of residency and update the health card	Only desk	Desk, Internet, mobile phone
			Reservation for medical examination	Only desk	Desk, Internet, mobile phone

Fig. 8.11 Current and expected values for the relevant qualities in the running example

perceive that the four services could be managed together. In the next phase of the eG4M methodology we will look for technologies that may enable such a choice.

8.4 Summary

In this chapter we have discussed the activities leading to determine an appropriate choice of services. In particular, we have discussed how to identify priority macro/micro-objectives on the basis of the outputs of the state reconstruction and eReadiness assessment steps. The choice of priority macro – micro-objectives is relevant in order to link the political vision to the operational level implementing the final services. Indeed, in this chapter we have described how the defined priority macro – micro-objectives lead to the choice of priority services and their related qualities. These latter exploit the outputs of the quality assessment step, providing details on the priority path of intervention for the different facets of the considered context. Finally, we have described the activity of definition of the quality target values to be achieved through the projects which result as output of the following steps of the operational planning phase.

Chapter 9
Choice of Projects

Conceiving ICT projects is a highly creative activity, for which experience of previous projects is needed, together with an in-depth knowledge of available ICTs. However at a macro-level most relevant choices can be conducted and/or understood also by PA managers devoid of a specific skills in ICTs. This characteristic of operational planning is of great relevance in eGovernment decisions, especially when, as frequently occurs, operational planning and design activities are in part outsourced to an external company; also in this case, it is crucial that in the presence of alternatives the final decisions are made by public managers aware of the consequences for the different issues considered in the eG4M-layered model introduced in Chap. 3. In this chapter first we describe in Sect. 9.1 a reference architecture for eGovernment projects; this will be refined from a technological point of view in Chap. 10. Then in Sect. 9.2 we introduce a methodology for the choice of project solutions, based on such reference architecture. Specific phases of the methodology are detailed in Sects. 9.3, 9.4, and 9.5. The running example is used in these sections to explain specific steps and activities.

9.1 A Reference Architecture for eGovernment Projects

The approach followed to improve the quality of services and reduce the burden of service provision for citizens is based on the adoption of ICT solutions which improve the effectiveness of the interactions between public administrations and users and among administrations. These solutions are typically based on a *cooperative ICT architecture* that with some variants follows the general structure shown in Fig. 9.1.

In the left-hand side of the figure the traditional stovepipe architecture in G2C and G2B interactions is represented. The two new layers shown in the right-hand side of Fig. 9.1 refer to the following:

This chapter is authored by Carlo Batini.

G. Viscusi et al., *Information Systems for eGovernment*,
DOI 10.1007/978-3-642-13571-2_9, © Springer-Verlag Berlin Heidelberg 2010

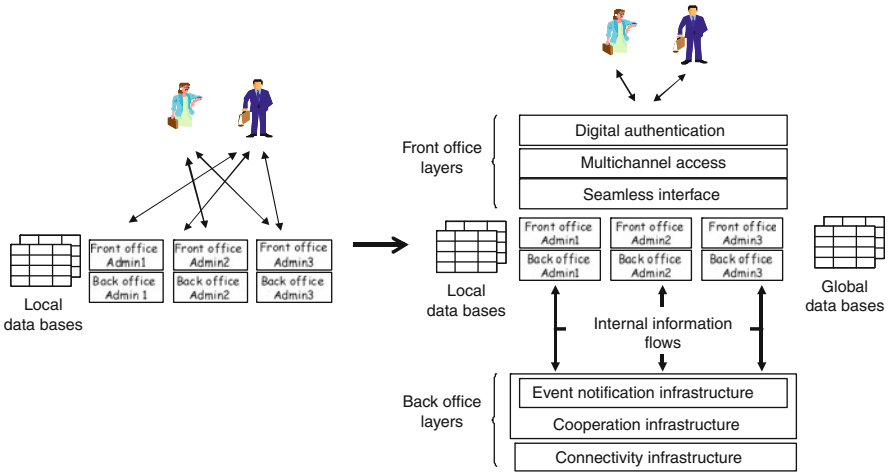


Fig. 9.1 A reference architecture for eGovernment projects

1. A *front-office layer*, which has the goal of improving the relationship between users and administrations, filtering the differences among the administrative procedures, and virtually showing the users a unique seamless set of agencies. The role of the front-office layer is also to provide a multichannel access and specialized interface for users, allowing the coexistence of different users' preferences and skills.
2. A common back-office layer that allows administration to interact through a cooperative infrastructure, to exchange data and knowledge needed to execute administrative processes.

More in depth, the front-office layer includes the following functionalities:

- *Digital authentication* provides univocal identification of users who need to interact with administrations to invoke services.
- *Multichannel access* allows users to access services by means of different channels, such as the physical desk, kiosks, cell phones, Internet.
- *Seamless interface* allows users to invoke services without knowing the concrete implementation of the service in terms of administrations to interact with, types of information needed, etc.

We have to note that the common front-office layer is not monolithic and usually involves small groups of administrations or even parts of administrations, such as directorates or lower level organizational units. This happens since it is usually very complex and costly to involve a wide number of administrations, also due to the autonomy that characterizes the evolution and long-term decisions of public administrations.

As a second observation in Fig. 9.1, the three functionalities related to digital authentication, multichannel access, and seamless interface, represented in the top of front-office modules, offer services that may be used by the entire set of software

Fig. 9.2 A better functional representation of the front-office layer

modules that form the front office; consequently, to put in evidence such orthogonal characteristics w.r.t. the software modules of the front office, they may also be represented as in Fig. 9.2.

Back-office functionalities concern the following:

- The *cooperation infrastructure*, which provides various types of *middleware* allowing administrations to interact, e.g., for performing queries involving different databases managed by different administrations. Among the different types of middleware available in cooperation architectures, a significant importance has:
- The *event notification infrastructure*, which allows an administration to publish data related to different entities that can be transferred with a unique asynchronous message to all the administrations interested to subscribe such type of data. Due to this function, the functionality is also called *publish – subscribe*. This layer is useful in all the (frequent) situations in which users have to communicate the same information (e.g., a change of residence) to several administrations or else an administration registers an event (e.g., for a hospital the birth of a newborn baby) that is of interest to several administrations.
- The *connectivity infrastructure*, which provides connectivity services.

9.1.1 Data

Besides the stovepipe organization of front and back offices of administrations, the second reason for the fragmented nature of relationships between users and administrations and the consequent delivery of low-quality services is the fragmented allocation of data used by administrations in (usually) a huge number of heterogeneous local databases. Local design, management, and update of databases lead to a plethora of inconsistencies among data referring to the same aspect of the real world. Coordination among different databases can be obtained in different ways:

1. For what concerns data updates, through the usage of the above-mentioned publish – subscribe layer for updates that involve data owned by different administrations.
2. For what concerns queries on data, the usage of *data integration architectures* with different technological solutions provides mechanisms which allow

to achieve at least partially the reconciliation of data and data schemas, without violating the autonomy of administrations.
3. For both updates and queries another solution consists in the physical *consolidation* of local databases into a unique global centralized database. This solution is more invasive than data integration, since it modifies the ownership of data through the creation of a new centralized database.

The above issues concern a relevant aspect of eGovernment projects, referred to the *data architecture*. The issue of data architecture will be investigated in Appendix A, through a more detailed description of the above-mentioned solutions and the provision of methodological guidelines that can be used to choose the most effective data architecture in eGovernment projects.

Besides the above architectural solutions, other typical components of a cooperative architecture are the repository of conceptual schemas and the repository of services introduced, respectively, in Chaps. 2 and 5. The two repositories can be used together by public administrations to achieve a common and comprehensive view of services and data managed and to achieve full *interoperability*, namely, the possibility to share data and services as if they were a unique administration, adopting common standards and a common meaning of data, instead of several different administrations.

9.1.2 Applications

In this section we provide more details on the variety of software modules that are used in front office and back office of the administrations to automatize administrative processes established by the law. Typical functions concern

- financial and fiscal affairs;
- education;
- health;
- public infrastructure and transportation;
- general public services;
- public order and safety;
- social protection;
- agriculture, forests, and fisheries;
- commerce, trade, and industry;
- urban development/territory management; and
- justice.

In order to provide services related to such a wide spectrum of functions, software assets of PAs are articulated in a vast amount of software applications whose typical architecture is shown in Fig. 9.3.

This architecture is a refinement of the front-office and back-office layers of the reference architecture of Fig. 9.1. We see three different application layers:

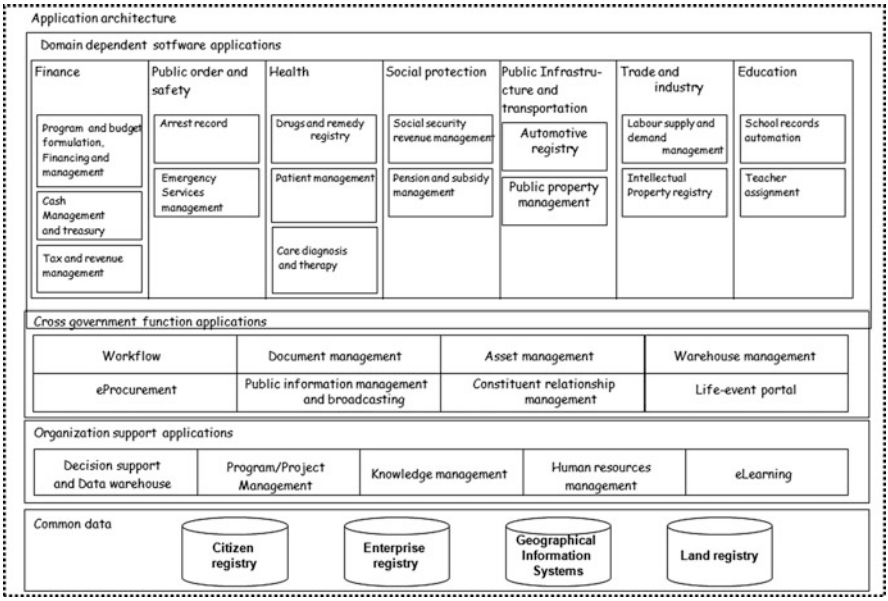


Fig. 9.3 An application reference architecture for eGovernment projects

- *domain-dependent software applications*, such as finance and health, represented at two hierarchical levels;
- *cross-government functions applications*, such as workflow and asset management;
- *organization support applications*, such as decision support and human resource management.

Furthermore, the architecture has some common databases, such as the citizen registry and the land registry, which may be seen as examples of centralized databases discussed before.

9.2 A Methodology for the Choice of Projects

Before analyzing the methodology for the choice of projects, first we have to characterize projects utilizing ICTs (in the following *ICT projects*) in two general categories, horizontal projects and vertical projects.

Horizontal projects concern technological infrastructures and/or software applications implementing general services, used by a wide range of users or administrations. Typical examples of horizontal projects are the creation of a common telecommunication infrastructure or a secure mail service. Horizontal projects are domain independent. Consequently, it is possible to identify a set of paradigmatic types, leading to the realization of

- the cooperation infrastructure (or parts of it) mentioned before;
- a *secure communication infrastructure*, which is in charge of offering a secure transport layer among back-office applications;
- a *secure and certified e-mail* for government-to-government, government-to-citizen, or government-to-business communications;
- a *presentation layer* for a set of multichannel interactions among end users and administrations;
- a *human resource management* software application for the personnel of different administrations;
- databases common to different administrations, such as a national or regional registry of businesses.

These kinds of projects define a common solution that can be used in principle by all administrations.

Horizontal projects are the typical projects related to macro-objectives or micro-objectives. Assume that there has been a political decision of activating a national project for making the web sites of public administration W3C compliant to facilitate the access to disabled persons, the resulting project has the typical character of a horizontal project.

Due to the great variety of horizontal projects, we will not consider them in more detail in the following.

Vertical projects refer to the automation of a specific process/service or a group of processes/services; a typical example of vertical project is the realization of a new software application, e.g., for secure tax payment that is made accessible through Internet to all tax payers.

Vertical projects mainly concern front-office layers which are common to several administrations and internal front-office and back-office layers of single administrations or groups of administrations offering the service (or the services) involved. Due to their nature, vertical projects are domain dependent, so their design is strictly related to the specific service or process.

Clarified in such a way the type of projects we have to conceive in the "choice of projects" step, we now propose (see Fig. 9.4) a methodology for this step, which will be discussed in the following sections.

In short, in order to identify vertical projects, first we have to find groups of service candidate for vertical projects (activity 1). For each project, in activity 2 we choose the best project solution that makes use of the reference architecture introduced in Sect. 9.1. Note that once project solutions have been chosen for a group of services, we can revise previous choices of groups of services or identify a new group not considered before that uses that solution. Thus we have a loop between activities 2 and 1. Finally, in order to identify the overall technological architecture that best fits design requirements, we put together (activity 3) all architectural layers adopted in the different project solutions. Also at the end of step 3 we may have a feedback to activities 1 and 2. In the next three sections we analyze the three activities in detail.

Activity 1. Cluster services
- 1.1 Group services inclusters
- 1.2 Find new services
- 1.3 Find bundles

Activity 2. Choose project solutions

For each cluster of services
- 2.1 define the set of quality dimensions and related targets involved
- 2.2 find two to three quality-improving project solutions
- 2.3 for each project solution determine the impact on quality dimensions and the costs in terms of a {very low, low, medium, high, very high} scale.
- 2.4 rate project solutions in the cluster and choose the project solution with the best quality/cost ratio
- 2.5 identify layers of the reference architecture used by the project solution

Activity 3. Identify reusable layers

Put together layers chosen previously avoiding duplicates and achieving scale economy savings.

Fig. 9.4 A methodology for the choice of projects

9.3 Cluster Services and Find Bundles

There are a huge number of services provided by administrations to citizens, e.g., in Italy about 500 primary services provided to citizens have been identified and a similar number to businesses. In order to optimize the budget available for projects it is not convenient to proceed service by service in the identification of project solutions, rather we have to group services in clusters, according to the criteria inspired for budget optimization.

A *cluster of services* is a group of services characterized by some type of similarity, which can be exploited in the design of solutions that optimize the cost of projects. Which knowledge can we use for identifying clusters of services? A first criterion corresponds to cluster of services according to their *similarity*, measured by their being in the same class in the functional classification. The idea here is that, e.g., two different certification services correspond to similar administrative processes made up of

- a request performed providing some kind of identification of the person who needs the certificate (managed by the front office);
- a query to a database containing the data to be mentioned in the certificate (managed by the back office);
- the production of the certificate (managed by the front office).

Note that the above description of the process is oversimplified, since querying data could need to perform transformations on data, exception conditions have to be managed, etc.

Another criterion we can use is to partition services on the basis of real life events, namely the second classification we introduced for services in Chap. 5. This criterion is based on the assumption that two services corresponding to the same life event should be invoked and provided together and should lead to related operations to be executed together. Note that life events are related by means of a taxonomy, e.g., the life event *change of residency* and the life event *change of residency in the same municipality* are the first a superset of the second one. The exploitment of this taxonomy can make the clustering process more structured and effective, since we may start from general classes and proceed by specialization to more specific ones.

Once we have identified clusters of services, we have to add new services to them that did not emerge from the previous analysis. Public administrations when they provide services are mainly driven by the obligations related to applying laws and rules. Thus it may happen that services that are perceived (often tacitly) as useful by users are not considered as an obligation by public administrations. So, they may not be included in the repository of services neither be discovered using the two classifications above, but, instead, are discovered by means of investigations and questionnaires or user needs and requirements.

Such discovering of new services allows to extend clusters to identify *bundles of services*, namely, groups of services that are needed together by users and, consequently, can be provided and delivered together, satisfying in such a way all the requirements of users. Private service providers, whose business activities provide and sell services in the market, are specifically interested in identifying groups of services to be sold together in bundles.

Consequently, new services and bundles can be discovered by means of social or marketing researches. A specific feature available in eG4M for this goal, due to the dual service- and data-oriented approaches of the methodology, is the joint usage of the service repository and the data repository. We will show an example of joint usage of the two repositories in the following discussion on the running example.

9.3.1 Running Example

Services in the running example may be easily clustered according to the two related events, the *change of residency* and the *need for a medical examination*. The first four services, namely

- communication of change of residency to the old municipality;
- communication of change of residency to the new municipality;
- change of residency in the driving license;
- change of residency in the health card

may be grouped in one cluster and the remaining service, reservation for medical examination, results in a second singleton cluster. This grouping has also been

considered formerly, when (see Fig. 8.11) we identified the reduction of the interactions from two to just one as a common goal for all of them.

Coming to the extension of clusters to new services and bundles, we now show an example of common usage of the service and data repositories.

In the example, to make the discussion more effective, we assume that, due to the "one service at a time" typical attitude of public administrations, only the change of residency event of life and related service has been considered so far (see Fig. 9.5). Thus, in the service repository we initially represent the service "change of residency" (see Fig. 9.5), which can be seen as the union of services "communication of change of residency to the old/new municipality." The service is related in the data repository to its *service data schema*, namely the schemas of data concepts (entities and relationships in the entity – relationship model) that are involved in the execution of the administrative process that produces the service. The idea here is to move from the service repository to the data repository, in order to understand which entities are close to the entities in the original service data schema, making the assumption that such entities belong to schemas of services that are candidates to be in the same bundle. Moving from the service repository to the data repository and looking for entities adjacent to `Person`, we obtain the schema in Fig. 9.6.

In the figure we also represent with closed lines the service data schemas and in rectangular boxes the databases where the entities are represented and managed. Such databases can be identified looking at the types of data/database matrix introduced in Chap. 5. Considering the databases leads us to identify the administrations managing them that have to be involved in the project solution related to the bundle we are constructing.

We move now in the inverse direction, from the data repository to the service repository, looking at services that have the schemas identified in the previous step as data schemas (or suitable compositions of those ones); see Fig. 9.7. Notice that at

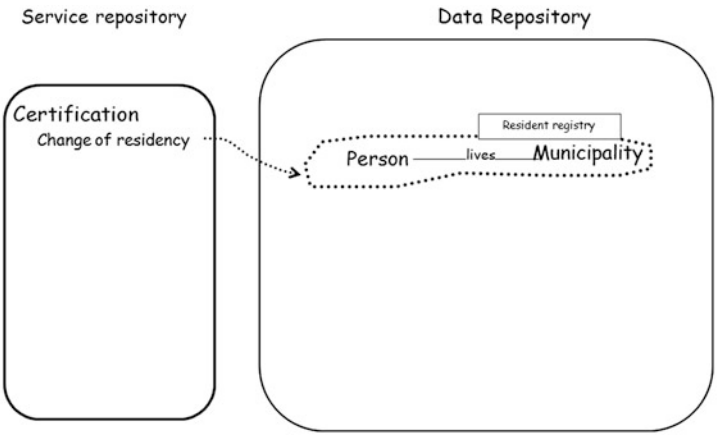


Fig. 9.5 Example of bundle identification using the service and data repositories together: first step

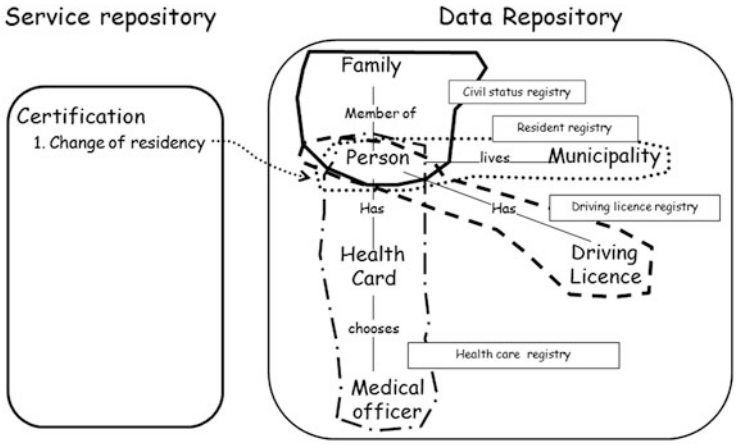


Fig. 9.6 Example of bundle identification using the service and data repositories together: second step

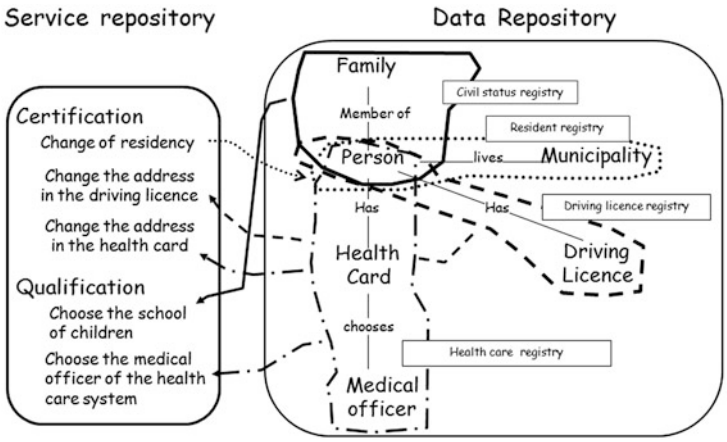


Fig. 9.7 Example of bundle identification using the service and data repositories together: third step

this stage we find two new services, namely *choose the school of children* and *choose the medical officer* that have never been discovered before in the running example, referring to the school of children and the choice of the new medical officer.

At the end of this step, in the running we obtain an example two bundles of services made of:

1. A first bundle consisting of

   a. communication of change of residency to the old municipality;
   b. communication of change of residency to the new municipality;
   c. change of address in the driving license;

d. change of address in the health card;
e. choose the school of children;
f. choose the medical officer for health care system;

2. a second bundle with only the medical exam reservation.

In the following discussion of the running example, to make things manageable, we consider the two initial clusters and do not consider the services related to the school of children and the medical officer.

9.4 Choose Project Solutions

In this step we have to move from generic definitions of projects (such as "automatize the cluster of services" or "use the e-mail for informal interactions among administrations in the provision of services") to the identification of project solutions. A *project solution* is a specification of the project in terms of layers of the reference architecture that are used, plus a description of the sequence of interactions among users, administrations, and applications in the usage of the layers selected. Finding from two to four project solutions is usually enough to achieve a complete view of the alternatives.

In the following section we will show several examples of this activity that, as we said in the introduction, can hardly be expressed with a step-by-step procedure.

At this point we have to define comparison criteria for choosing different project solutions to be adopted for the same or bundle of services. For such a goal we use a table such as the one shown in Fig. 9.8.

In the table the following are highlighted: (i) the general objectives to be achieved in the automation of the bundle of services, (ii) the related bundle, (iii) the project solutions, and for each project solution (iv) the quality dimensions chosen in previous phases of eG4M as relevant, (v) the effect (of the project solution) on quality dimension improvement targets, and (vi) the economic cost of the project solution

Objective	Bundle of services	Project solution	Quality dimension	Effects on quality dimension	Cost
		Description of project solution 1	Dimension 1		
			Dimension 2		
			Dimension 3		
			……		
			Dimension n		
		Description of project solution 2	Dimension 1		
			Dimension 2		
			Dimension 3		
			……		
			Dimension n		

Fig. 9.8 A form for project solutions comparison

implementation. The heuristics here is to re-examine the general organization of project solutions, in order to be able to estimate

- discrete *quality improvement scores* (QIS) in the domain QIS = [very low, low, high, very high] for all quality dimensions selected;
- a rough evaluation of the cost of the solution, expressed in the same domain, where positive values are considered in the inverse order (very low cost corresponds to very high quality improvement score).

Note that in this activity we can weight the scores on the basis of the influence of political objectives.

The different project solutions are now compared on the basis of quality + cost scores and the one with the highest ratio is chosen. It may happen that the best project solution is in the area <quality = "high or very high," cost = "high or very high">, but the cost is not compatible with the budget available. These situations may lead to discarding or postponing the realization of the best project solution, first adopting a solution with a lower score. This is another reason that suggests selecting three/four solutions instead of just one.

9.4.1 Running Example

In the following we use the term *group of services* to mean cluster or bundle of services interchangeably. For the first group of services, we have to reconsider the information resource/organization matrix and the quality dimensions chosen in previous phases of the methodology. Looking at the information flows and the reference architecture, we may conceive three solutions:

1. The online provision of the certificates; in this case we privilege the adoption of an ICT.
2. The introduction of self-certification; here we leverage the normative issue.
3. The exchange of the information on residency directly from the inter-administrative back-office, through the publish – subscribe layer; again a technological solution.

The first solution results in a complex technological project, see Fig. 9.9, where we have represented technological layers adopted and interactions among users and administrations. Note that in the figure we have highlighted the two types of interactions between users and administrations, namely digital and physical interactions. The project is complex since in order to identify citizens requesting certificates and provide them digital residency certificates, a secure authentication technology is needed (i) at the front-office layer (see Fig. 9.9 for authentication) and (ii) at the back-office layer for signature of certificates. However, the solution has a limited impact on improving quality dimensions. In fact, it only partially reduces the user time for the part related to certificate a request and delivery, while it does not

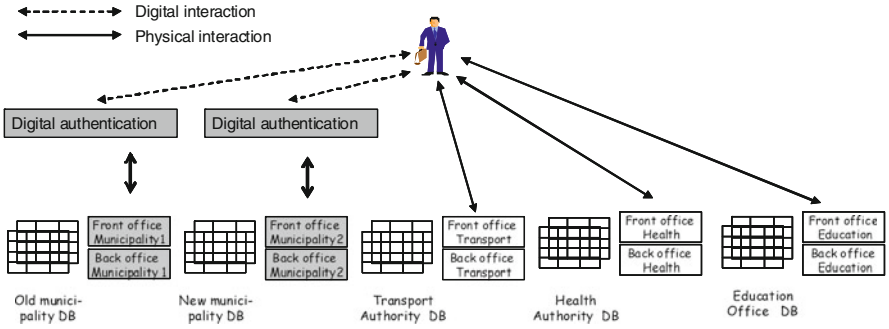


Fig. 9.9 First solution (for the first cluster of services)

influence the time for certificate provision. Service provision time is not modified at all, while the level of simplification is improved only for interactions needed for certificate acquisition.

The introduction of self-certification (second solution, see Fig. 9.10) simplifies a number of bureaucratic procedures with a reasonable effect on efficiency, without introducing the complexities involved in the previous solution. In fact, the processes that are needed for the residency information to proceed are speeded up, while the costs are very low. The negative side is due to the users that in this solution must provide the PAs with information that is already available in the local databases. In this case the intervention involves mainly legal issues, since new laws have to be enacted to allow self-certification and oblige administrations to accept self-certification as a substitute of certificates. Furthermore, in order to discourage false self-certifications and persecute abuses, random sample controls have to be performed that verify the correctness of residency information.

The third solution fully adopts the cooperative reference architecture; adapting the architecture to the specific case, we may produce the architectural solution shown in Fig. 9.11.

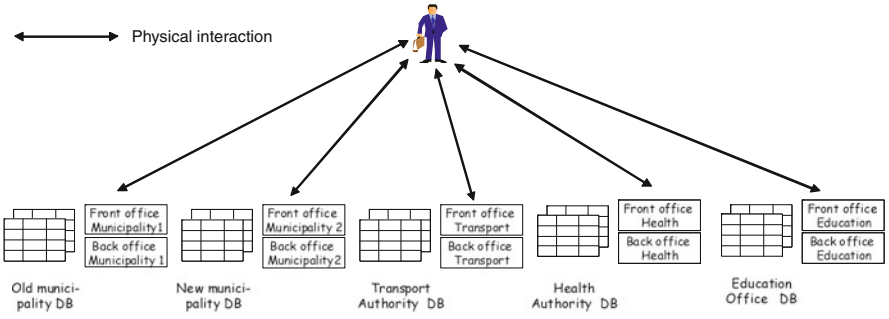


Fig. 9.10 Second solution (for the first cluster of services)

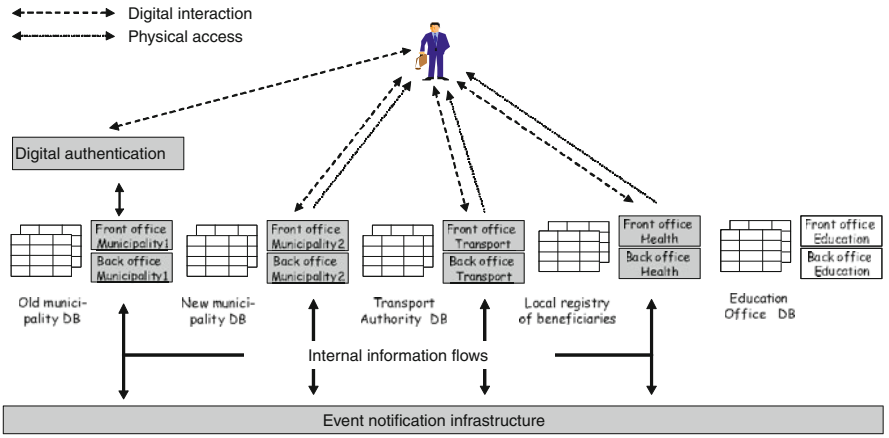


Fig. 9.11 Third (long-term) solution (for the first cluster of services)

The third solution is the most effective one because it fully re-engineers the administrative process and performs all the updates of the residency information through the event notification infrastructure, releasing users from all activities of information provision, except the provision of his/her own identity, which is performed only once at service request time. This unique contact between citizens and the front office of an administration can be performed in two ways: (i) using the Web and a digital authentication infrastructure (see Fig. 9.11) or (ii) with traditional desks, avoiding the complex technological project of electronic identification. The delivery of the new documentation to users can be performed using the post channel or else the Internet channel. Notwithstanding these advantages, the third solution in both of the above cases is expensive, since it requests a huge modification of the public administration back-office technological architecture.

The effects of the three solutions on the selected quality dimensions and their costs are represented in Fig. 9.12. We also report the major objectives related to the project.

The comparison of the three solutions leads to the adoption of self-certification for the short term, while launching for the long term the restructuring of the back office, giving priority to administrations characterized by the most relevant exchanges of information. According to our experience, such administrations are those in the fiscal and social security areas.

We now discuss with the last service, namely the medical exam reservation. To exploit this service we have to conceive a vertical project. Here we have (among others) two possible project solutions. The first solution (see Fig. 9.13; here and in the next figure a pictorial representation is shown, instead of the reference architecture representation) corresponds to speeding up the server to which the access points at the desk are connected. This solution leaves the administrative process and the actual interactions between users and administration at the desk level unchanged. Service request/provision may also be performed with the phone channel.

Objective	Cluster of services	Project solution	Quality dimensions	Effects on quality dim.	Cost
1. To improve The effectiveness of the administration activity 2. To simplify the process for the change of residency	1. Comm. of change of residency to new municipality 2. Comm. of change of residency to old municipality 3. Change of residency in the driving licence 4. Change of residency in the health card	Online certification	Temporal accessibility	–	Very high
			User time	Low	
			Service provision time	Low	
			Level of simplification	Low	
			Channel availability	Low	
		Self-certification	Temporal accessibility	–	Low
			User time	High	
			Service provision time	Low	
			Level of simplification	High	
			Channel availability	Low	
		Information on residency sent through the publish and subscribe system	Temporal accessibility	–	High
			User time	High	
			Service provision time	High	
			Level of simplification	High	
			Channel availability	High	

Fig. 9.12 Quality/cost-driven choice of the solution for the first group of services

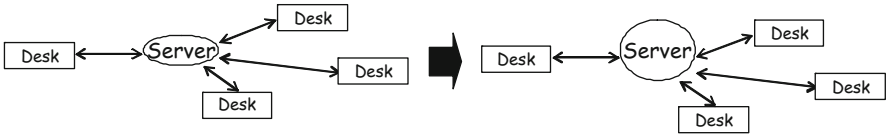


Fig. 9.13 First solution for the reservation of medical exam service

The second solution (Fig. 9.14) completely modifies the interactions, through (i) the creation of a call center accessible, let us say, 12 h a day on week days, which may be accessed by means of the phone network, and (ii) the creation of an Internet site that allows request and delivery of services via web.

The second solution exploits the reference architecture in the layers shown in Fig. 9.15.

Now we compare the two solutions on the basis of the effects on quality dimensions (see Fig. 9.16). The speeded-up server has a low effect on all the quality dimensions, as its only influence is on the response time of the point of access, leaving the most critical and time-consuming phases of service request and provision unchanged. The second solution significantly improves all the dimensions considered, both in the case of Web access and in the case where the call center is involved. The second solution exploits positive dependencies among dimensions more than the first one, e.g., channel accessibility greatly reduces user time, due to the phone access instead of the physical access.

Furthermore, the second solution also outperforms the first one also in the frequent case of a change of reservation, for which we may make the same positive

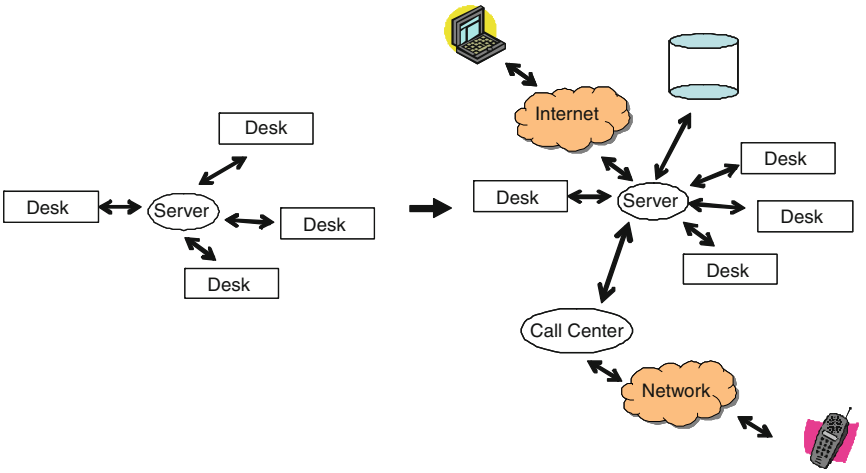
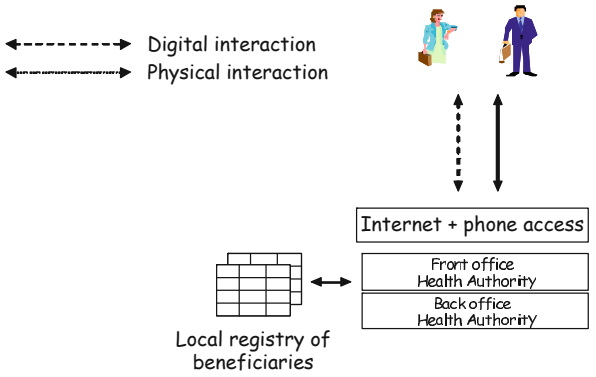


Fig. 9.14 Second solution for the reservation of medical exam service

Fig. 9.15 Layers of the reference architecture involved in the second solution



Objective	Cluster of services	Project	Quality dimensions	Effect son quality d.	Cost
Improve the present scarce quality of health services	Medical exam reservation	Enhancement of the server used by the desk clients	Temporal accessibility	Low	Low
			User time	Low	
			Service provision time	Low	
			Level of simplification	Low	
			Channel availability	Low	
		Opening a call center	Temporal accessibility	High	High
			User time	High	
			Service provision time	High	
			Level of simplification	High	
			Channel availability	High	

Fig. 9.16 Quality/cost-driven choice of the solution for the case of medical exam reservation

considerations with respect to the first solution. The only negative point of the second solution is the cost, which in any case is lower than the cost of the inter-administration back-office infrastructure to be realized for the change of residency, due to its restrained administrative system of reference. We decide to adopt the second solution.

9.5 Identify Reusable Layers

In order to identify reusable layers, we may consider the layers of the architecture utilized by the two selected project solutions (here we select for the first cluster of services the long-term solution), resulting in the architecture of Fig. 9.17. In this case we do not have cases of multiple usage of the same layers; generally it is quite probable that this situation may occur, e.g., another cluster of services could request for a publish – subscribe layer for information, let us say, referring to businesses instead of persons. In the more complex cases we have to choose which subset of administrations to connect and provide with the publish – subscribe layer or we could even make use of two different and separate layers related, respectively, to persons and businesses. These kinds of choices are typical of subsequent phases of eGovernment projects, which may need a deeper feasibility analysis and cost – benefit evaluation.

At the end of activity, we represent projects selected on a list (see Fig. 9.18), where for each project we report the legal/organizational/technological impact and for each involved quality dimension the impact of the project on the dimension.

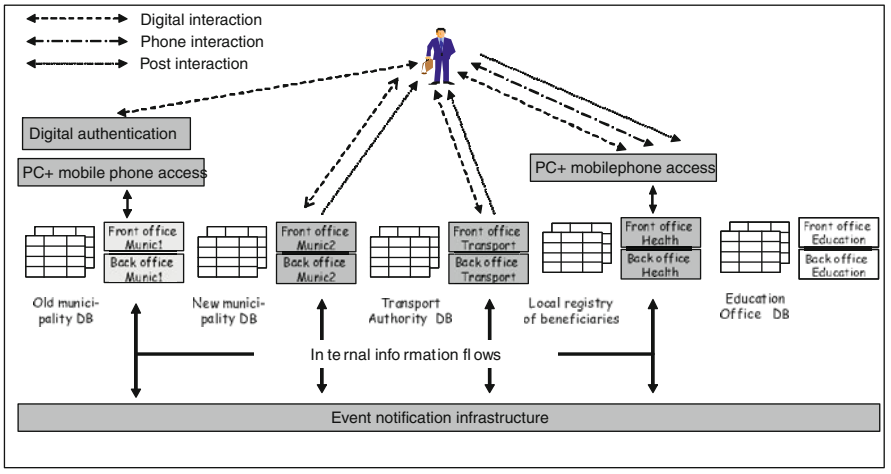


Fig. 9.17 Layers of the architecture requested by the two selected project solutions

Project	Impact	Temporal accessibility	User time	Service provision time	Level of simplification	Channel accessibility
Long term→ realize the publish and subscribe architecture	Mainly technological	-	High	High	High	High
Short term→ Self-certification	Mainly juridical/ organizational	-	High	Low	High	Low
Call center for reservation of medical exams	Both technological and organizational	High	High	High	High	High

Fig. 9.18 The list of projects selected

9.6 Summary

In this chapter we have proposed a methodology, which using approximate models and reasonings allows to group services selected in previous phases, conceive alternative ICT project solutions, and choose the project solutions that maximize the achievement of selected qualities at a given cost. The phase discussed in this chapter exploits all the products of the planning activity, generating a list of ICT project solutions that are the input to subsequent operational planning phases. We have tried to demonstrate that in these choices the public administration managers not skilled in ICT can play an active role; the discussion of the running example, in particular, shows the pragmatic style of eG4M in making complex decisions, using simple yet effective strategies.

Chapter 10
A Reference Technological Architecture

This chapter presents a possible reference technological architecture for eGovernment projects, based on the service-oriented architecture (SOA) paradigm and related technologies and approaches. Such a reference architecture leverages the Italian experience called SPCoop (in Italian *S*istema *P*ubblico di *Coop*erazione, possible English translation as "nationwide cooperative system"), which was designed recently and subsequently developed and used in ongoing Italian projects. It is a refinement of the reference architecture introduced in Chap. 9 and introduces technological details and software elements for modern eGovernment infrastructures. In particular, Sect. 10.1 provides some organizational and strategic guidelines that the governments and other political bodies should consider when setting up a reference architecture for eGovernment. Section 10.2 introduces basic concepts and definitions which are useful in the following of the chapter. Section 10.3 provides an overview of the reference architecture, whereas Sects. 10.4, 10.5, 10.6, and 10.7 provide technical insights on the different elements of the reference architecture. Finally Sect. 10.8 compares the presented architecture with similar initiatives currently undertaken in Europe.

10.1 Organizational Considerations for Setting Up a Reference Architecture

In this section we briefly consider the Italian case as a possible reference example, as we argue that such an experience and the proposed organizational solutions are not limited to the Italian scenario, but can be reproduced and enhanced in many other contexts (European and Mediterranean in particular) in which the implementation of eGovernment should face with a decentralization process.

Before 2000, the scenario of the ICT in the Italian public administrations was quite dishomogeneous: there were sectors of excellence in some central PAs as far

This chapter is authored by Massimo Mecella. It is based on papers [14, 15].

G. Viscusi et al., *Information Systems for eGovernment*,
DOI 10.1007/978-3-642-13571-2_10, © Springer-Verlag Berlin Heidelberg 2010

as basic and advanced interoperability and cooperation was concerned, and other central or regional PAs which acted as almost isolated systems.

The reform of the Italian Constitution in 2001 attributed indeed new possibilities for action to local authorities. Since then, the right of regional public administrations to pass laws autonomously represented an increasingly effective means for decentralization with respect to administrative, organizational, and also technical aspects. But from an ICT management point of view, this decentralization generated different points of decision, possibly leading to different ICT choices as well as different organizational processes.

In general, decentralization can rapidly bring the proliferation of different interoperability infrastructures (a sort of "spaghetti" connections/middlewares) with the consequent high risk of inefficiency. Even though the process of decentralization of competencies and diversification of ICT solutions can help in rapidly defining and actuating political objectives (defined by law) at the regional or local level, it becomes tremendously difficult to implement political objectives at the interregional or national level sharing local and central competencies. Many examples of such strategic objectives can be found in the areas of health care, employment, register offices, tax offices. If not mastered properly, this process of decentralization, instead of turning out as an advantage for the country, can lead therefore to a lack of interoperability among the PAs.

Given this context, the Italian issue was to set up an organizational process, together with technical solutions, which would allow the development of nationwide application cooperation/integration among back offices. Even if Web services nowadays are the technological instrument enabling the solution, such a solution requires a strategic vision, based on a bottom-up process for reaching a shared PA-wide service-oriented architecture, and for maintaining it, and (ii) a deep and comprehensive technical specification of such an eGovernment SOA.

In 2003 the government, supported by the CNIPA,[1] started the coordination of a nationwide bottom-up consensus operation, from basic telecommunication services to advanced application cooperation. Different working groups were started with the participation of over 300 representatives of central and local PAs, universities and research centers, and Italian ICT companies. In parallel to the bottom-up process for the definition of SPCoop, the government issued a law decree, approved by the local governments, that defined the legal framework of the whole initiative. The law decree no. 42 (February 2005) establishes the scope, the sectors of interest, the technical rules, the concept and the scope of a national shared infrastructure, the

[1] CNIPA – Centro Nazionale per l'Informatica nella Pubblica Amministrazione [Italian National Center for ICT in the public administration], during 2010 renamed as DigitPA (digital PA), is a government agency that supports and implements policies for reformation and innovation in the public administration. In particular it (i) establishes the strategies of the ICT innovation, (ii) proposes and supports the drafting of laws and related technical rules for the use of ICTs, (iii) organizes "call for projects" to innovate ICT infrastructures in the PAs and then funds and reviews selected projects, and (iv) promotes best practices and coordinates the planning process. Moreover, it monitors (by providing technical/economic congruence opinions) procurement of ICT services. Finally, it is responsible for the ICT training of PA managers.

governance, the management, and the governing board. The board is composed of 17 people, from central and local governments, who approve the technical rules, the guidelines, the areas of evolution, the condition for participation. In particular, law decree no. 42 establishes two important principles:

- The cooperation among administrations is exclusively carried out on SPCoop, with its tools and according to its technical rules; it has *legal* value and no further decree or official publication (e.g., on the Gazette) is needed (e.g., when defining standard XML formats for data exchange).
- The public ICT managers need to organize their information systems, including organizational and management aspects, in order to accommodate SPCoop rules.

Therefore, SPCoop is not only a software framework but also a technical and organizational platform whose aim is to create the conditions for a long-lived *legally valid* cooperation among administrations. It is based on four pillars which are leading edge in terms of technologies, best practices, and organization: (i) formalization, and successive publication, of *service agreements* between PAs; (ii) definition of a federated identity management system for access control; (iii) definition of the metadata about the effective data to be used for cooperation, of the semantics and of domains' ontologies and/or conceptual schemas; (iv) open and continuous update of the SPCoop model, by taking into account the latest progress in technologies and standards.

Then in 2006 four public tenders were launched concerning the following:

- Network services, including VoIP and ubiquitous connectivity. Such network services form the basic communication infrastructure connecting national and local authorities.
- Shared network infrastructures, including services for managing the service-level agreements (SLAs) of the providers, the security, and the VoIP services.
- An initial set of interoperability services of SPCoop, including identity management, PA web site/portals creation and management, domain gateways and tools for wrapping back-office applications as SPCoop Web services to be deployed in the domain gateways.
- The effective SPCoop infrastructure.

Moreover, 56 regional projects on eGovernment, focused on network and interoperability infrastructures, have been launched for an overall amount of 100 M€. These projects provided best practices as well as reference implementations of the different SPCoop elements, in order to govern the bottom-up approach. The biggest project was ICAR (Interoperability and Application Cooperation among Regions), started in June 2006 and concluded in 2009,[2] the main results of which have been the compliance of large *horizontal* projects with SPCoop, and the complete definition and advertisement of about 100 service agreements, the development of a

[2] `http://www.progettoicar.it/Home.aspx`

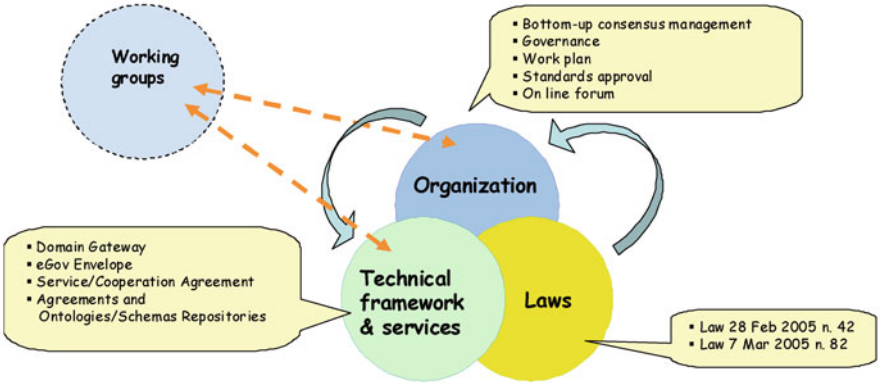


Fig. 10.1 The interplay of organizational, legal, and technical aspects in SPCoop

directory of public employees reaching 800,000 entries, and finally the reference implementation of all the components.

Before concluding this section, we would like to point out how the governance and strategic actions presented above represent the element of success; adopting a common infrastructure for interoperability and cooperation on the basis of solely technical solutions has proved unsuccessful in the past, conversely the use of a community approach to realize evolving versions of the framework and to create an SPCoop "culture" in the PAs seems a better solution. Such a community is expected to be led by administrations, with the active participation of industries and universities. This also constitutes an enabling factor for the overall innovation process of the whole country. The documents published in 2005 represented a technical road map for such a community toward the effective SPCoop development, whereas typical community tools (e.g., online forums, development community, and the continuous evaluation of standards by CNIPA) support the process. Figure 10.1 shows the overall approach to SPCoop.

10.2 Basic Concepts

In this section we provide some basic definitions needed in the rest of the chapter:

- An *external service*: as introduced in previous chapters it is a service as seen by the final user (citizen, entrepreneur, etc.). In the following, we consider only the case in which such a service is accessible electronically; the channels used to receive such a service are the (dynamic) HTML, e-mail, SMS/MMS. Such a service is often referred to as *e*-service, in order to highlight it being accessible through electronic/digital channels.
- An *internal service*: as introduced in previous chapters it is a service as seen by an administration, often offered in order to make it collaborate with other PAs for

the provision of an external service. In the following, as the reference architecture aims at eliminating human intervention in the cooperation, we only consider the case of internal services realized as Web services.[3] An internal service may be offered as either (i) it directly supports an external one (offered by the same PA) – in this case we refer to it as *intra-PA* internal service or (ii) it supports, jointly with other internal services of other PAs, an external service which requires the cooperation of different PAs – in this case we refer to it as *inter-PA* internal service. Clearly an internal service may be of both types. An example is the tax certification service, i.e., a service which given the social security number (SSN) of a citizen and a year returns the taxes paid by the citizen. It is realized as an internal (Web) service and supports both the equivalent external service (thus playing the role of intra-PA) and a complex external service which allows the access to some gratuity for nursery service, and which requires, during the computation, the verification of taxes paid w.r.t. a threshold (thus playing the role of inter-PA). In the following, if not otherwise specified, we write "service" to mean internal services.

- A *composite service*: it is a service which has to implement the coordination of other services in order to be offered. An example has been provided above, i.e., the service which allows free day care and requires the interaction with a tax service, with a health authority service, etc. A composite service *orchestrates* several inter-PA internal services and is offered as an external service. Such an orchestration is basically the realization of the macro-process needed to carry out the external service.
- A *service owner*: it is the PA which is legally responsible/appointed for offering the external service.

From the previous definitions, it emerges that an external (*e*-)service can be realized either by an intra-PA internal service or by a composite service orchestrating several inter-PA internal services.

10.3 Overview of the Reference Architecture

The model proposed for the reference architecture is based on the following principles:

- The PAs cooperate through the supply and use of (internal) services; these services are offered by single administrations through a unique (logic) element belonging to its own information system called *domain gateway*. This way

[3] Web services (WSs) are remote application components that can be invoked via SOAP protocol [3]; they only present interfaces toward other software modules, whereas they do not have an interface toward the final user. Generally speaking, an *e*-service can be realized invoking a WS (e.g., inside a servlet deployed on a WWW server), even if it is not compulsory; on the other side, a WS is not necessarily used for *e*-service supply.

the complete autonomy of the single administration is guaranteed, as far as it concerns the implementation and management of the provided services, since they can be based on any application platform, being it pre-existent or new, as long as they are supplied through the domain gateway. The fruition of the services is carried out through the SOAP protocol (and its possible extensions, if needed: see also [2, 166][4]). Such services can be offered and used either in a traditional request – reply mode or according to a publish – subscribe paradigm (use of WS-notification standard [153]).

- A service works on the basis of an agreement among at least two subjects (supplier and client); such agreements have a technical and an institutional/jurisdictional basis. These agreements should be formalized in order to support the development and life cycle of services in a (semi-) automatic way. The agreement specification is called *service agreement* and is based on the XML language.
- Sets of administrations which need to cooperate in order to provide composite services form a *cooperation domain*; the services supplied by such a domain are *externally* described through service agreements and *internally* by a specification describing how the different PAs concur to compose the final service, referred to as *cooperation agreement*.

It emerges that this cooperation model is organized as an SOA [3]; but even if the basic aspects related to an SOA are well defined from a technological point of view, conversely it is necessary to extend the advanced aspects in order to make the architecture suitable to the specific eGovernment scenario. The reader should note that all the SOA architectures[5] need a neutral element,[6] with the goal to mediate between the different subjects cooperating for the service supply/use; the reference architecture here proposed includes a set of infrastructural components, overall referred to as eGovernment cooperative support system (eGCSS), to be used to simplify these operations (e.g., retrieving a service through automatic categorization, managing digital identities). These are represented in Fig. 10.2:

- The *agreements repository* is the software component used to register and to maintain the cooperation/service agreements. It can be considered as the "database" of the cooperation. This component offers functionalities for the registration, the access, the update, and the search of the agreements. The UDDI standard is the core of this component; however, this standard does not offer all the required functionalities; therefore, it should be extended.
- The *schemas/ontologies repository* is the software component offering functionalities to deal with the service and data semantics, in order to find out services

[4] In the Italian case, SOAP has been extended in order to provide some specific guarantees in terms of reliability. Such a standard is called *e-Gov Envelop*.

[5] This is true for both the W3C and ebXML/OASIS standards.

[6] Technically called *service directory*, the technological counterpart of the service repository introduced in Chap. 5; see also the end of this section.

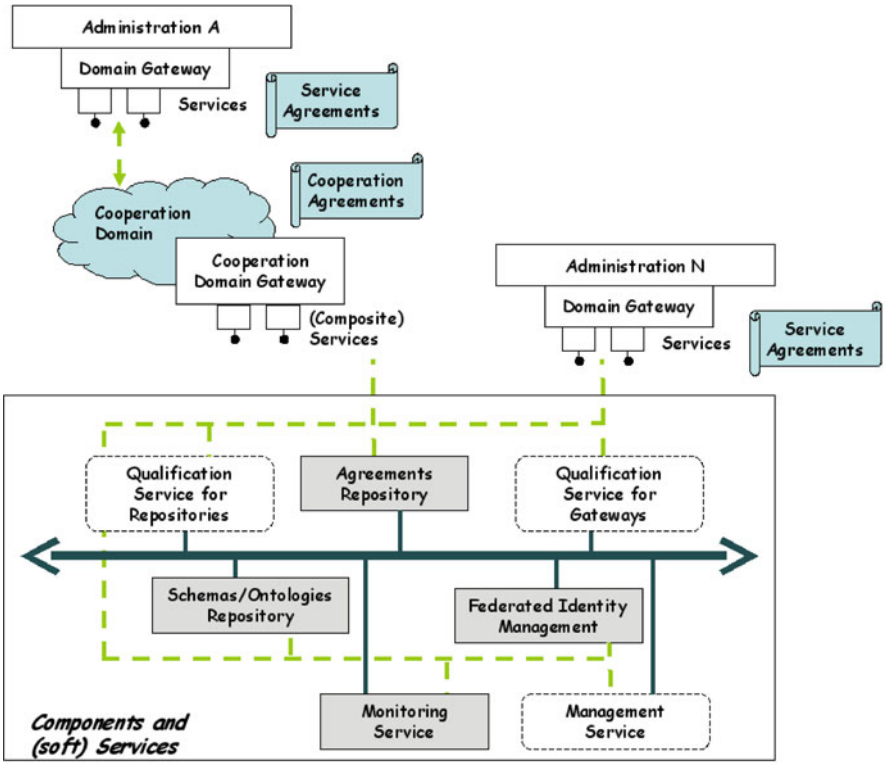


Fig. 10.2 The components and (soft) services of the reference architecture

that are more suitable to provide required functionalities. Conceptual schemas have been discussed in Chap. 2, while an *ontology* (a concept that we have met several times in this book) is a formal representation of a piece of knowledge by a set of concepts within a domain. Roughly speaking, the main difference between a conceptual schema and an ontology lies in the fact that the former has a "shallow" semantics; while the latter has a formal semantics, thus, reasoning can be performed on it. See [96, 97] for an introduction to ontology.
This component acts as a structure to store ontologies and conceptual schemas, offering functionalities of registration, access, update, and reasoning on them.

- The *federated identity management* is used to authorize and control the access to application services; the federation is needed to reuse the already in-place identity management systems of regional and national authorities. Integration can be made through specific interfaces supporting SAML v2.0.
- The *monitoring service* is in charge of monitoring the respect, by the different services, of the service level agreements (SLAs) declared in the service agreements.

In addition to the previous components, a set of soft services, i.e., functionalities that need to be provided through different tools (either software or managerial) in order for the infrastructure to be effective, are defined: (i) *qualification services* for both the repositories and the gateways, i.e., coded procedures for certifying that the components are compliant with the technical rules and (ii) services for the management of the whole infrastructure.

In the next sections, some technical details on the most innovative aspects of the reference architecture and the eGCSS will be provided.

The reader should note that the relationship with the conceptual architecture was presented in previous chapters. Basically here we describe how the back office of Fig. 9.1 is concretely realized and which infrastructural elements are needed. For what concerns the front office, nothing is said in this chapter, as it can be realized with usual technologies and tools for interface and multi-channel development. Regarding the back office, it is realized through Web service technologies, which provide both the cooperation infrastructure and the event notification infrastructure. What in previous chapters has been roughly named as repository of services, here is better specified in its concrete realization, in terms of agreements repository (where service descriptions can be searched) and schemas/ontologies repository (where data definitions and semantics as used by the services can be searched).

10.4 Service Agreements

A service agreement is a well-specified XML document that regulates the relationships of a service between a supplier and a client in the following aspects:

(i) service interface;
(ii) conversations admitted by the service;
(iii) access points;
(iv) service level agreements (SLAs);
(v) security characteristics and descriptions of the semantics of the service.

The formal and well-specified nature of the service agreement is needed in order to support the development and the life cycle of services in a (semi)-automatic way. Moreover, the public nature of the service agreement makes easier the establishment of domain conceptual schemas/ontologies that allow to aggregate services with similar semantics. Finally, in the context of a set of public administrations (i.e., a cooperation domain), services can be composed and orchestrated, thus generating other services described in turn by service agreements.

The services are supplied/used through Web service technologies and standards "enforced" by public service agreements. WSDL can be used to describe the elements (i) and (iii). The element (ii) is considered as a typical service that requires multiple interactions between the service supplier and the client, and not all the

offered operations are invocable in every step during the interaction. Thus, in order to use the service correctly (and therefore to develop *correct* clients), it is important to know in which steps operations can be invoked. This is different from the description of the internal process of a service, i.e., the description of the workflow implemented by the service to offer such operations; nevertheless, such conversational protocol can be obtained from the internal process by making abstractions in order to eliminate the details (*internal view*) while focusing on those service functionalities that are visible outward (*external view*) [215, 3]. The model that describes the conversation protocol through a finite state machine [25] is considered meaningful and simple at the same time. Nowadays it does not exist a standard in the Web service arena having the characteristics needed to describe this element, and therefore new languages, specifically designed for this purpose, can be introduced, by leveraging previous standard proposals (WSCL – web service conversation language[7]) and academic ones (WSTL – web service transition language [26]). We envision a near future in which new standards or existing one will mature and will be appropriate for describing such an element.

As far as points (iv) and (v), their importance is related to the particular scenario: services that are used to offer to citizens and enterprises operations belonging to the administrative/bureaucratic field, have to declare the supported levels of quality and of security. Again, nowadays, standards with the needed characteristics do not exist: (a) the WSLA (web service level agreement) proposal did not become a standard, yet showing many interesting conceptual elements; (b) WS-agreement is implied in a process of standardization in the limited context of the Grid computing, whose final outcome is not yet clear; (c) OASIS web service quality model is a work-in-progress proposal, but its real adoption is again not clear; (d) WSSF (web service security framework) seems to be promising, but its time of diffusion is not outlined. For all these reasons, those aspects can be described in a service agreement through whichever of the just cited languages, as well as through analogous formalisms based on the XML language and publicly available, according to an agreement between the supplier and the client.

The last point we have to address is that, in an eGovernment scenario, many concepts that should be shared and universally accepted conversely show deep differences of meaning among different cooperating subjects, presenting different descriptions and formats. As a result, the description of the conceptual schemas and the ontologies related to the information carried out by a service have the same importance of the definition of the interface [216]. Proposals for the description of these aspects are rapidly emerging, but the proposals related to OWL and/or WSML/WSMO (the so-called *semantic web*) are not yet considered as standards, and their relationship with Web services and the related standards is under investigation; moreover, techniques to compute semantic queries are still under investigation. The aim in the near future is to have, in the near future, as few conceptual

[7] `http://www.w3.org/TR/wscl10/`

schemas/ontologies as possible through which to describe the semantics of all the services offered by the different administrations.

10.5 Cooperation Domains and Cooperation Agreements

A service agreement describes a *two-party* collaboration/cooperation, with a subject offering an application service and another subject using such a service. Many administrative processes do not only concern a single administration, but they involve different subjects.

The *cooperation domain* is the formalization of the wish of different subjects to join in order to cooperate for the automation of administrative processes. Inside the cooperation domain, a *responsible coordinator* should be identified; it assures the organizational and technical effectiveness and the coordination of all the involved subjects and of the set of *composite services* supplied outward by the cooperation domain. It becomes the de facto service owner of the composite services. The cooperation domain is seen outward as a service supplier acting like a normal domain of a single administration; the main difference is in the way its services are designed and deployed: in the cooperation domain they are built by composing and integrating simple services offered by the involved administrations, whereas for the single domain the supply of a service is related to applications that are fully under the responsibility of the single administration.

A *cooperation agreement* represents the specification services offered by a cooperation domain. The service supply is characterized by three basic elements:

- Services offered outward by the cooperation domain: From the user point of view, these services (*composite services*) are identical to any other service directly offered by a domain, and like them they are described by a service agreement.
- Services used internally by the cooperation domain to build the composite services, referred to in the following as *component services*; they are also described by their own service agreements; the reader should note that such services are inter-PA internal services offered by the cooperating PAs.
- The specification of the way the component services are coordinated to build the composite service. This specification, needed for each composite service, can be defined either in terms of *orchestration* (i.e., from the point of view of the composite service, by describing the process for composition and coordination of the component services) or in terms of *choreography* (i.e., by an external point of view, by describing the constraints on the messages exchanged among different component services). Currently we suggest the first solution, through the use of WS-BPEL.

Therefore, a cooperation agreement consists of (i) an *institutive document*, expressed in natural language, describing the purposes and the normative or institutional basis of the cooperation domain; (ii) a set of references to the service agreements, describing the composite services offered by the cooperative domain; (iii) a

set of WS-BPEL documents (one for each composite service) describing the coordination processes among component services; such documents can be processed through suitable orchestration engines that are able to automate the coordination and the supply of a composite service; and (iv) a set of lists of references to the service agreements describing the component services (a set for each composite service).

In summary, a cooperation agreement is the technical tool for the definition of an external service which requires the realization of a complex macro-process.

10.6 Repositories for Agreements and Schemas/Ontologies

The reference architecture previously outlined provides some *infrastructural* software components, a.k.a. infrastructural services, which are needed in order to correctly manage the service (and cooperation) agreements and to monitor the cooperation among PAs. Such services are overall referred to as *eGovernment cooperative support system* (eGCSS). Among these services, there is an infrastructural software component to register and to maintain service (and cooperation) agreements – it can be defined, as we already noticed, as the "database" of the cooperation. This component offers functionalities for the registration, the access, the update, and the search of the service/cooperation agreements. The UDDI standard is the starting point to define and implement this component; but this standard does not offer all the required functionalities, in particular UDDI defines content-unaware queries, while the repository will offer the capabilities for queries about the content of the agreements. Therefore, specific software layers have to be designed to extend UDDI in order to realize all the envisioned functionalities. From a deployment point of view, the repository can be organized into two layers, namely *general* and *local* (in order to accomodate decentralization of responsibilities, typical in many countries).

In particular, it is organized in a distributed *master – slave architecture with replication of information* with the following structure: (i) a singleton instance of the *general repository* contains all the information needed for the supply of the provided functionalities; (ii) *N* instances of the repository, referred to as *local repositories*, contain (sub-)sets of information, defined according to different rules (e.g., geographic location, functional relationship, relationship with the supplier): if an information is in a local repository, it is surely in the general one, while the vice versa is not always true. Updates can be performed either at the level of general and local repositories and a synchronization mechanism based on publish – subscribe technologies has to be devised in order to guarantee the correctness of all the repositories.

The schemas/ontologies repository is the software component offering functionalities to deal with service and data semantics, in order to find the services that are the most suitable for providing required functionalities. It may be seen in SOA as a technological realization of the repository of conceptual schemas described in Chap. 2. As described in Sect. 10.4, the "operational" point of view for the provided

services is not the only possibility, since sometimes it is better to search a service on the basis of the type of information that it carries on/deals with (as we discussed at a more abstract level in Sect. 9.2). The ontologies and the conceptual schemas represent the mechanism to describe this aspect. Suitable technologies, commonly referred to as *semantic* ones, allow the achievement of (semi-)automatic reasoning on the basis of such information. Even if the semantic descriptions are part of the service agreements, they are more effectively managed as separate elements.

Therefore, the schemas/ontologies repository acts as a structure to store ontologies and conceptual schemas, offering functionalities of registration, access, update, and reasoning on them; it is, in fact, the "database" of the ontologies and schemas. Figure 10.3 shows the complex architecture according to which agreement repositories (one general and various local) and the schemas/ontologies repository (unique in eGCSS) are arranged in a distributed fashion.

10.7 Other Elements

10.7.1 Security Services

The cooperation model provides guarantees of suitable security levels for both the PA services and for the infrastructural ones: each element in the system has to be qualified (i.e., each element has to pass some particular tests assuring the fulfillment of some security levels) and requisites of authenticity, privacy, integrity, and traceability must be assured for all the messages exchanged.

Security in this context is characterized by many technological, architectural, and organizational aspects, in particular:

- *Architectural aspects*: the architecture is structured according to two levels: PAs expose services through the domain gateways and at the inter-administration level; there are a set of infrastructural components/services that are needed for the work and the management of the services of the administrations. The security deals with both the two levels, consequently it has to be defined both for the single administration level to make the domain gateway and the exposed services secure and for the infrastructural components. For these reasons some architectural elements are introduced: (i) *XML firewall* is needed to protect the domain gateway and the messages exchanged across it, under an application point of view; this element belongs to the single administration; (ii) *authentication authorities* are needed for the management of public key infrastructures (PKIs) and *federated identity managers*, based on SAMLv2, for the identification of all elements (humans, software elements, etc.) of the system.
- *Technological aspects*: the architectural elements introduced above have to be realized with standard technologies and have to be consistent with the Web service technology. The so-called Web service security framework should be adopted.

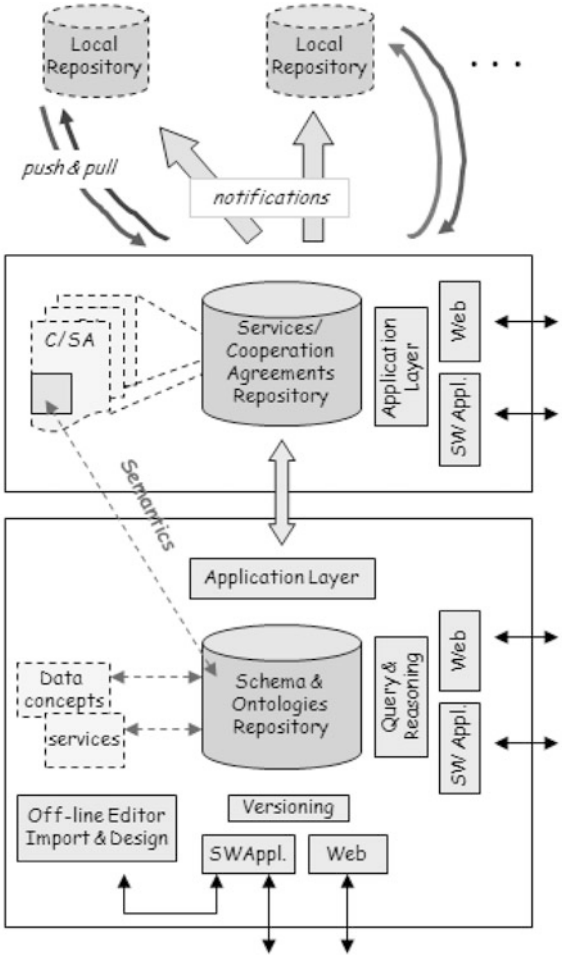


Fig. 10.3 The architecture of repositories

- *Organizational and management aspects for security*: the security is an aspect related not only to architectural elements and technological standards but also to organizational *best practices* of policies for the management of additional services (such as qualification, intrusion detections, logging, permission management) realized by each administration.

10.7.2 Monitoring, Management, and Qualification Services

In order to manage a complex system, a suitable support for monitoring and management is required. The monitoring assures that the statements in the service

agreements are observed, while the management has to provide some procedures dealing with the non-observance of these agreements.

Moreover, an *organizational* model has to be defined to find all the phases of the life cycle of the single system element (e.g., whose actions must be enacted when a new registry enters/leaves the system), to be then realized as a qualification service; and a set of software components must be implemented to verify the presence of anomalies.

10.8 Similar Initiatives in Europe

Many European countries have carried out, in the last few years, nationwide eGovernment initiatives similar to the Italian SPCoop and to the reference architecture presented in this chapter. As an example, the eGovernment Interoperability Framework (eGIF[8]) in the UK is mostly focused on the definition of standard XML schemas to be used for data integration and exchange among different PAs. Currently in Germany (cf. the IDABC observatory[9]) there is no overall legal framework for eGovernment (i.e., something equivalent to the law decree no. 42 cited in Sect. 10.1), and no nationwide technical framework has been established yet (to the best of the author's knowledge). In France (cf. again the IDABC observatory[10]) a national infrastructure is being developed on top of the AdER network. For a complete overview of the various eGovernment initiatives at the European level, the reader is invited to refer to IDABC [75], which is also developing a pan-European framework (EIF) for cooperation among PAs; the Italian SPCoop is fully compliant with such specifications, as well as the proposed reference architecture which leverages many concepts there presented.

10.9 Summary

This chapter has described a possible reference technological architecture for eGovernment projects, based on the service-oriented architecture (SOA) paradigm and related technologies and approaches. In particular, the chapter discussed basic concepts related to Web services and service-oriented architecture, by focusing on different levels of agreement (service, cooperation domains, and cooperation agreements) together with other elements such as repository of schema/ontologies, security, monitoring, management, and qualification of services.

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[8] `http://www.govtalk.gov.uk/schemasstandards/egif_document.asp?docnum=949`

[9] `http://ec.europa.eu/idabc/en/document/6508/396`

[10] `http://ec.europa.eu/idabc/en/document/5955/421`

Chapter 11
Guidelines for the Specification of New Administrative Processes

This chapter presents some guidelines on how to specify a new administrative process (*composite external service* in the terminology of Chap. 10) in the eG4M methodology on the assumption of using a service-oriented architecture (SOA) and related engineering approaches, techniques, and tools. In particular, the guidelines address the case in which an external service has been identified as target of the project (cf. Chap. 9) and the realization of such a service requires the coordination of different PAs, which have to offer (or already offer) inter-PA internal services (cf. Chap. 10) to be coordinated. Before moving to the effective realization of the project (out of the scope of this book), a final step of operational planning is needed to analyze and conceptually model the new services and the coordinating process, which serve as technical input for possible tenders aimed at effective realization. Section 11.1 presents the overall description of the guidelines, by introducing the steps to be realized in order to automate the process. Then Sect. 11.2 outlines the modeling tools, i.e., the techniques and the possible software tools that we suggest to use in order to support the managers and system/software engineers during the specification of the process at design-time. Section 11.3 gives some highlights on the important issue of managing legacy systems. Finally, Sect. 11.4 outlines, through a specific case study, how to specify an entire process. This chapter assumes the reference architecture and the eGovernment cooperative support system as presented in Chap. 10, as they are the target deployment environment for the artifacts produced by the guidelines presented here.

11.1 Overview of the Guidelines

The presented guidelines aim to specify the automation of macro-processes (see Chap. 5) among different PAs in order to implement more efficient and advanced external composite services toward the clients requiring such services. The guidelines aim toward the realization of three objectives:

This chapter is authored by Massimo Mecella.

G. Viscusi et al., *Information Systems for eGovernment*,
DOI 10.1007/978-3-642-13571-2_11, © Springer-Verlag Berlin Heidelberg 2010

- *Formalization of the process*: Assuming that the service to be automated has been previously identified (cf. Chap. 9), it consists in
  - the conceptual description of the process realizing the service through appropriate modeling tools, namely business process modeling notation – BPMN – cf. Appendix B and unified modeling language – UML or entity – relationship model;
  - the description of operations enacted by such a process through suitable technological languages (e.g., XML, WSDL, WS-BPEL); see Chap. 10;
- *Definition of the specific cooperation domain*: It consists in the precise description of different services involved in the process and of the data exchanged among PAs.
- *Realization of the process/service*.

Overall the guidelines consist of five activities, as shown in Fig. 11.1. We now comment the activities:

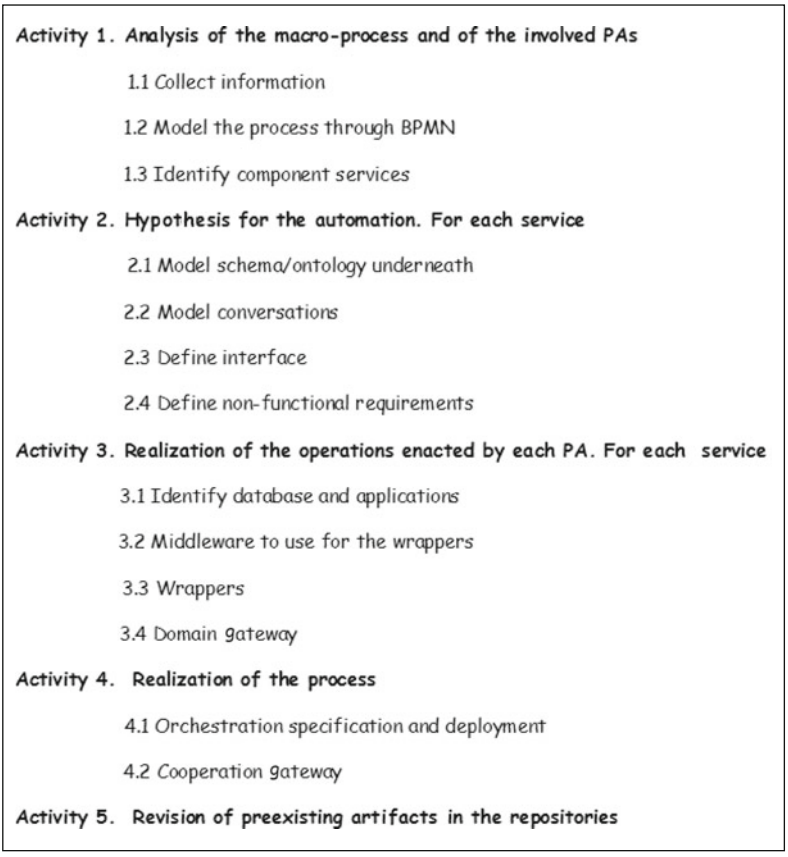

Fig. 11.1 The activities of guidelines at first glance

1. *Analysis of the macro-process and of the involved organizations*: It is assumed that the macro-process to be automated has been identified, as discussed in previous chapters. It is important to note that automation should aim to provide a more efficient external service to clients by improving the quality (see Chap. 7) reducing the delays. Delays are due to inefficient interoperation among different PAs involved, due to differences in the information systems, to missing information, and to the fact that currently most information exchanges require using hard-copy documents sent through ordinary mail with the client who often serves as a messenger, providing the information needed to establish communication between the PAs. The choice of the process, as discussed previously in the book, is based on the usefulness, the political/strategic visibility of the process, and the technological readiness of the clients in the use of new services. Indeed, according to what was discussed in Chap. 10, the new service will be an *e*-service, and therefore, if the target users are not ready to use electronic channels, the automation may be hindered or reduced. Examples may be health services for elderly persons (i.e., not customary with the use of Internet and WWW browsers, etc.), which may be automated, but still need to be provided through a classical front-desk, and not only as an *e*-service on the Web.
   The analysis of the chosen macro-process starts by collecting some information needed for the subsequent specification, namely

   - number and type of clients using the process;
   - the description of the old process;
   - documents and information related to the pre-existing component services offered by the PAs involved (e.g., documents describing the service, documents describing the laws that regulate the supply of the specific service, the identification of PAs which are in charge of supplying the service, the description of the internal administrative procedures currently in use in the PAs);
   - the legacy information systems of such PAs.

   All of the above information should have been collected during the state reconstruction step (see Chap. 5). It could be necessary at this stage to complete the documentation for specific or more detailed aspects. This way, the relationships among (i) process/services, (ii) PAs, and (iii) data exchanged are clearly and completely identified. This activity requires the participation of the staff (technicians, civil servants, and managers) of the PAs involved. Having all this information, this activity consists in the analysis and modeling of the macro-process.

   In particular, the use of the language BPMN is suggested in order to represent the workflow of the process and to model parallel processes and their synchronization. Moreover, it is suggested to use UML sequence diagrams to specify the dynamics of the system and the interaction among the subjects involved, showing the temporal sequence of the messages exchanged by them. The language BPMN is described in Appendix B, whereas for a comprehensive introduction to UML and UML diagrams, see [159].

2. *Hypothesis for the automation of the processes*: The previously elaborated models representing the logic of the process are used as the starting point for the definition of the component services, namely inter-PA internal services. Here the following should be defined:

- The conceptual schema/ontology underneath the component service: it is necessary because in dynamic and decentralized contexts, each subject involved has to define suitable schemas/ontologies supporting the comprehension of the semantics of the service and of information carried by it.
- The service interface: it is defined as the set of operations (each one with its own signature) offered by the service.
- The service conversational protocol: it describes which sequences of operations (conversations) are supported/admitted by the service.
- A set of non-functional requirements: they express the levels of quality for the provided service, the characteristics of security of the service, etc.

Basically, this activity identifies the conceptual elements needed in order to implement the service agreements (as defined in the target reference architecture). In particular, the definition of a conceptual schema/ontology for the description of the service is important in order to address the issue of differences of (i) meanings, (ii) descriptions and formats of the data, and (iii) the concepts held by different cooperating subjects that now should be shared and accepted by all the subjects involved.

According to an "incremental approach," for possible cases in which PAs may not be ready to use rigorous/formal approaches, as a simplified tool, we propose the description of the characteristics of the services using a service/description form whose rows represent the services, while the columns represent the service characteristics. Each service should be defined through

- a description;
- a set of inputs;
- the set of outputs; and
- non-functional requirements (e.g., quality of service, security).

The activity consists in the description of the operations enacted by each service (i.e., its interface) and in the representation of the conversations among the services involved in the process through a suitable modeling tool (e.g., UML sequence diagrams). In the description of conversations in an eGovernment scenario it is important to know the point of the process in which an operation can be invoked. This is different from the description of the internal process of a single service, i.e., the description of the workflow implemented by the service to offer such operations.

3. *Realization*[1] *of the operations enacted by each PA involved*: The aim of this activity is the realization of the operations that must be enacted by each PA involved in the macro-process. The inputs are the previously obtained diagrams and the assessment of the technologies in use (e.g., legacy systems). After the formal definition of the macro-process with the identification and the description of (i) the data exchanged, (ii) the interfaces/operations enacted, and (iii) the conversations among the component services, in this activity the following tasks are carried out:

   a. The identification of the databases and of the applications involved in the macro-process that must be wrapped in order to be exported and used. The chosen databases contain the data owned by the PA and exchanged in the macro-process, while the chosen applications realize the operations that will be offered by the services (such databases should have been identified during the state reconstruction step, see Chap. 5).
   b. Choice of the middleware to export the applications: Indeed, each service can be internally implemented in different languages and technologies (coherent with the internal technologies of each organization), and externally it is exposed through a Web service interface (i.e., WSDL).
   c. Design of wrappers, that is of the software level that hides the actual implementation of the functionalities of the system of a PA and presents them through a well-defined service interface.
   d. Realization and deployment, if not already in place, of the domain gateway, which is basically the container of the services exposed by the PAs.

   In summary, this activity leads to the definition of service agreements (cf. eGCSS of Chap. 10) for all the PAs involved in the process/service.
4. *Realization of the macro-process*: This is the actual realization of the composite service provided by the set of PAs involved in the macro-process. Given the descriptions of the interfaces of the component services and of the data exchanged and given the description of the choreography/orchestration representing the conversations among services, in this activity the macro-process is technically specified and deployed on the composition/orchestration engine of the service owner in order to manage the communications among component services and to orchestrate the component services, thus coordinating the operations. If not already in place, the cooperation gateway is also realized. Moreover, now the cooperation agreement is formalized and realized.
5. *Revision of the pre-existing conceptual schemas/ontologies*: The objective of this activity is the realization of a revision process of the ontologies/conceptual schemas describing the pre-existing services, in order to update the repository

[1] With the word "realization" we mean a very precise and concrete definition of all the elements. Indeed we are in an operational planning phase, and no software realization is performed here. All the artifacts outcome of this and the following steps are useful design documents to be used as technical documentation for possible tenders, etc.

of services and descriptions/agreements. Indeed, after an initial period in which the first services start to be deployed, composed, and orchestrated in order to obtain macro-processes, the cooperative system will be populated by a set of simple and composed services. Each service will be characterized by its own semantics description and by its own interface. Therefore, after a while it will be necessary to revise the service descriptions in order to adjust them to conditions that possibly are changed in the meanwhile. Concretely, in this activity the tables, diagrams, and XML files representing the services are revised and updated.

11.2 Tools for the Design Time

In this section we want to briefly recapitulate the modeling tools that the system/software designer can use in order to realize the design steps of our guidelines; in particular, in the previous section we have identified three main modeling tools:

- Business process modeling notation (BPMN): It is used to represent the workflow logic of the process(es) and to model parallel processes and their synchronization. In our guidelines BPMN diagrams are used for the design of the flow representing the macro-process. Appendix B presents a very brief introduction to BPMN.
- UML sequence diagram (SD): It is introduced to represent the dynamics of the communications between the main actor (the client) requiring the service and the PAs. In our guidelines the SD is also used to describe the conceptual model of conversations among the services composing the macro-process. An alternative, more similar to the possible concrete XML syntax for describing conversations, is to use UML state diagrams.
- UML class diagram (CD): It is an alternative to the ER model used to represent the conceptual schema/ontology needed for the description of the component services. UML class diagrams are very similar to ER diagrams. The advantage of using UML class diagrams instead of ER model lies in their inclusion in the same suite of models of sequence diagrams, namely UML [159].

Clearly a lot of tools, either commercial or open source, are available in order to support the system/software designer in the production of such design artifacts.

11.3 Dealing with Legacy Systems

11.3.1 Legacy Systems Classification

Applications and legacy systems (LSs) (see Fig. 11.2) can be classified as follows:

1. *Highly decomposable*, when they are well structured and present some fundamental properties: application modules are structured in three logic layers: (i) a presentation logic, an application logic, and an access/presentation logic; (ii) application components are independent (there are no hierarchical

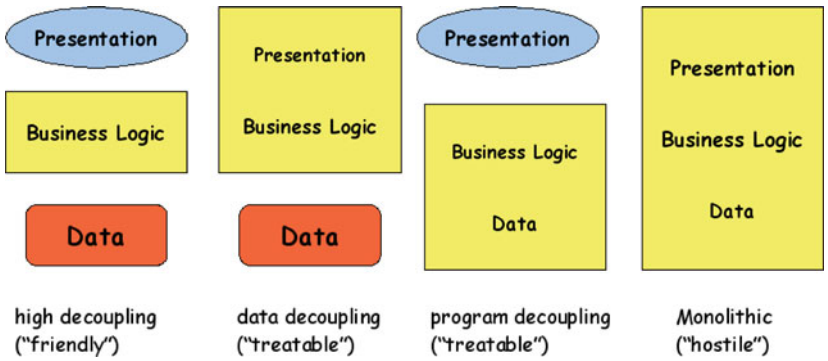

Fig. 11.2 Legacy systems classification

interconnections); (iii) application modules have well-defined interfaces with the database, the access/presentation logic, and the operations exported from other applications.

2. *Data decomposable*, when they are semistructured systems based on the following characteristics: application modules are separated into two layers, namely the modules for data access and the modules for presentation and application logic (the latter ones included in a unique layer). In these systems it is possible to directly access to data, but it is not possible to use the application logic without the presentation/access one.
3. *Program decomposable*, when they are also semistructured with the following properties: modules can be divisible into two layers, namely presentation and data access and application logic (the latter ones included in the same layer). In these systems data are not directly accessible, but it is necessary to invoke predefined functionalities/procedures for accessing them (e.g., stored procedures, CICS transactions). Most legacy applications are classified in this category.
4. *Unstructured*, when they are systems where a single module realizes all three layers. These systems are usually accessible through a terminal.

From the point of view of difficulties in dealing with them, legacy systems can be classified into three categories:

- *Hostile*: Legacy systems classified in this category are not easily interfaceable with external components.
- *Manageable*: Communications with these systems are possible only through ad hoc technologies and developing dedicated interfaces.
- *Friendly*: Interfaces are well defined and easily accessible.

Clearly, highly decomposable systems are friendly, data/program decomposable systems are usable, while unstructured ones are hostile.

11.3.2 Management of Legacy Systems

A system is subjected to a long list of activities for its change and evolution: *assessment*, *maintenance*, and *management*.

Concerning the assessment, here we use the term with a wider meaning than in Chap. 7. In this context the strategy and objectives of organization are evaluated; moreover, the system is analyzed to define if it is valid and usable in order to satisfy organization objectives and consequently to decide to modify the system. Cost analysis has a fundamental role in this phase: the assessment and consequent modifications can be executed only if their costs are not comparable to the cost needed to develop a new system.

Moving to maintenance, for a long time it was the only activity associated with the evolution of a system. In fact, systems were developed, deployed, and only updated for correcting errors, until their substitution. Recently, management is also acquiring a fundamental relevance, but it can require a deep knowledge of system that we want to modify (white box) or can require only knowledge of external interfaces of our system (black box) [213]. The *white-box* approach requires reverse engineering emphasizing a deep knowledge of different modules composing the entire system (program understanding) and activities of reconversion. The *black-box* approach studies only external interfaces of the system and it defines the encapsulation needed to work with them (wrapping). Reverse engineering is a process of analysis whose principal aim is to identify components of a system and their interactions in order to create a representation at an higher abstraction level. Starting from this representation, it is possible to substitute the system (through a clean substitution or gradually), reconverting its code to a new environment, to develop ex novo some parts or adding some new components. It is a slow, specialistic, and expensive process that has high risks and requires miscellaneous knowledge.

Wrapping is a different approach that tries to avoid needing to know the internal structure of the system. It builds a software module around some units that have well-defined interfaces. Wrapping, coherently with the object-oriented paradigm, is based on encapsulation and information hiding and requires less work than reverse engineering. Useful approaches to manage a legacy system are the following:

- *Ignore*: the system is omitted from the next development.
- *Clean substitution*: the system is developed from scratch.
- *Gradual migration*: the system is gradually transformed.
- *Integration*: the system is integrated in future applications without modifications and using wrapping with ad hoc technologies.

Among these approaches we can distinguish two final objectives: substitution of a system with a new one, or its maintenance, adapting to a new environment (integration).

For a long time, the only possibility was substitution, implemented through a single step (clean substitution) or incremental steps (gradual migration): in any case the aim was to create a new system which could reproduce and extend functionalities and data of the old system. Recently, an evolution of the substitution approach

has emerged, based on the idea of leveraging legacy, resulting in the integration of legacy system, based on middleware and the service technologies and the concept of wrapping. In the literature, there is no systematic nomenclature of all the approaches. Consequently, authors can use different terminologies, for example, *integration* can be used to define integration problems in a broader context. Here we use the term *management* when we want to refer to the general problems, *migration* to specify an incremental substitution, and *integration* to indicate the presented approach where we do not want to completely substitute the system but reuse some of its components, suitably wrapped. Other different approaches can often be used. For example, *revamping*, when the system is cleaned in its external component and then in its user interface. More generally, revamping does not change the systems core but it restricts its activities to create a better interface.

There are three possible strategies to deal with such systems:

- *Application engineering/system replacement* consists in the development of a new information system from scratch.
- *System migration* consists in a gradual modification of the system.
- *Application re-engineering* [100] consists in the reuse of some components of the legacy systems (i.e., reuse of working elements).

In eG4M this last approach is proposed and implemented through the study of external system interfaces and their wrapping, avoiding a deep comprehension of the system technology, building a software case (wrapper) containing the units of the systems with well-defined interfaces.

A *wrapper* is a software level hiding the actual implementation of the functionalities of the system while presenting them through a well-defined object-oriented interface; thus the old-wrapped application appears as an ordinary object of the external world. In the use of wrappers there are two most common behaviors: the first consists in the attempt to use the old system as much as possible with the wrapper which has the aims to export the application interface in the new environment. This way no new functionalities are added, while old applications are made available in the new system. A more mature solution (that can be defined *object-oriented strategy*) brings a real integration for the system; in such an approach the new application domain is built and afterward it determines the set of functionalities of the legacy application it needs. Frequently, what happens is that a small percentage of the functionalities of the legacy system are really useful in the new context. With such a solution the component specification is driven by the necessities of the organization more than by the constraints belonging to the legacy [143, 145].

11.4 A Case Study

In this section the above guidelines are applied to the two sets of services considered in Chap. 3, namely the change of residency bundle and the medical examination request. We have seen that according to the “old” mechanism, the citizen has to

spend a lot of time acting as a "messenger" among the several PAs involved. The aim of redesign is reducing the time spent for its provision while increasing the efficiency.

According to what we have previously discussed, the design phase is started with (i) the identification of the external service (in our case the change of residency), (ii) the identification of the involved PAs, and (iii) the evaluation of the interactions among them and with the citizen requiring the service. We assume that the service for the change of residency is provided in a given territory through physical desks. In order to obtain the service, citizens have to go physically to the desks during their opening time and must fulfill a set of other requirements, e.g., they need to produce certificates or documents and fill in forms. Each information to be acquired, provided, and modified usually needs several interactions with the front offices of the administrations, together with several interactions with the back offices of the involved administrations.

The component services of the macro-process we intend to automate are as follows:

- S1: request of the old certificate. The citizen notifies the change to the municipality he/she is leaving. The involved PA is the municipality A (MA).
- S2: request of the new certificate. The citizen notifies to the local administration where he/she transfers the new address. The involved PA is the municipality B (MB).
- S3: communication of the new address to the police department (PD).
- S4: once obtained the change of residency, update the local registry of health-care beneficiaries. The involved PA is the local health authority (LHA).
- S5: medical exams reservation. The involved PA is the LHA.
- S6: if the citizen has a driving license, update the residence information in the driving license. The involved PA is the traffic control authority (TCA).

In a non-cooperative scenario, we can assume that the involved PAs communicate indirectly through the mediation of the citizen that has the burden of the exchange of necessary information and documents. We can also assume that PAs communicate directly only to verify the correctness of the procedure, e.g., when the PD receives the communication of new address, it verifies that the citizen is registered to the municipality B, asking for information to MBB directly.

The *analysis of the macro-process* is a refinement of the results of the analysis carried out in the state reconstruction step (see Chap. 5). At this stage it creates the PA/services matrix containing

- the PAs involved in the process;
- the simple services that will compose the macro-process;
- the input information and data for the service;
- the output of each service.

With reference to the previous example, we can produce Table 11.1. On the basis of evaluation of the output and input of the several services, it is possible to find out a sequence of building services for the definition of the macro-process. In particular

Table 11.1 Set of services of PAs involved in the macro-process

PA	Service	Input	Output
Municipality A	S1: old certificate request	i.1 citizen's birth i.2 citizen's name i.3 citizen's address	o1. old certificate o2. CCA db updated
Municipality B	S2: new certificate request	i.1 citizen's birth i.2 citizen's name i.4 citizen's old certificate i.5 citizen's new address	o3. new certificate o4. CCB db updated
Police department	S3: communication of the new address	i.6 new certificate	o5. PD db updated
LHA	S4: enrolment in the LHA registry S5: medical exams reservation	i.6 new certificate i.7 medical prescription	o.6 LHA db updated o.7 medical booklet updated o.8 exams done
TCA	S6: update of the information on the driving license	i.6 new certificate i.8 driving license i.9 new medical booklet	o.9 TCA db updated o.10 driving license updated

we represent the internal workflow of the process through a BPMN diagram and the specification of the dynamic of the system through a UML sequence diagram representing the interactions among the involved subjects showing the temporal sequence of the exchanged messages. The two diagrams are shown in Figs. 11.3 and 11.4.

In the next step of *hypothesis for the automation*, the old process is elaborated on the basis of the previously defined models. In this step, some basic aspects of the component services and of the complex process are defined. In particular we need to provide

- a description of the component services;
- the description of the operations they enact;
- the conversations (i.e., the communication paths among services);
- the non-functional properties.

According to our incremental approach, we start with a service/description matrix for the description of the services and afterward we move to UML diagrams. A possible example of matrix for the systematic description of the component services is shown in Table 11.2. In the matrix each service is defined through (i) a description (plain text in the example), (ii) the required input, (iii) the produced output, and (iv) a description of non-functional properties.

A more advanced technique would consist in the use of an extended UML class diagram representing the conceptual schema of the services involved. Such a diagram is extended as it represents both the concepts used as input/output of the services, the administrations, and the input/output relationships among them. The

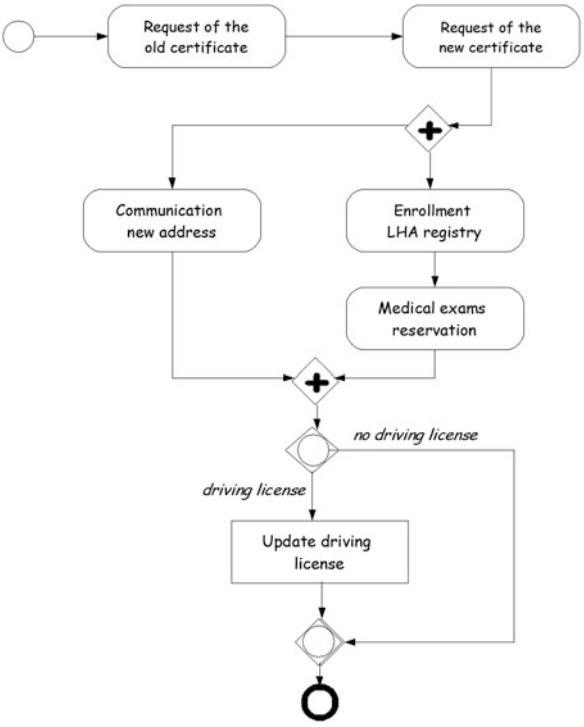

Fig. 11.3 The diagram representing the workflow of the process

reader interested in specific techniques for the use of class diagrams for representing information flows among services can refer to [47].

At this point the design of conversations of the services involved in the *new process*, that is the representation of dynamic of the system in the new automatic approach, follows. Such a representation is realized with a UML sequence diagram representing the communication path in the macro-process and the temporal sequence of the actions enacted in order to realize such macro-process. The diagram is shown in Fig. 11.5. Here we suppose to use Web services, each one deployed on the domain gateway of the owner PA. In the figure, Web service of a PA is indicated as WS@PA (i.e., the Web service of municipality A is indicated as WS@MA).

In the previous steps we have described the composite services and analyzed the macro-process we want to automatize; with these elements the fourth phase of methodology consists in the definition of *operations enacted by each PA*. After the choice of suitable middleware technology (the WS technology) supporting communications among PAs, this step consists in the building of wrappers for the management of different technologies that implement the services for each PA represented in the example. In this step the operations belonging to the simple component services of each PA are wrapped and exposed to the other PAs in the domain gateway.

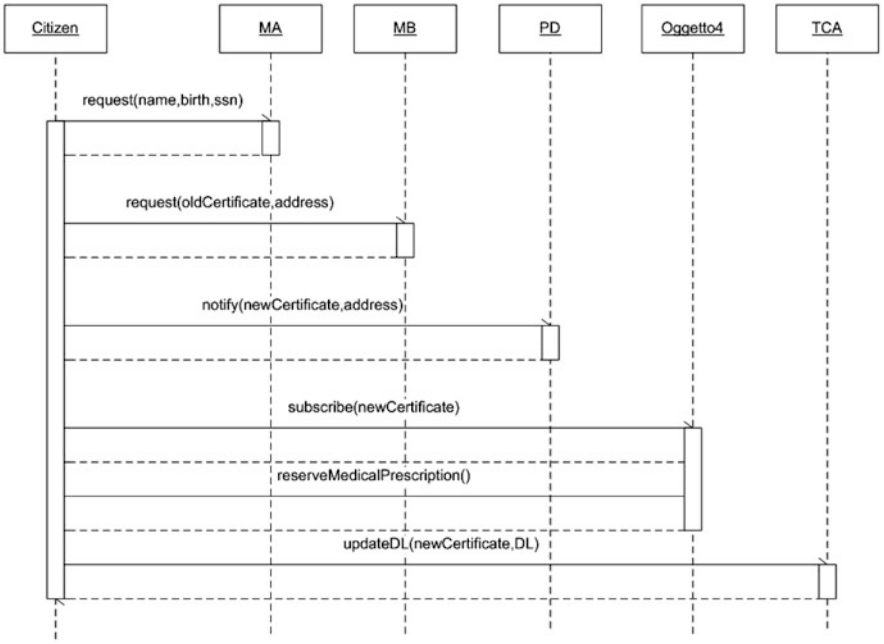

Fig. 11.4 The sequence diagram representing the dynamic of the old process.

Table 11.2 Systematic description of the services

Service	Description	Input	Output	Non-functional req
S1. old certificate request	The service provides a certificate to attest the residence of the citizen. Given the following input it returns the specific output	Citizen's birth Citizen's name Citizen's address	Old certificate MA db updated	nf1. the data of the citizen should be sent via Internet through a secure connection
S2. new certificate request	The service provides a certificate to attest the new residence of the citizen	Citizen's old certificate Citizen's name Citizen's birth Citizens's new address	New certificate MB db updated	nf1. nf2. the data of the different db should be coherent
S3. communication of the new address	The citizen communicates to PD the new address for possible controls	New certificate	PD db updated	nf2.

Table 2 (Continued)

S4. enrollment in the LHA registry	The citizen is enrolled in the medical registry	New certificate Medical – prescription	LHA db updated medical booklet updated	nf2. nf3. enrollment done assuring the privacy
S5. medical exams reservation	Before the enrollment the citizen needs to make exams	Medical – prescription	Exams done	nf3.
S6. update of the information on the driving license	With exams and the new address the citizen has to update his/her DL	New certificate Driving license New medical - booklet	TCA db updated Driving license updated	

The last step is to define the orchestration identifying the macro-process in a suitable language (i.e., WS-BPEL) and such a description is deployed on a suitable orchestration/composition engine.

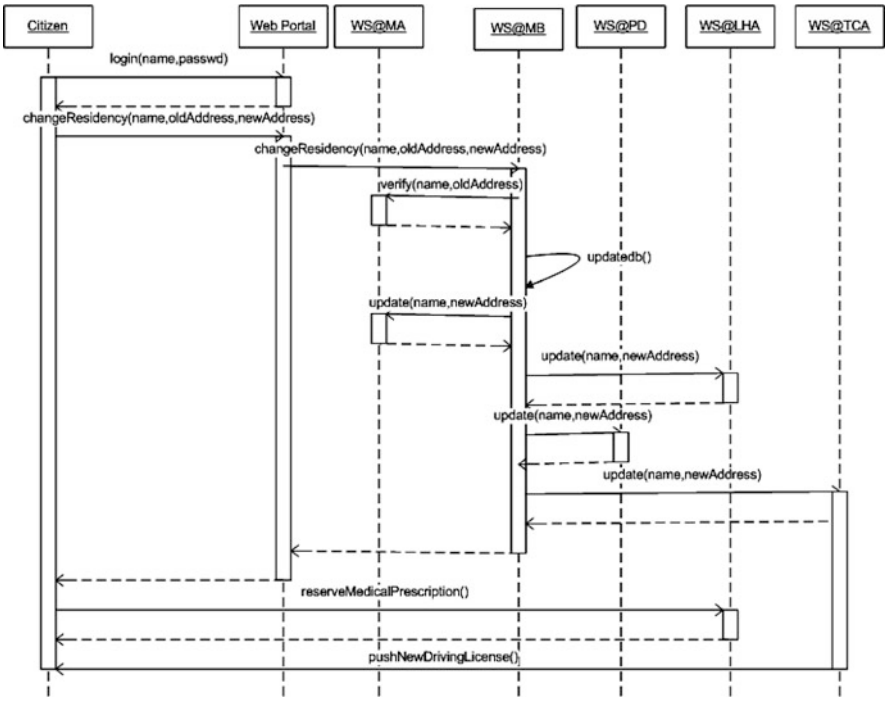

Fig. 11.5 The sequence diagram representing the dynamic of the system after the process of automatization

11.5 Summary

In this chapter we have provided guidelines for the specification of (external) services requiring the automation of macro-processes. Such guidelines are the last activity of the operational planning. The artifacts produced are used as technical specifications for the effective software project, both in the case if a project is internally realized by the PAs involved and in the more common case if a tender is launched for such an activity.

Part IV
eGovernment in Mediterranean Countries Public Administrations: Case Studies

Chapter 12
eGovernment Initiatives in Italy

This chapter focuses on several initiatives carried out in Europe and in Italy in the last years; such initiatives are analyzed under the socio-economic point of view, providing quantitative measures that are behind the decisions previously described in the book.

The recent debate about the limiting factors to the growth of Italian economy has shown a convergence of at least two strategic aspects: (1) the need for innovation in order to improve the competitiveness of our products and services and (2) the inadequate allocation of material and immaterial externalities, which is plaguing the Italian economic system. Both of these critical factors highlight the lack of attention paid in recent years to the inefficiency of public and private services. This condition is likely to continue to distort the private and public strategies of overcoming the present difficulties.

Since the policy-maker strategy must seek to ensure both the economic and social development of Italy and the reduction of regional imbalances and of social inequalities, the related instruments are a priority for the creation of a network of services, rules, and organizations that serve this strategy. It is up to the government to create and/or to boost the incentives for an externality of networks and to implement a policy of services needed by the private sector in order to make advances in the European Union and also in terms of becoming an information society. A successful business strategy requires an extensive and innovative use of information technology and communication associated with the ability to operate in the network, both within and outside the company by relying on the spread of knowledge, the delocalization of the simplest and most labor-intensive activities, and the selection and acquisition of a service network in collaboration with other innovatory administrations. It is also up to the government to define the strategies as they seek to modify services, manufacturing processes, and especially all the intangible components (organization, sharing of knowledge, rules) without neglecting the wealth of knowledge that comes mostly from experience. In order to set up an innovation strategy, it is necessary on the one hand to be aware of the expected benefits and costs and on the other hand

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This chapter is authored by Guido M. Rey (Scuola Superiore Sant'Anna di Pisa, Italy) and Sandro Clementi (formerly CNIPA, Italy).

G. Viscusi et al., *Information Systems for eGovernment*,
DOI 10.1007/978-3-642-13571-2_12, © Springer-Verlag Berlin Heidelberg 2010

have human resources available at all levels in order to understand and to develop the actions needed for such a change.

Section 12.1 adopts a socio-economic point of view in the discussion of strategic guidelines for eGovernment initiatives, an issue that we have already considered in Chap. 4. The main topics of Sect. 12.2 are three different surveys performed in Italy on dematerialization of documents, ICT adoption in Italian companies, and cooperation among agencies. Section 12.3 critically analyzes open problems in eGovernment in Italy.

12.1 Technological Innovation as a Guide to Redesigning Government

Innovation strategies evolve along a narrow path from which it is easy to fall back into the previous indolent situation or it is easy to embark on an improbably formulated modernization without solid prospects of success. In tackling a reform of government with the support of technological innovation, it is necessary to start out from the elements of a polycentric model such as a network of information-sharing government departments, IT-imposed transparency, clear identification of official tasks and responsibilities, rapidity, improved work procedures, and awareness of the user's needs. The path leads to success if one can allow for the coexistence of technological innovation, organizational innovation, professionalism, and motivation of the staff and especially the improvement of services that are not only attractive but also statistically measured and controlled by the citizens [184].

12.1.1 The Strategic Guidelines

The strategic guidelines of the spread of technological innovation and information [230] focus on the need to

1. place citizens at the focal point of government's mission, reducing the layers of intermediation and simplifying compliance procedures and direct access to services;
2. enlarge the principle of subsidiarity to the relations between the private and public sectors in order to define the public – private alternative of service supply. This alternative should be based on the principles of efficiency as well as fair competition;
3. raise efficiency by improving the organization of self-administration and service provision, exploiting the potentialities of the networks;
4. leave the hypothesis that government is a single organization and implement a new architecture of government following a federate and/or decentralized model; the architecture proposed in Chaps. 9 and 10 goes in this direction;
5. separate data from applications in order to improve data quality and foster data-sharing and cooperative use of applications (see Chap. 2);

6. carry on direct and real time exchange of information;
7. introduce direct channels of communication (web sites, e-mail, traditional personalized information, calls centers, etc.), with periodic checks on the levels of service and user satisfaction.

It will also be possible to increase transparency in administrative action, decentralize the provision of services, bring government closer to people, and increase the accountability of all governmental offices. In brief, the characteristic elements of the government innovation are network administrations, information sharing, transparency required by computerized procedures, clear identification of tasks and responsibilities of officials, time saving and improvement in administrative processes, and awareness of the needs of citizens and enterprises. Central and local administrations have different missions and organizations that make them different and sometimes competitive if not in conflict with each other. Therefore, it is necessary to allow more discretion to the contracting organizations and to allow them full accountability in the allocation of human, technological, and financial resources. The choice of technologies is not just public demand, but it is a strategic decision that has ripple effects throughout the economic and social system, since it also has implications for the role to be played by the entire public sector, in powering or braking national economic growth.

12.1.2 The Modern Public Administration: A Network of Systems

In order to analyze the elements necessary for the reform of public administration based on technological innovation, once it has been established that information is key to the functioning of government, it follows that a modern vision of the functioning of administrations requires not only the creation of managerial information, decision making, and control systems but also their integration into an informative unified but decentralized system based on the decisional and managerial autonomy, the cooperation of applications, and data sharing [5, 71]. Decentralization, a particularly complex organizational model, requires more information than centralization and implies the "re-engineering" of procedures (as we have seen in Chap. 11) to enhance the value of the information economy's ultimate function, namely communication. Without communication, information is stored but not used by public and private agents; the resulting informational asymmetry would render decentralization vain and justify centralization as an information-saving organization in which synthesis is performed by the authority at the organization's apex.

The premise of this technological vision of decentralized and/or federate government is the accomplishment of a network of networks, where each administration maintains its autonomy, but where all the organizations can share the technological structure and can exchange data, information, files, and documents in real time supplied together with security issues. This reorganization of the public administration should include the transportation network, the network of interoperable services, and the layer of applications, defined as technologies that allow cooperation among

information systems. The key factor in the re-engineering of procedures is to separate data from applications in order to be able to customize the procedures, while at the same time it is necessary to have cooperation between different procedures and the sharing of databases. All these principles are coherent with the organization of the reference ICT architecture described in Chap. 9.

12.1.3 eEurope and the Economic and Social Growth

The recent eEurope initiative of the European Commission aimed to accelerate the development of the new economy, of which e-commerce, e-banking, and eGovernment are just some aspects, in order to exploit the potential for economic and social growth. This has had an impact on the whole economic system, but it is indispensable to create the institutional and technological infrastructures in order to stimulate the use of new technologies and also to get the labor market to accommodate the new needs for professionalism and flexibility through training and permanent education. Consequently, the public administrations should be given the task of providing and stimulating the externalities of the web without which the private sector would encounter difficulties and by itself would not be able to create favorable conditions for the development of an information society.

It is indispensable to improve the functioning of institutions (markets, private and public enterprises, public administrations, rules, rights of ownership, controls) in order to reduce costs, help development, and create suitable normative and organizational conditions. This should be done so that public and private decisions and the behavior of all the operators, both private and public, have efficiency as their main goal. This is true not only for sectors where competition comes into play but also for the entire economic and social system. Agreements should be promoted for safeguarding the interests of consumers and in general the weak parts of the contract, even though it may be difficult to identify whose interests should be protected, particularly if the spatial and temporal dimensions are taken into account.

In addition, the evolution of technologies needs to be monitored in order to avoid the behavior of producers harming the public interest, such as the right to access technologies or save the investments made by administrations or by private individuals. This involves safeguarding the fundamental values of the economic constitution of a country and not just the sovereignty of the consumer. Thus, everyone should have the possibility to directly contact public offices in order to get services and receive information. If this principle is adopted, then this is automatically valid for all the operators on the web. Reaching this objective means having institutions that are equipped with wide-ranging technological knowledge, making large investments, and instigating considerable innovations even at the institutional level. However, there are substantial returns both for the national industry and for each individual citizen.

Related to the theme of governance is the need to establish a *culture of measurement*. This should be done in order to change the relationship between the public

administration and the citizens. It is essential not only to study a coherent set of indicators but also to review the system of formal and informal incentives tied to the performance of the new organization, especially in a system lacking indicators comparable to those provided by the market. If there is no culture of measurement, then a strategic element will be missing that is fundamental to the transparency in relations with citizens and companies.

On the other hand, limiting transparency to procedural aspects without pushing for comparisons in terms of results prevents the exercise of democratic control and delegates this control to professional controllers. If there are no established rules from the start, such controllers will not necessarily be bothered about checking the achievement of the results assigned, but will tend to emphasize the formal aspects of what the administration has done.

One can observe the move toward a form of state that is articulated on centers of autonomous decision and on different organizational models. This leads to hybrid organizational roles that have little to do with central government. One of the weak points in the functioning of public administrations is that there is a low level of information in terms of quality (we have considered this issue in Chap. 2). This is due not so much to limited opportunity to acquire information but rather to an incapacity to process it.

The attribution of power regarding technical norms in the sector responds to the need to produce a discipline in that sector which has the following characteristics: (a) expertise and thus someone with extremely high technical and scientific professionalism; (b) flexibility toward continuous and rapid technological change; (c) quick reactions to ensure a simultaneous re-adaptation of the technical rules in relation to technological advances and to avoid irreversible efficiency due to ex post interventions.

Only the second solution allows individual citizens to access all the public offices from the same point in order to have the services provided by all of them. This online public administration network is thus one of the fundamental points of modernization because it allows a service to be provided by delocalizing the relationship between users and administrations. In this situation information desks are virtual and the administration office itself can be hundreds or thousands of kilometers away from the user since access to the desk is online.

This model breaks through the monolithic and monopolistic visions of most public functions. It opens up institutional options that are not restricted to the state market alternative, but are based on decentralized and federated solutions or on solutions based on competition between institutions. These solutions mean that realistic and well-documented cost – benefit analyses can be carried out. Finally, the relationships between the public administration and private intermediaries need to be clarified.

In fact, the web does not actually allow direct exchanges between administration and citizens and businesses, in reality it requires numerous intermediaries and brokers and it develops market niches. Thus, the idea of delegating some public functions to private enterprise may end up replacing a public monopoly with a private monopoly. Getting private enterprise to be a supplier of public services entails widening the network of the administrations to private enterprises, which then have

to be authorized to send data via the web to the administration in charge of the service. Moreover, for private bodies to carry out the service, they need access to public information services, and this entails having security regulations to identify who has access rights and who is authorized to modify public databases, etc.

12.2 eGovernment Development

Society bears the costs of insufficient information on the selective public services which help the weaker members of society and enhances the efficiency of private enterprises. Unfortunately, government inefficiency, arising from complex procedures and a lack of transparency, encourages opportunistic behavior and discriminates against those who should be the real beneficiaries of assistance through solidarity policies. Cross-referencing the tax database with the social security database improves the tax compliance, and furthermore cross-referencing the beneficiary databases with the tax and social security databases reveals many false invalidity claims, and the multitude of people who collect benefits they are not entitled to. The dissemination of knowledge in governmental agencies has not remained at the strategic stage but has shown some success despite the budget difficulties.

12.2.1 Survey by CNEL on the Dematerialization and Network Transmission of Documents

In 2004, the Italian National Council of Economy and Labour (CNEL) commissioned the University of Roma Tre to make a survey on the computer services provided to private enterprisers by various public agencies and their degree of interaction. Four public agencies were involved in the case study: the customs agency, the union of chambers of commerce (Unioncamere), the social security agency (INPS), and the revenue agency. The aim of the survey was to collect information on the following:

1. Document exchange between the agencies and the enterprises, and the provision of network services by the government agencies
2. The identification of direct relationships or relationships through professional intermediaries
3. Estimates of costs and savings arising from the use of computer services and the ability to put them into practice
4. Identification of the most widespread technologies in this environment
5. Sharing of information between multiple agencies
6. Possibility of sending information simultaneously to various agencies

The exchange of e-documents from businesses to government agencies was done almost completely by using online documents (6 million a year for the customs agency, 2.2 million for the Unioncamere, 15 million for INPS, and more than 37

million for the revenue agency). The return flow by the agencies to the businesses was equally significant (42 million documents for the revenue agency, 23 million for Unioncamere, 12 million for INPS, while there are no data for the customs agency).

The companies' involvement was very high even though they were not legally obliged to use computerized tools. The reason for the online use was that companies wanted above all to save the time from going to the agencies, while they did not consider the savings in direct costs significant. Companies had the means to communicate directly to the agencies or through intermediaries. In general, services were activated directly by the users and their cost was borne by the agency, except for the Unioncamere.

As for the processes, all the agencies knew of the progress and processing of their files. The technological solutions were differentiated and often proprietary, while the solutions adopted for transmitting data and modules used Internet + VPN on http and https and ftp protocols, digital signatures, and public key infrastructures.

In most cases, several offices of the same agency shared the same documents, while both the customs and the revenue agencies shared the documentation with four other agencies. Process modeling tended to make the online/computerized service as close as possible to the traditional service in order to provide a smooth transition from the use of traditional services and the use of computerized ones. Long-term storage was purely digital, but the speed of innovation in the market and in technologies could make even established standards quickly obsolete.

The survey showed also the involvement of intermediaries, to which businesses are turning to liaise with government agencies on the basis of non-uniform regulations. This solution has certainly simplified the work of public administrations and intermediaries, but it has not shown an advantage in terms of monetary costs for businesses, while there were certainly time-saving advantages. Intermediaries are a factor in the spread of e-documents, but it is unclear whether this process of innovation also extends to businesses and if the savings are passed on to companies. The transparency of the process has improved because it is now possible to get information online with regard to individual files/records that are still open, but there are no obvious advantages in the re-engineering of the processes.

12.2.2 Survey on ICT in Italian Companies

The Italian National Statistics Institute (ISTAT) carries out an annual survey on the spread of ICT in Italian enterprises that have at least 10 workers employed in industry and services. In Italy, 97.9% of companies are connected to the Internet having adopted the necessary technologies to do so, with small differences in percentages found among companies of different sectors, locations, and size (see Fig. 12.1). Consequently, the focus is now shifting to the differences in how companies make use of these technologies to improve their processes and to increase their competitiveness. Within companies, there is still substantial room to utilize the ICT services to their fullest potential and to share and to integrate information (see again Fig. 12.1).

BUSINESS ACTIVITY SIZE CLASS GEOGRAPHICAL LOCATION	Company strategy	internal Newsletters	Work documents	Manuals, guides, training materials	Products and services catalogues
BUSINESS ACTIVITY					
Total industry	32.6	54.6	76.6	63.0	60.0
Total services	40.1	65.1	76.0	73.0	58.7
SIZE CLASS					
10–49	34.0	57.5	74.2	64.1	59.3
50–99	42.2	63.0	83.9	77.5	60.1
100–249	44.7	69.4	81.0	80.4	58.0
250 +	49.1	77.1	82.5	89.9	59.2
GEOGRAPHICAL LOCATION					
North west	34.0	59.7	74.9	68.2	56.7
Northeast	35.4	60.8	75.1	67.4	58.8
Center	40.9	62.9	82.6	72.7	64.7
South and islands	39.1	56.7	73.5	64.5	59.4
ITALY	36.6	60.1	76.3	68.3	59.3

Fig. 12.1 Enterprises with at least 10 staff and with intranet by the type of shared information within the internal network and by business activity, size classes, and location (2008). Several answers to the same question are possible on the questionnaire. Thus, the sum of percentages per line may be over 100

For example, only 37% of all enterprises share information on business strategies, while more than 75% use internal networks for the simple exchange of work documents. These differences are related not only to the complexity of the tasks but also to the characteristics of the sector. As the size of a company increases so too does the need to share information regardless of the type of industry or location.

Nearly 50% of all enterprises shares information automatically within the enterprise on sales orders and more than 40% on purchases. This same information involves accounts and inventory management. Only 11% of the companies use enterprise resource planning (ERP) systems, but with great variability between small and large enterprises: from 7.6% which have 10–49 employees to 63.4% which have more than 249 employees.

For businesses that have Internet access, it was found that 87% of them get network services from public authorities, with minor differences found by location (see Fig. 12.2). The percentage rises to 98% for companies with 100 employees and more and to 85.6% for companies with 10–49 employees. Over three quarters of companies use the network to receive information and forms, with wider differences between them with respect to the previous case.

BUSINESS ACTIVITY / SIZE CLASS / GEOGRAPHICAL LOCATION	All purposes	PUBLIC SERVICES EXPLOITED ONLINE: Obtaining info	Obtaining forms	Returning filled in forms	Treating administrative procedure completely electronically	Offers for contracts	Other procedures /activities
BUSINESS ACTIVITY							
Total industry	87.0	77.8	75.7	43.6	43.4	9.9	30,5
Total services	86.9	80.2	75.2	46.0	44.9	8.8	34,8
SIZE CLASS							
10–49	85.6	77.1	73.2	40.8	41.0	8.5	31,1
50–99	95.9	88.9	89.4	64.4	59.5	13.8	36,9
100–249	98.2	93.7	95.8	80.3	73.1	17.5	43,9
250 +	98.1	95.6	95.7	84.6	78.3	22.1	48,5
GEOGRAPHICAL LOCATION							
Northwest	88.6	80.9	77.5	47.8	47.4	10.0	30,2
Northeast	87.4	78.5	76.7	45.1	40.7	7.5	28,7
Center	84.4	77.1	74.0	41.5	45.1	10.4	36,6
South and islands	86.0	77.4	71.9	41.2	41.7	10.2	36,7
ITALY	87.0	78.8	75.5	44.6	44.0	9.4	32,3

Fig. 12.2 Enterprises, with at least 10 staff, using Internet to interact with public authorities, by purpose, by business activity, by size classes, and by location, 2007 (percentage values on the total of companies with Internet). Several answers to the same question are possible on the questionnaire. Thus, the sum of the percentages per line may be over 100

In particular, in the textile and retail industry the percentage of enterprises getting this service makes up two-thirds of the total or 10 percentage points below the average. In general, online banking or financial services bring together all types of enterprises, more than 90% of the total (see Fig. 12.3). Instead, a difference is seen in the demand for online training services, which although rarely requested in general (only 19% require them) are relatively less in demand by small businesses, especially the traditional industries.

The automated exchange of data, practiced by 36% of all enterprises, is a variable that separates the small companies from the medium and large ones. More than 60% of medium and large enterprises use this type of exchange and when compared to small companies they make twice as much use of automatic data exchange (XML, EDIFACT, etc.).

The use of e-commerce is minimal among companies. Only 28% of enterprises buy online, and the value of these purchases represents less than 1% of the total purchases. Even fewer companies sell online: only 4.8%, with a total value of 2.9% of the total turnover. The use of e-commerce is greater in the service sector (hotel, telecommunications, etc.) with businesses of more than 249 employees (about 14%). Despite the significant use of security protocols, the percentage of firms making use of these procedures is nearly 40%.

BUSINESS ACTIVITY NUMBER OF EMPLOYEES GEOGRAPHICAL LOCATION	Access to banking and financial services	Acquisition of market data (e.g., prices)	Acquisition of services and data in digital format	Acquisition of post-sale services	Staff training
BUSINESS ACTIVITY					
Total industry	91.8	67.2	53.6	45.4	14.9
Total services	90.6	62.2	53.6	43.5	23.6
SIZE CLASS					
10–49	90.9	63.6	51.3	44.0	17.1
50–99	92.4	72.9	66.2	47.7	25.0
100–249	96.6	79.1	73.3	50.4	26.9
250 +	93.7	87.3	83.4	52.7	43.4
GEOGRAPHICAL LOCATION					
Northwest	93.3	67.5	54.6	46.3	18.5
Northeast	92.4	63.6	55.8	47.5	18.3
Center	89.6	64.2	51.5	42.7	18.6
South and islands	87.9	64.1	50.9	39.5	18.4
ITALY	91.3	65.1	53.6	44.6	18.5

Fig. 12.3 Enterprises with at least 10 staff using Internet, by type of online service used, by business activity, by size classes, and by location (2008 – percentage values on the total of companies with Internet). Several answers to the same question are possible on the questionnaire. Thus, the sum of the percentages per line may be over 100

12.2.3 ICT Cooperation Within Government Agencies

The extent and methods of interactions between public administrations both in the back office and between government agencies and external players exemplify the vision of a "network system" for the provision of end-user services (see Fig. 12.4). The use of information technology increases the potential of *horizontal* and *vertical cooperation* between levels of government by providing improved and expanded services. At the same time, with increased feedback possibilities, there is an improvement in implementation possibilities and in fostering innovation in the administrative processes of public administrations. Recent examples can be found in testing and the use of innovative technologies, such as VoIP, Wi-Max, RFI.

Another example of a public – private cooperative project with high-impact innovation is the role assumed by the public administration in the implementation of *single euro payments area (SEPA)* from the supranational level to the national level. The goal is to reduce the use of cash in retail transactions while increasing electronic payments (see Fig. 12.5).

The treasury annually places about 50 million retail credit transfers (13% of the total), and although only a few tens of thousands are related to cross-border

Type of local administration	Online services provided by										
	Ministries	Other central PAs	Social security offices	Regions	Provinces	Municipalities	Consortiums of mountain municipalities	Chambers of Commerce	Health authorities	Universities	Other local administrations
Municipalities	97.7	99.8	85.1	56.3	28.7	12.6	8.9	35.0	13.6	2.3	16.9
Mountain municipalities	63.7	91.2	67.7	58.1	31.1	18.8	13.3	26.3	3.1	1.9	14.6
Provinces	87.2	94.2	70.9	82.6	24.4	33.7	16.3	67.4	5.8	8.1	24.4
Regions and autonomous provinces	100.0	100.0	63.6	40.9	31.8	40.9	45.5	86.4	72.7	45.5	31.8
Total local administrations	96.3	99.4	84.2	56.6	28.7	13.2	9.3	35.2	13.3	2.5	16.9

Fig. 12.4 Local governments using online services offered by public administrations (2007 – percentage of the respective totals of local administrations). *Source*: 2007 ISTAT survey on ICT in local PAs

Type of local administration	Northwest	Northeast	Center	South	**Italy**
Municipalities	8.6	13.8	10.0	7.5	9.4
Mountain municipalities	4.3	0.0	3.1	1.4	2.3
Provinces	4.3	0.0	4.8	0.0	2.0
Regions and autonomous provinces	50.0	50.0	0.0	25.0	31.8
Total local administrations	8.5	13.3	9.5	7.2	9.1

Fig. 12.5 Local administrations that allow citizens to make online payments, by location, and type of administration (2007 – percentage of the respective totals of local administrations). *Source*: 2007 ISTAT survey on ICT in local PAs

operations, the implications of computerized administrative payment cycles are significant. This means that a new wave of investments is needed for

1. implementing new techniques (integrated treasury and administrative systems);
2. developing systems for the acceptance of micro-payments, especially by local administrations;
3. increasing security measures related to payments;
4. providing authentication systems;
5. reducing fraud and combating money laundering.

In parallel to the retail payments in the PA is the computerization of administrative payments, the basis of the *information system on operations by public agencies* (SIOPE), which is the archive maintained by the Bank of Italy on behalf of the RGS, the Italian general accounting agency. This system daily collects from government treasuries information about cash receipts and payments. It currently reports to the

system 12,500 subjects, equal to 92% of all agencies and 98% of all spending. Beginning in 2010 it has replaced the paper quarterly reports and becomes the main tool for monitoring the cash flows of the public administration. Further progress will be made in the computerized updates of ISTAT, the general accounting agency, and Bank of Italy archives. All this is intended to increase the supply of online services that from this point of view show evident delays.

Recent legislation has encouraged citizen and business interactions with the bureaucracy of the public administrations, by making certified electronic post-mandatory for enterprises for their inclusion in the business register and to the professionals. In addition, it has made the adoption of the XBRL standard for financial data collection and reporting mandatory (a requirement for financial statements closed from the beginning of 2009).

Currently, the quality levels for services provided by central administrations is still quite low and in many cases needs the intervention of qualified intermediaries as is reported by the CNEL survey.

12.3 Conclusion and Open Issues

Institutional reform would not generate major shocks to the information systems enabled by the new architecture, whose design centralizes in unitary databases information for decision support, while it decentralizes operational information systems and requires each administration to view the system as a whole and to respect the rules for dialogue between different administrations. If we have an organization based on the strategic use of information, we will hold the whole system, the whole country together. The transition is very delicate. It is not sufficient to enunciate the rules, even if these are handed down by the legislator. The change will make resource allocation more efficient. It also represents a hard-to-quantify but easily perceptible externality.

The view on network services discussed in this chapter is not universal, in spite of having been successful at different government agencies and private companies. Instead, the network concept is applied to the technological component and not to the exchange of services available online. In summary, not everyone agrees with the principle that service networks require the involvement of various stakeholders with a unified vision. If there is a lack of participation and incentives are given to individual agencies and firms, the result will be random, depending on the motivation of the individuals and not on the variety of services and the relative abundance of the clients.

According to economic theory, there are activities, functions, production, and consumption that cannot be left to the individual because their interest does not agree with the social welfare.

It is difficult to identify producers who are willing to supply a service whose cost is not definite or a consumer willing to buy a service whose price is not settled. Furthermore, there are scale economies that create a bias in favor of someone wait-

ing to enter the network and use the service. In these cases the debate is focused on identifying who and how, and what resources are necessary for the provision of these goods and services.

An approach is needed that goes beyond individualism (either enterprise or public agency), otherwise progress may not arrive, or if it does, certainly with much delay. The upgrading of the network service is feasible since system conditions exist, and the data analysis has been made by many research centers and has been shared.

Public interest should not be limited to private individuals or to individual government agencies which often have substantial human and financial resources and realize projects that they consider will increase their power. However, they do not realize that with their individual initiatives they cannot fully exploit the advantages of the network, thus delaying the diffusion of network services in the country.

There is a cultural resistance to the use of network services, but there have been successful achievements, such as the provision of online banking services or the sending of documents to individual public administrations. In general, they consist of simple services, although they require careful security measures to overcome the psychological resistance of the end users. Surveys suggest that there is not a widespread desire to go online, especially among small and micro-enterprises and among families. On the one hand, companies are waiting for a large number of suppliers and/or customers to go online with more sophisticated services and on the other hand, consumers have not yet given up their preference for personal contact with the commodity choice and the manufacturer.

In conclusion, the development of an innovative design should focus not only on the interests of the individual agencies and enterprises but must also promote the social interest. This needs to be applied not only to the public administration but also to complex economic and social systems (industrial districts, associations, etc.) in order to get out of the present stalemate in Italy's economic and social system.

The modernization of government has a positive return for the whole country; it sends a message of change that compels economic agents and individuals to equip themselves culturally. The change also has positive returns for innovative industries and contributes to job creation in the private sector, without falling back on unproductive public spending and parasitic public sector employment.

Clearly, the effort of product, process, and organizational innovation in the public sector cannot be begun and managed in episodic fashion; it requires a unitary vision – political above all, then strategic – since the modernization of government is not just a technological problem. Information, service science, and ICT are elements of a strategic design that profoundly affects not just the functioning of government departments and agencies but the country's productive system [182].

Therefore, one must also be cautious in comparing data on the diffusion of ICT services. The criticism does not apply to official statistics that are now becoming part of eGovernment indicators such as the ones proposed by OECD [157]. However, many research centers are not able to accurately and completely analyze the statistics entrusted to them by the European commission and by many governments.

Within the context of eGovernment, the European commission has taken the initiative to provide the European Union with a number of indicators on ICT usage in households, businesses, and governments. This has provided a set of indicators that allow correct, adequate, and verifiable comparison of statistics, thus reducing the previous difficulties.

Eurostat's annual surveys on ICT usage and e-commerce in enterprises and ICT usage in households and by individual are used in the context of the i2010 initiative.[1] For the i2010 benchmarking the characteristics to be provided for enterprises are drawn from the following list of items: development of broadband, use of Internet and other electronic networks, security, e-business, e-commerce, impact of adoption of ICT, interactions, and contacts between enterprises and public administrations. For household and individual ICT utilization the characteristics provided concern access to and use of ICT systems, use of Internet for different purposes, barriers to use, ICT competence, contacts with public administrations. Indicators from these surveys are used to meet the targets of the i2010 initiative.

To build up a coherent and useful set of indicators it is necessary to have in mind a model to analyze the operators' behavior and their needs together with relations among them and the public administrations. This becomes stringent when the institutional framework is a polycentric model that involves a network of information sharing central and local administrations. It is widely recognized that decentralization requires a larger set of information and indicators compared with centralization [183].

As a second step it is necessary to identify uniform rules to define the variables investigated, the measurement units, and the distribution of statistics. Finally, lacking the comparison with analogous outcome supplied by the market it is relevant to select efficiency indicators to compare with the widely known best practices.

A few examples for different sets of indicators could help to identify the priorities in planning and control activities (see also some examples in Chap. 7). Examples of *performance indicators* are output of services either in quantity or in value, number of certificates issued, productivity measures, number of contacts with citizens and/or enterprises.

Efficiency can be measured with an average cost analysis, the length of queues, the standard costs, the opportunity costs, etc. Quality indicators are the number of wrong outcomes both from the information systems or from the offices, the time involved in the definition of an administrative procedure, etc.

12.4 Summary

In this chapter we have examined several eGovernment issues such as the network/cooperative approach, the need of homogeneous statistics and indicators, and others considered from a socio-economic point of view both in the Italian and in the

[1] A list of benchmarking indicators has been defined and set out in the i2010 benchmarking framework endorsed by the i2010 High Level Group in April 2006.

European scenery. In conclusion, the view on network services is not universal, in spite of having been successful at different government agencies and private companies. Instead, the network concept is often applied mainly to the technological component and not to the exchange of services available online.

Chapter 13
Tunisian Ministry of Agriculture Planning of New Services and Information Systems Integration

As we said in the preface, the eG4M methodology has been applied to eGovernment projects in the Mediterranean area. In this chapter we focus on the data governance part of the methodology that has been applied in the Tunisian Ministry of Agriculture, in parallel with running initiatives on the reorganization of databases managed in the different administrative organizational structures of the ministry. The documentation available has been partial and, consequently, the case study has been simplified w.r.t. the real context and in some cases, modified. The reader has to be conscious that the Tunisian agricultural domain has only inspired the case study that, as a consequence, has to be seen as a paradigmatic example of any initiative of integration of databases, in particular in the agricultural domain. In Sect. 13.1 we provide some insight on the organizational structure of the ministry considered. Section 13.2 describes the activities performed, the roles of the different players, and the organization of work. In Sect. 13.3 we introduce the databases considered in the case study and their conceptual description. Following the methodology discussed in Chap. 2, in Sect. 13.5 the repository of the database conceptual schemas is produced. The analysis of the repository for strategic planning of future possible initiatives discussed in Sect. 13.6 concludes the chapter.

13.1 Organizational Structure of the Ministry of Agriculture

As happens in a great number of countries, we start our description assuming that each department in the ministry has information systems integrated at a vertical level, namely with decentralized agencies providing to the central databases data originated in the Tunisian regions they are in charge of administering. A strategic challenge for the ministry of agriculture and hydraulic resources (MAHR in the following) is the integration at a horizontal level of databases of the central administrative departments; the goal is to have an integrated vision on the whole set of activities and matters the ministry is in charge of, supporting strategic and political decisions and forecasts, e.g., on the productivity of the agricultural sector.

This chapter is authored by Carlo Batini and Gianluigi Viscusi.

G. Viscusi et al., *Information Systems for eGovernment*,
DOI 10.1007/978-3-642-13571-2_13, © Springer-Verlag Berlin Heidelberg 2010

Because of their role in MAHR core processes, we assume in the following that four major administrative departments have priority in the horizontal integration objective, namely

- the department in charge of the restructuring of agricultural state-owned domains;
- the department of veterinary services;
- the department of water resources; and
- the department of agricultural production.

Several feasibility studies and preliminary projects have been proposed in the past, always focused on a single department. Indeed, in this case the goal of the application of the eG4M methodology is to plan horizontal integration of the databases of the four considered departments.

13.2 The Activities Performed and Organization of Work

The MAHR has been the focus of the application of the eG4M methodology mainly for the strategic planning phase. State reconstruction has been focused on the following issues:

- The re-engineering of the current databases, namely the production of the corresponding conceptual schemas and the production of the repository of schemas, in order to produce the integrated representation of the whole information system of the MAHR, analyze the drawbacks of the current usage of databases, and conceive the target database architecture.
- The data quality evaluation of the databases, in terms of their currency and completeness, in order to assess the effectiveness of the current administrative processes and services provided by the public administration.
- The representation of the interactions between organizational units of MAHR in terms of services and related processes, together with the types of information involved and the ownership of the databases; the goal is to define the priority intervention areas in the integration initiative.

After a set of courses introducing the methodology and related topics, the above-described three issues have been developed through participatory design workshops involving four teams composed of three civil servants (one senior manager and two middle-level managers) each from the four departments. A three days a week workshop had a monthly frequency. ICT skills and computer literacy among the participants were not homogeneous, where a major divide was mainly related to the age of the attendees and to their functional role in the organization (some departments being represented by the IT staff while others by non-IT human resources).

In the following we focus on the first objective, the evolution of the data architecture. We suggest the reader to anticipate the reading of Appendix B, where different technologies and solutions to achieve integration among databases are described.

The four databases analyzed concern the following topics:

1. Agricultural state property
2. Veterinary services
3. Water resources schema
4. Agricultural production

The topics correspond one to one to the departments mentioned above. Workshops were dedicated mainly to a participated design [110] of the re-engineered conceptual schemas for the databases of each department and of the final integrated conceptual schema; besides this activity, a check of the matrices filled by each department representing organizational units and data flows (see Chap. 5) has been carried out.

Participatory design of the local conceptual schemas and of the integrated conceptual schema (using as formalism the entity – relationship model discussed in Chap. 2) started from the current logical schemas of the department databases, previously designed by external (often private) agencies.

Our main goal has been to build a complete and integrated view of the information content managed by MAHR with the collaboration of administration. To achieve this goal, we applied the data governance methodology described in Chap. 2.

The process followed and the different outputs produced are shown in Fig. 13.1. A different type of line is associated with each schema that will also be used in the following to distinguish the different schemas.

We assume that the four databases analyzed are documented in terms of a hybrid logical – conceptual schema plus a natural language description of requirements.

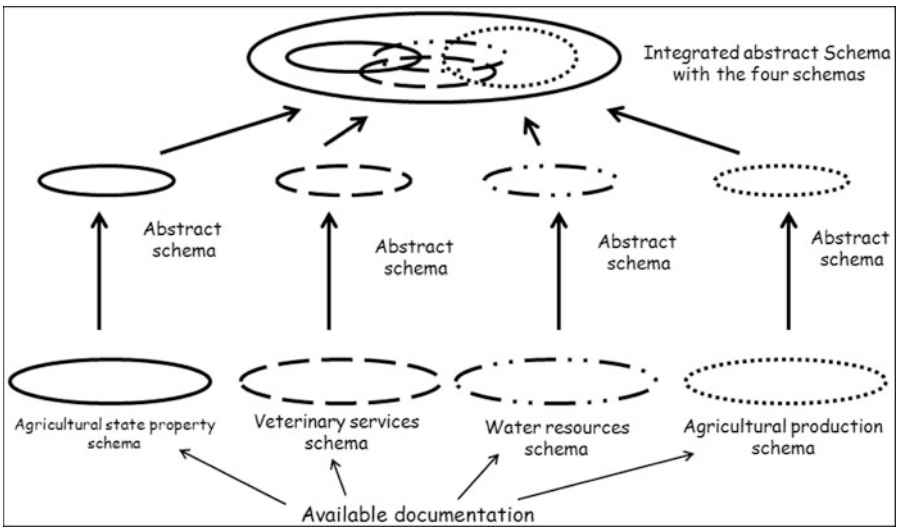

Fig. 13.1 The abstraction integration tree of the four schemas

Starting from this documentation, a reverse engineering activity is performed that produces the four conceptual schemas.

At this point, since the total number of entities is around 50, we first produce an abstract version for each schema and we integrate subsequently the four abstract schemas into the final abstract integrated schema.

13.3 Conceptual Schemas of the Databases

The four conceptual schemas resulting from the reverse engineering step of the methodology are shown in Figs. 13.2, 13.3, 13.4, and 13.5.

For reasons of simplicity, in the representation we have included the entities, the relationships, and IS-A hierarchies defined among them, while attributes, identifiers, and names of relationships are not reported. Note that the terms used for names of entities belong in part to a domain-independent vocabulary, such as in the case of `Project`, `Region`, `Grant`, and in part to domain-specific vocabularies, such as the public administration vocabulary for `Governorship` and `Delegation`, and the agriculture vocabulary, such as `Apiculture`, `Intensive farming`, and `Vaccination`.

The schema integration activities on conceptual schemas are greatly facilitated by the availability of this vocabulary, especially in the issues related to semantic relationships between terms such as synonymies or homonymies. We recall that a *synonymy* among two terms occurs when the two terms have the same meaning.

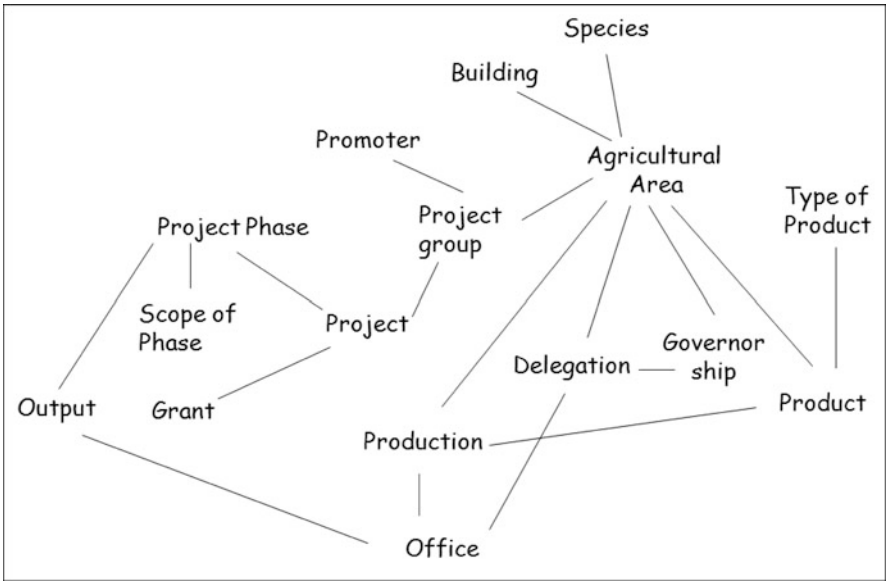

Fig. 13.2 The agricultural state property schema

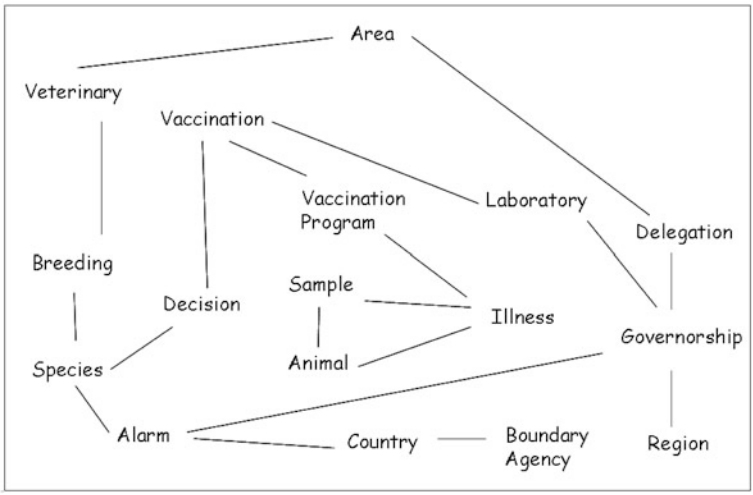

Fig. 13.3 The veterinary services schema

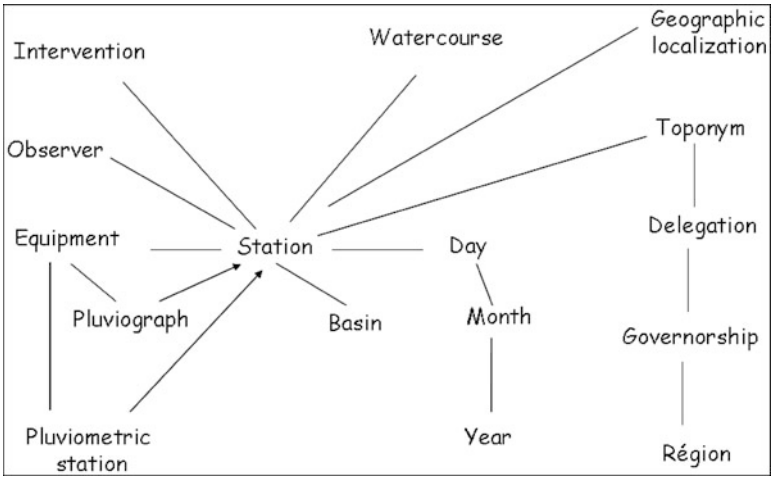

Fig. 13.4 The water resources schema

A *homonymy* among two occurrences of the same term in different schemas occurs when the two occurrences of the term have different meanings (for a complete discussion on semantic relationships among terms, see [78]). When a vocabulary is enriched with semantic relationships between terms it is called *lexicon*. For a discussion on lexicons the reader may refer to [78].

In the case of four schemas, we have been very careful in the reverse engineering activity to choose exact terms, not too general, not too specific, in order to minimize the occurrences of synonymies and homonymies. Looking with attention at similar terms in different schemas, we conclude that a synonymy exists between

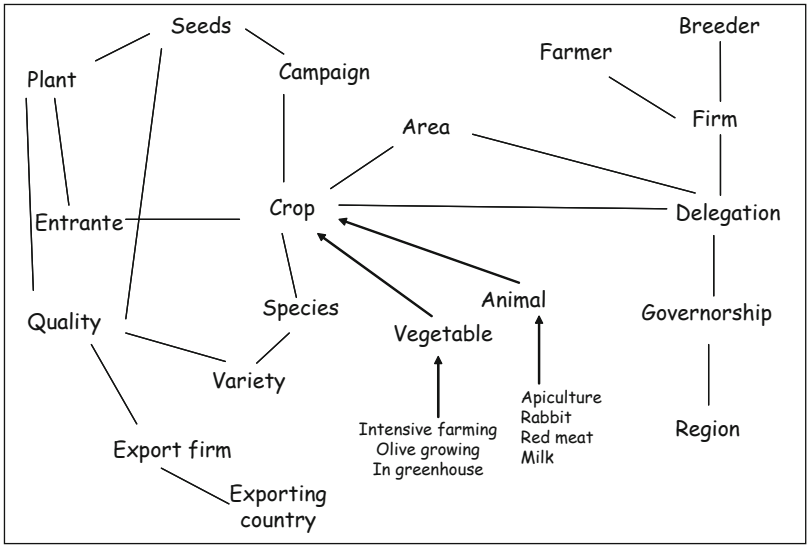

Fig. 13.5 The agricultural production schema

the entity `Agricultural area` in the `Agricultural state property` schema and the two entities `Area` in the `Veterinary services` and in the `Agricultural production` schemas. We may solve the synonymy by changing `Agricultural area` into `Area`.

13.4 The Abstractions on Schemas

We move now to the second step of the methodology, namely the production of abstract schemas. For each schema we have to choose the groups of concepts (entities, relationships, IS-A hierarchies) to be abstracted into a unique concept in the corresponding abstract schema. The abstractions chosen for the four schemas are shown in Figs. 13.6, 13.7, 13.8, and 13.9. We put in evidence the groups of concepts to be abstracted by means of closed lines and add a box to the border of the line with a name for the abstract concept.

In order to avoid the introduction of new synonyms and homonyms, in the assignment of abstract names it is worthwhile to have a look at the entire set of schemas, e.g., a choice that we made has been to assign the same name, `Agricultural production resource`, to two groups of concepts in the water resources schema and in the agricultural production schema. Looking at the two groups, they are dissimilar. If the repository had more than two levels, it would be worthwhile to assign `Agricultural production water resource` and `Vegetable and animal production resource` as abstract names, respectively, to put in evidence the difference between the two types of resources. Another possible choice could be to distinguish among input resources and output resources.

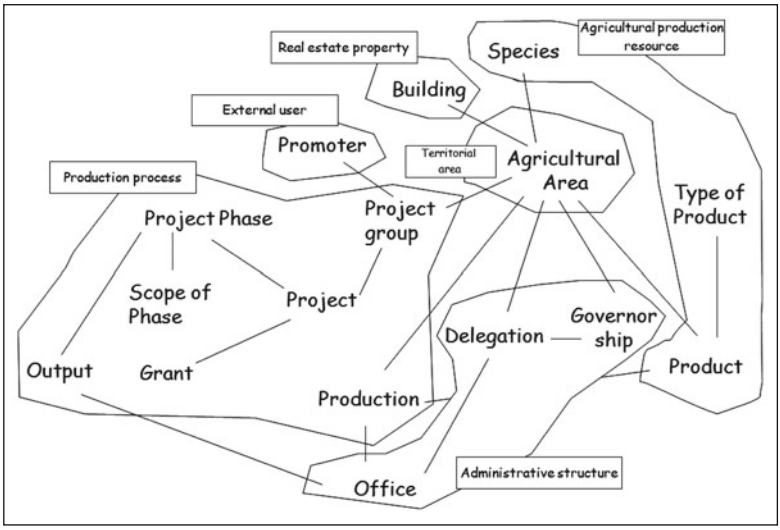

Fig. 13.6 Abstractions for the agricultural state property schema

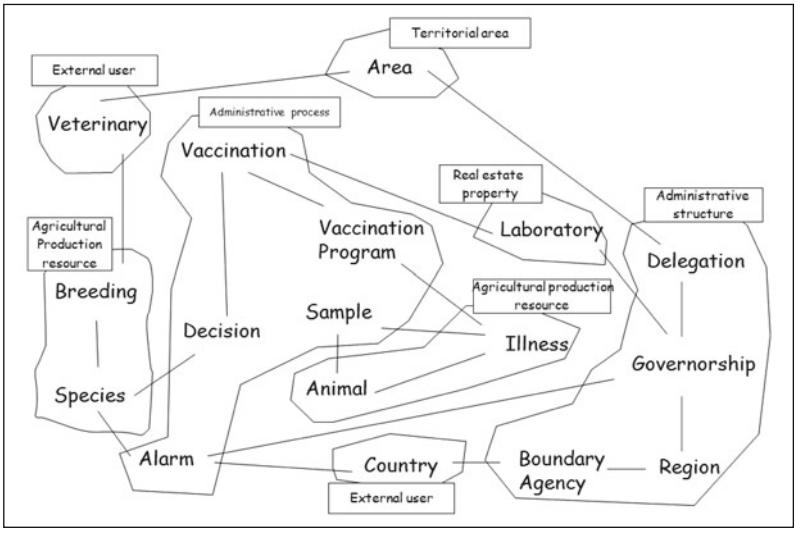

Fig. 13.7 Abstractions for the veterinary services schema

A second example concerns the abstract concepts `Geographic localization` and `Territorial area`. Starting from the same motivation as before, namely, the unique level of abstraction available, we could assign the same name to the two abstract concepts. This choice would lead to an error, since `Geographic localization` is a concept with a very specific meaning that has to be represented in the abstract schema to put in evidence the differences w.r.t. `Territorial area`.

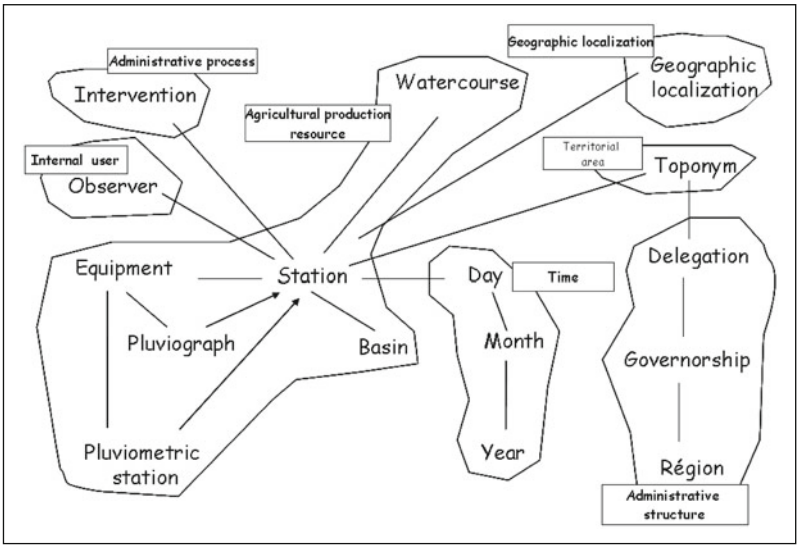

Fig. 13.8 Abstractions for the water resources schema

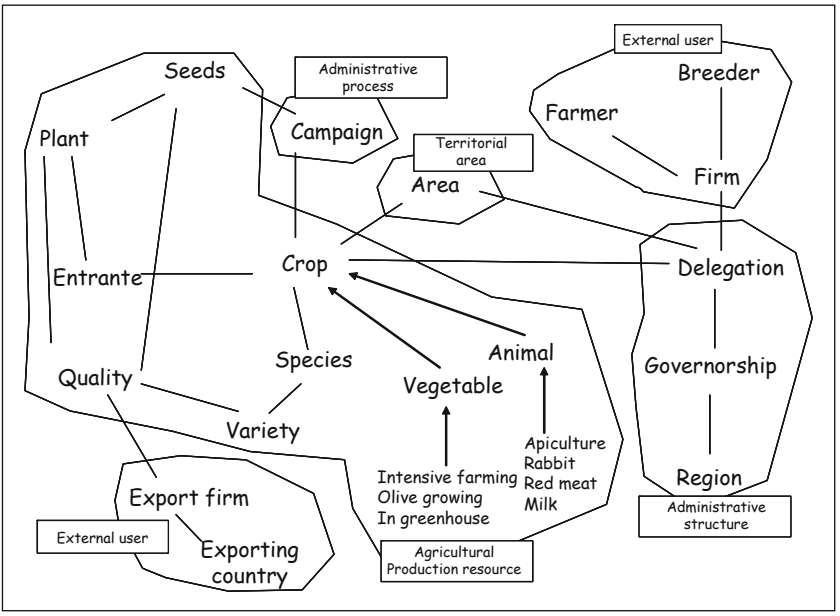

Fig. 13.9 Abstractions for the agricultural production schema

To conclude, we have to note that there are no fixed rules for the abstraction process and that experience is helpful in uncertain contexts.

Another issue that deserves a comment concerns the size of clusters of concepts to be abstracted. Coming back to the previous example, the clusters associated

with `Agricultural production resource` are wider than the clusters associated with `Administrative structure`. This is not surprising since the number of resources used or produced in agriculture is wide while (fortunately) the number of different types of administrative structures is usually small. Other times the difference in size could be an indication of a different "abstraction speed" in the abstraction process. In these cases we have to fragment large clusters into smaller ones, in order to achieve better balancing in the abstraction process.

13.5 The Repository of Schemas

We are now ready to produce the upper levels of the repository of schemas. We obtain the abstract schemas corresponding to the four initial schemas by substituting each cluster of concepts with the unique abstract concept chosen. In doing so, we have also to inherit the connections of clusters of concepts with other clusters. The process leads to produce the four abstract schemas shown in Figs. 13.10 and 13.11.

The final step concerns the integration of the four abstract schemas. We follow the methodology described in Sect. 2.4. Synonymies and homonymies in the four initial schemas have been analyzed and solved before; we have also checked in the abstraction steps that no new name heterogeneity has been introduced. Thus, we can simply superimpose the four schemas obtaining the integrated schema shown in Fig. 13.12. In this regard, we have to add the *interschema properties*, corresponding to the semantic relationships among concepts in different schemas which were hidden previously, but have to be added now for concepts that have been merged. An example of interschema property is the generalization hierarchy between `External user` and `Internal user` that leads to the introduction of a common ancestor between them, namely `User`.

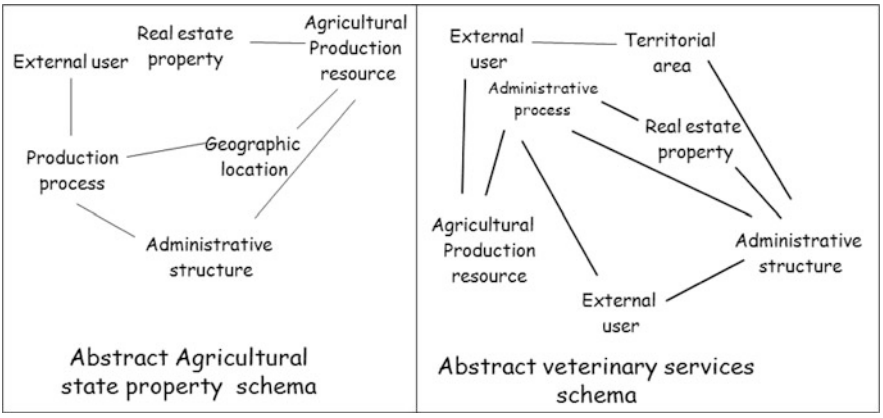

Fig. 13.10 The abstract agricultural state property and veterinary services schemas

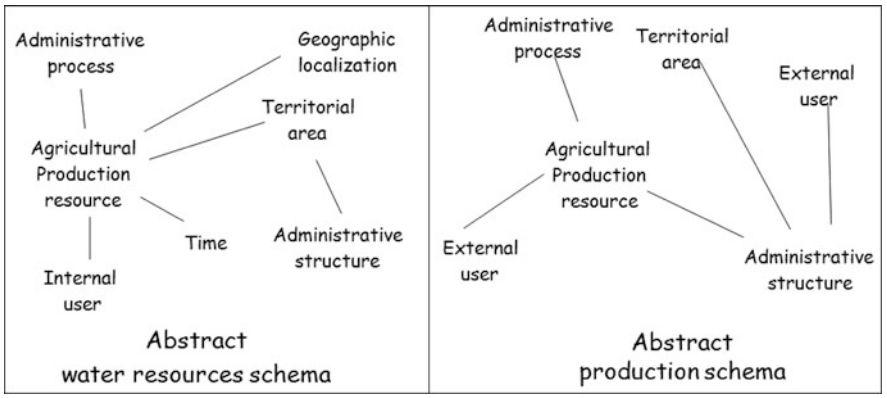

Fig. 13.11 The abstract water and production schemas

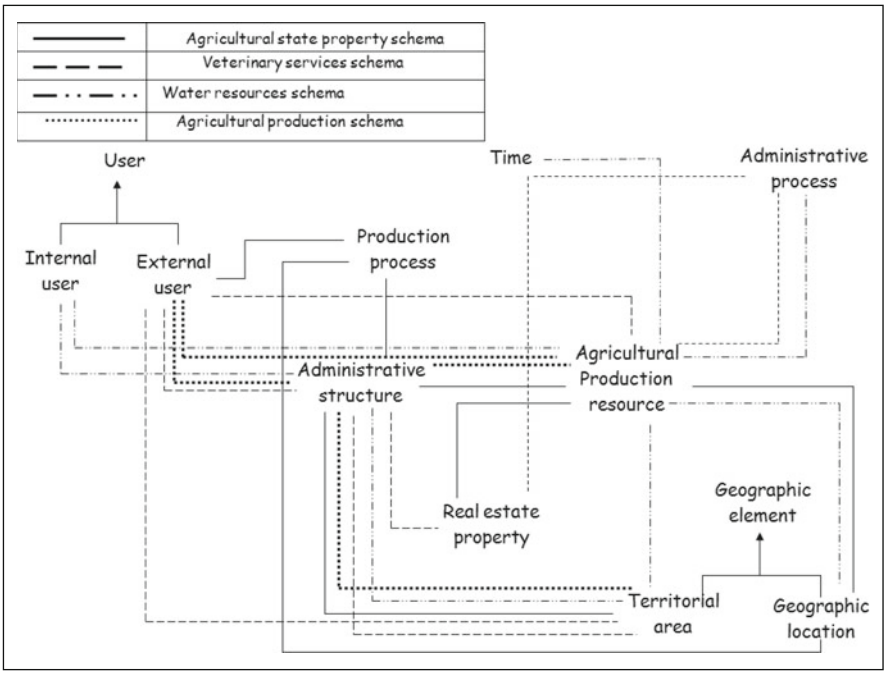

Fig. 13.12 The abstract integrated schema with the four local schemas in evidence

13.6 Analysis of the Schema Repository to Achieve Effective Strategic Planning Decisions

The analysis of the repository of schemas can be performed at different levels of abstraction. Looking at the entire documentation we highlight the following problems.

- Different entities exist which are common to several schemas. Looking at the schema of Fig. 13.12 the multiplicity of schemas in which an entity is involved is graphically highlighted by the number of incoming/outcoming edges. This situation usually leads to redundant representation of data and high risks of misalignment among the different copies of the same data. In the choice of future projects we may consider the possibility to establish a publish – subscribe layer among schemas that disciplines and aligns the updates of the entity instances in different databases.
- As natural for any ministry of agriculture, the MAHR jurisdiction is in practice on all the territory of the country. While all databases need to represent the territory, only one database, the `Water resources` database, explicitly represents the *geographic localization*. This choice results in heterogeneities in the representation of the territory and leads to limited integration in the representation of the different entities grounded in the territory, e.g., the state property resources cannot be correlated with the cadastral databases, which another ministry is in charge of. A design choice to be evaluated in more detail in a feasibility study should be to move to a homogeneous representation of the territory in the four databases, by means of a spatial DBMS, namely a DBMS that allows to represent spatial objects (such as points, lines, polylines, areas) natively in the logical model.
- Looking at the different types of `Internal` and `External users`, an incompleteness in the representation of users is perceived. This observation may lead to looking at services provided by the ministry in such a way to find the set of all possible types of users, so as to discover in case new services are to be provided effectively.

The participatory analysis activities put in evidence other problems. Once designed the re-engineered conceptual schema for the department of agricultural production, one of the managers attending the workshop pointed out that the schema was wrong, due to the lack of a relationship between the entity `Farmer` and the entity `Agricultural product` (a kind of strategic information in the case of MAHR).

We first checked with the help of other attendees that the schemas produced exactly match with the one produced by the external company involved in the production and maintenance of the current database, the result was negative. At this point all the attendees became aware of the fact that in order to maintain the control over the outsourcer companies, the methodology and the participatory work can be very helpful in providing an effective instrument for managing information and knowledge of interest for the administration.

Furthermore, the awareness arose that in strategic and operational activities on the information system of administration it may be worthwhile to leave the deployment and maintenance activities to the market (namely, private vendors), while the public administration has to retain the planning, design, and quality evaluation of the eGovernment projects, with particular attention paid to data governance decisions.

We finally applied the decision process on the optimal evolution of the architecture described in Appendix A to the four databases (we suggest to read the appendix

before reading this part). We first collected information on the application load and other variables considered in the decision process.

Figure 13.13 shows a decision table for the participatory choice of technologies suitable to support the exploitation of the integrated architecture. The figure results from the usage of the decision table shown in Fig. 13.14 and discussed in detail in Appendix A.

Figure 13.13 shows that publish – subscribe is a suitable technology for all the departments, these latter fulfilling requirements such as high autonomy and low relevance of querying with respect to update operations; whereas a data warehouse solution is needed for some of the involved departments, i.e., the department in charge of the restructuring of agricultural state-owned domains, the department of veterinary services, and the department of agricultural production. The conclusion is that

1. all databases fit the criteria shown in the upper gray line, thus leading to the proposal to adopt a publish – subscribe architecture on common entities for all of them;

Condition of use (advantage)	Condition of use (inconvenience)	Department	Technology
▪HIGH AUTONOMY OF MANAGEMENT ▪HIGH ECONOMIC VALUE OF THE INTEGRATION ▪LOW RELATIVE IMPORTANCE OF THE QUERYING WITH RESPECT TO THE UPDATE	▪LOW OVERLAPPING OF THE DATA BETWEEN THE DIFFERENT DATABASES	1) The department of animal production; 2) The department of the restructuring of agricultural state-owned domains; 3) The department of veterinary services; 4) The department of water resources management	Enterprise Application Integration/Publish & Subscribe
▪LOW AUTONOMY OF MANAGEMENT ▪ HIGH COST OF HETEROGENEITY ▪HIGH ECONOMIC VALUE OF THE INTEGRATION ▪HIGH COMPLEXITY OF MANAGEMENT	▪ HIGH AUTONOMY OF MANAGEMENT	-	Central Database
▪LOW AUTONOMY OF MANAGEMENT	▪HIGH NUMBER OF LOCAL QUERIES	-	Distributed Database
▪HIGH AUTONOMY OF MANAGEMENT ▪LOW VOLATILITY OF SOURCES ▪HIGH IMPORTANCE FOR THE ACCESS TO HISTORICAL DATA ▪HIGH RELATIVE IMPORTANCE OF THE QUERYING WITH RESPECT TO THE UPDATE ▪HIGH ECONOMICAL VALUE OF THE INTEGRATION ▪HIGH COMPLEXITY OF THE QUERYING	▪LOW RELATIVE IMPORTANCE OF THE QUERYING WITH RESPECT TO THE UPDATE ▪HIGH VOLATILITY OF SOURCES	1) The department of animal production; 2) The department of the restructuring of agricultural state-owned domains; 3) The department of veterinary services	Datawarehouse
▪HIGH AUTONOMY OF MANAGEMENT ▪ HIGH VOLATILITY OF THE QUERYING ▪HIGH RELATIVE IMPORTANCE OF THE QUERYING WITH RESPECT TO THE UPDATE ▪HIGH COST OF HETEROGENEITY ▪HIGH ECONOMIC VALUE OF THE INTEGRATION	▪LOW RELATIVE IMPORTANCE OF THE QUERYING WITH RESPECT TO THE UPDATE ▪HIGH VOLATILITY OF SOURCES	-	Enterprise Information Integration

Fig. 13.13 Decision table for the participatory choice of suitable technologies

Decision criteria									Suggested solution
Autonomy	Relevance of historical data	Query complexity	Relevance of currency in queries	Economic value of integration	Relevance of queries wrt transactions	Volatility of queries	Management complexity	Costs of heterogeneities	Preferred solution
-	High	-	-	-	-	-	-	-	Data Warehouse
High	-	-	Low	High	-	-	-	-	Publish & Subscribe
Low	-	-	-	High	-	-	High	High	Consolidation
Low	-	-	-	High	-	-	High	High	Consolidation
Low	-	-	-	High	-	-	High	High	Consolidation
High	-	-	High	High	High	High	-	High	Data integration
High	-	-	-	-	High	-	-	-	Data integration
High	-	High	-	High	-	-	-	-	Data Warehouse

Fig. 13.14 Decision table for choosing the optimal data integration architectural solution

2. the three databases related to

   - agricultural state property
   - agricultural production
   - veterinary services

   all need a common data warehouse.

13.7 Summary and Conclusion of the Book

The overall activity discussed in this chapter has shown that the eG4M methodology is a good point of equilibrium between simplicity of application and effectiveness of decisions. We also have to underline that, as said previously, before moving to production, feasibility studies are needed whose goal is to deepen the technical analysis and evaluate costs and benefits of the project more precisely.

Finally, at learning process level the eG4M methodology-related workshops held in Tunisia fulfilled the share of IT skills among the participants, improving knowledge and computer literacy of some attendees with no previous IT capability. In terms of absorptive capacity, the eG4M methodology has successfully supported the assimilation by the organization of IT-related knowledge [82, 233].

In conclusion of the book we may say that eG4M, as expressed in the title of the book, is a methodology suitable to be used in a wide spectrum of strategic and operational planning activities for service-oriented information systems. Its modular approach makes easy an adaptation of the methodology to specific and more focused needs of the public administration, as shown by the case study discussed in this chapter. Clearly, every methodology needs a suite of tools in order to be effective. For we are currently developing, experimenting, and using such a suite of tools as a business activity of NexTTLab, a spin-off of the University of Milano Bicocca (Italy).

Part V
Appendix

Appendix A
Information Integration Technologies

In large organizations the database architecture is typically built through a sequence of projects and realizations that result in a number of heterogeneous and sometimes overlapping data sources. Data fragmentation significantly reduces the possibility for an organization to exploit its information assets. A technology that partially alleviates these problems is *data integration middleware* that allows users to read-only access data stored in heterogeneous data sources through the presentation of a unified view of these data.

In this appendix, after discussing the drawbacks of current database technologies (Sects. A.1 and A.2), we describe data integration technologies (Sect. A.3) and conclude (Sect. A.4) with a simple yet effective methodology to plan the optimal evolution of the data architecture of an organization/set of organizations.

A.1 Drawbacks of Database Architectures in Organizations and the Value of Enterprise Integration

Database technologies have evolved over the years, resulting in different architecture types. Organizations tend to create and manage their databases of interest through a sequence of projects and realizations that result in a database architecture characterized by a set of anomalous behaviors, such as redundancy of representations, misalignment of data among different databases, scarce coherence in business rules related to the same objects in different databases, errors in data that result in the heterogeneous representations of records pertaining to the same real world object. This trend is made more and more critical by the continuous evolution of organizations due to, e.g., merger and acquisition activities that add new data sources from external organizations to the existing data architecture. Consequently the problem of managing the whole data architecture is a primary issue in modern organizations.

The concept of data architecture has been informally introduced in Chap. 2. With the term *data architecture* we define the allocation of the types of data of interest of

This appendix is authored by Carlo Batini.

G. Viscusi et al., *Information Systems for eGovernment*,
DOI 10.1007/978-3-642-13571-2, © Springer-Verlag Berlin Heidelberg 2010

an organization among database management systems available in the organization's information system.

Note that this definition of data architecture is sufficiently general to also cover the case of relational databases, where the architecture is the allocation of types of data (attributes and keys, in relational terminology) in relational tables that define the logical schema of the database. According to this definition of data architecture, many possible relational architectures correspond to a same conceptual schema, at which different levels of normal forms (see [9]) are associated. The normal form in the relational model is a kind of quality that is associated with the data architecture.

Due to the uncoordinated planning and design of (usually) a large amount of databases, the data architecture is characterized by several types of heterogeneities in data representation that can be generally classified into (i) technological heterogeneities, (ii)schema heterogeneities, and (iii) instance-level heterogeneities. We introduce the heterogeneities making use of the example in Fig. A.1. We assume that in the two databases a relational table is defined that stores data about professors of Italian universities:

1. *Technological heterogeneities* are due to the use of products by different vendors, employed at various layers of an information and communication infrastructure. An example of technological heterogeneity is the usage of two different relational database management systems like IBM's DB2 vs. Microsoft's SQLServer.
2. *Schema heterogeneities* are caused by the use of (i) different data models, such as one source that adopts the relational data model and a different source that adopts the XML data model and (ii) different data representations, such as one source that stores addresses as one single field and another source that stores addresses with separate fields for street, civic number, and city. In the example, the two databases adopt the same model, namely the relational model, while two different data representation heterogeneities occur; (ii.a) identifiers of university members are different and (ii.b) the format of the `DateofBirth` is different.
3. *Instance-level heterogeneities* are caused by different, conflicting data values provided by distinct sources for the same object. This type of heterogeneity can be caused by quality errors, such as accuracy, completeness, currency, and consistency errors; such errors may result, for instance, from independent processes that feed the different data sources. In the example we assume that the same person "Carlo Batini" is represented, while the last name is "Batini" in one case and "Btini" in the other case, the difference is due to a double imputation of the data.

Note that the schema- and instance-level heterogeneities may also occur inside the same database, if the design of different parts of the database (or the maintenance over the years) has been performed by different uncoordinated teams.

Note also that a traditional solution to the problem of heterogeneity of data is the periodical *file transfer*, namely the communication of data from a database A to a database B, followed by a homogenization performed at the node hosting the database B. This policy has several drawbacks, namely it is costly, since it has to

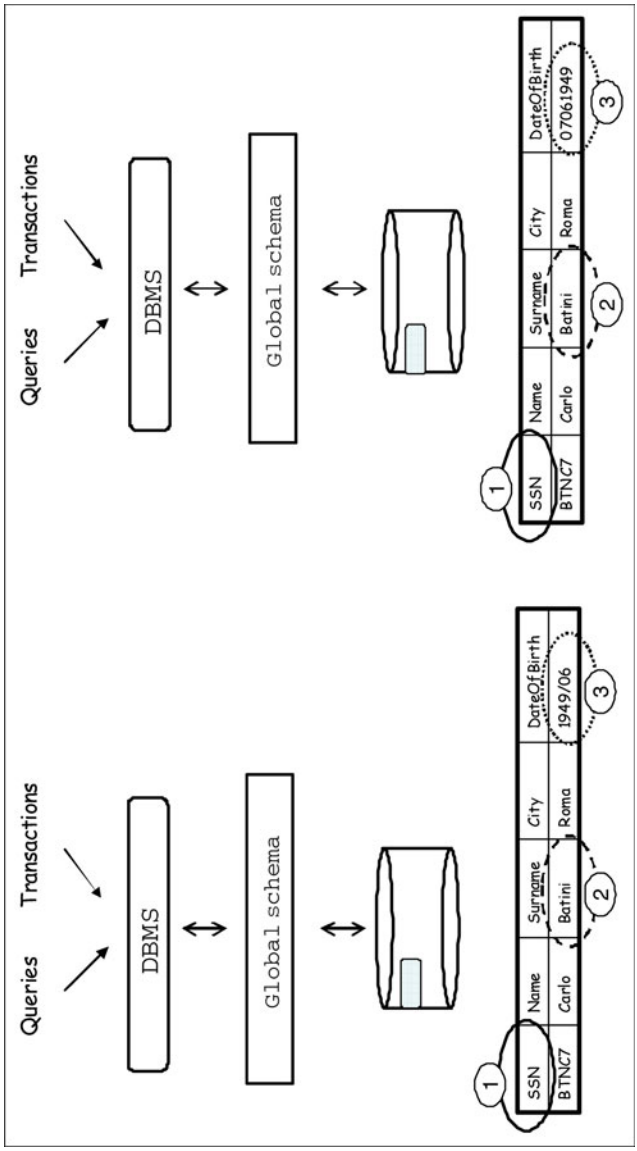

Fig. A.1 Examples of heterogeneities in a set of databases

be performed periodically. It also aligns the two databases only at given snapshots, while constantly reproducing the heterogeneities as long as the following alignment occurs.

A.2 Traditional Centralized and Distributed DBMS Architectures

Traditional DBMSs adopt a centralized architecture, characterized by the existence of a unique logical schema (and, correspondingly, a unique conceptual schema) and an application load made of queries and transactions that operate onto a unique database (Fig. A.2).

With the advent of networks, the traditional centralized database architecture has evolved, leading to the distributed architecture shown in Fig. A.3, in which queries and transactions can be executed in each node of a distributed infrastructure, where the data are distributed in the set of nodes. The common aspect between the centralized and the distributed architecture is the uniqueness of the logical schema across the architecture, so that, for example, professors are represented in the different nodes according to their affiliation, their date of birth with the same format defined in the unique logical schema. So, the distributed architecture may lead to an improvement of the efficiency in query and transaction management, while heterogeneity problems are unchanged w.r.t. the centralized solutions.

Consolidation is a solution that goes in the opposite way. Data that actually reside in different databases and are managed by different DBMSs are now integrated in a unique database, which will be used from now on instead of the set of fragmented databases (see Fig. A.4). In the process of consolidation, the schemas of databases have to be integrated first, to achieve a common homogeneous conceptual representation of data, in such a way that schema heterogeneities are solved. Second, data have to be integrated, solving the instance-level heterogeneities. In practice, the two integrations can be performed together. Another relevant activity concerns queries and transactions that have to be changed and adapted to the new global schema.

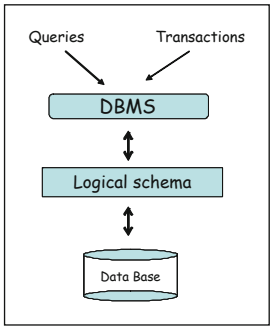

Fig. A.2 The centralized DBMS architecture

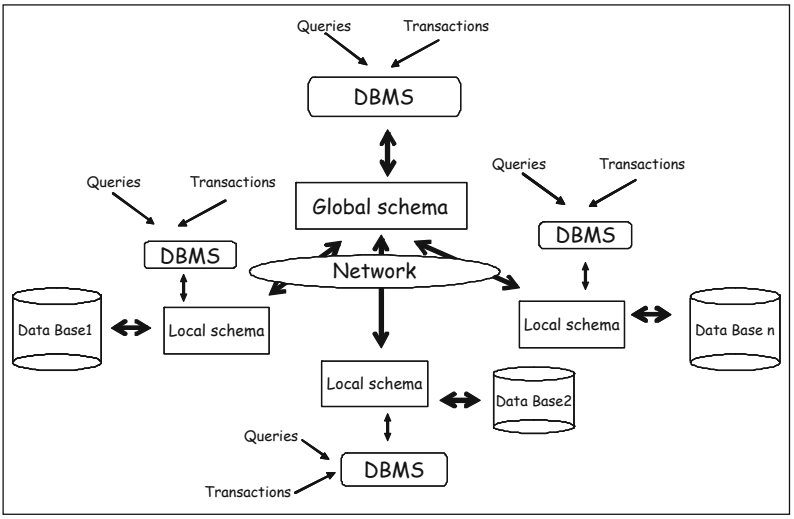

Fig. A.3 The distributed DBMS architecture

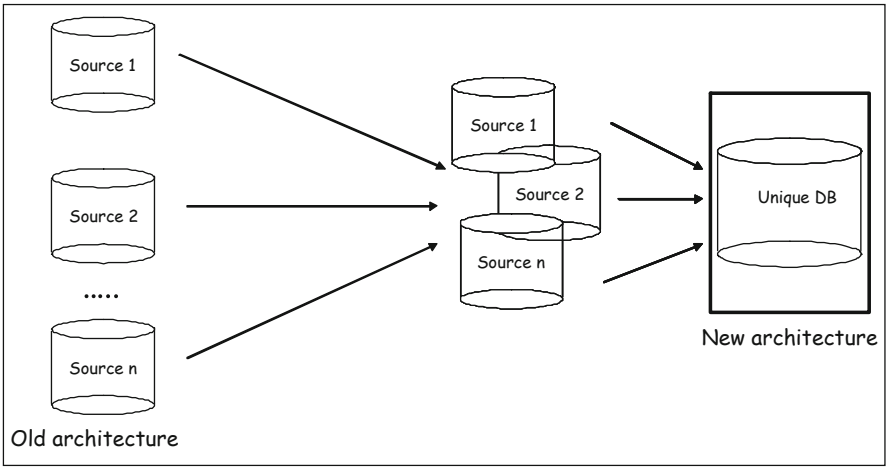

Fig. A.4 The consolidation architectural solution

A.3 Data Integration Solutions

Data integration [99] is a major research and business area that has the main purpose of allowing a user to access data stored in heterogeneous data sources, through the presentation of a unified and reconciled view of this data.

However, data integration faces all the types of heterogeneities previously described. There are two main approaches to data integration that can be identified, based on the actual location and shape of the integrated data, namely

1. *materialized data integration* where the (unified view of) data are materialized; this solution is usually called *data warehouse*;
2. *virtual data integration*, where the unified view is virtual and data reside only at sources.

Let us see the two solutions in more detail in the following sections.

A.3.1 Data Warehouse Architecture

In a data warehouse solution (see Fig. A.5) a new database is added to the set of databases already present in the architecture. A data warehouse solution is typically chosen to separate analytical queries to be performed over the materialized integrated database and operational queries and transactions to be performed on the local databases. This has two advantages: (i) complex analytical queries are performed on a separate database w.r.t. the operational databases and (ii) they are performed over an integrated version of data. At the same time, the materialized integrated and reconciled database has to be periodically maintained, since in the meantime operational databases have changed due to update transactions. For a comprehensive introduction to data warehouses, see [90].

A.3.2 Virtual Data Integration Architecture

The virtual data integration architectural solution is shown in Fig. A.6.

The two middleware components characteristic of the data integration solution are the *wrapper* and the *mediator*. Wrapper/mediator integration systems

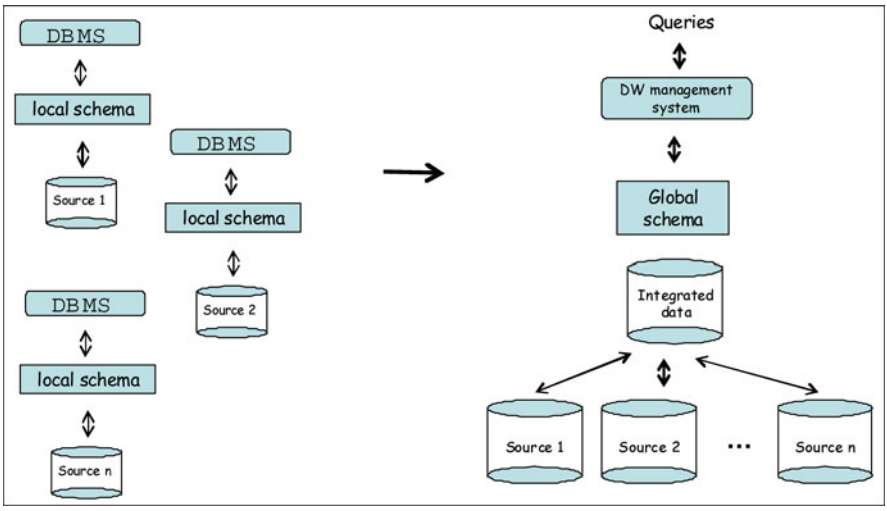

Fig. A.5 The data warehouse architectural solution

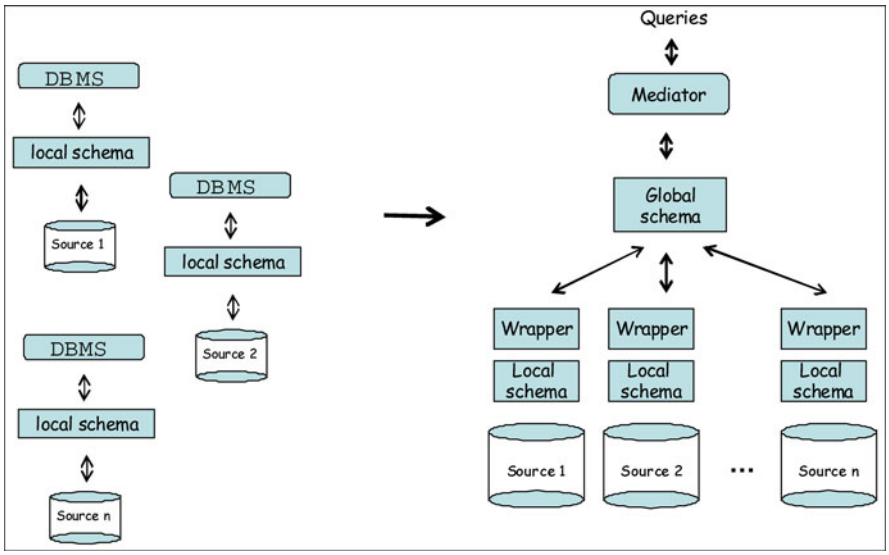

Fig. A.6 The virtual data integration architectural solution

manage data coming from different data sources by means of a global view. In a wrapper/mediator architecture data reside in local sources and the global view is an entry point for data retrieving. The wrapper (that we met also in Chap. 11) is a piece of software built on top of the data sources. At design time, the role of the mediator is to build the global schema resulting from the integration of local schemas and enable users to formulate queries on it; the role of the wrapper is to represent the local schemas in terms of a common model.

When a user at run time poses a query to the global schema, the mediator translates the query into a set of subqueries for the involved sources by means of automatic unfolding – rewriting operations taking into account the global and sources schemas. At this point the wrapper translates the subqueries in terms of local schemas. The results of the subqueries are translated by the wrapper in terms of the common model. Results from subqueries are then unified by the mediator leading to the final result.

A.4 Optimal Evolution of the Database Architecture

In this section we propose an innovative approach to the evolution of data architecture of an organization, with the goal of optimizing the quality of the overall data architecture when data integration solutions are used. We also consider the publish – subscribe middleware introduced in Chap. 9 as a possible solution to be adopted, since it can be used to align the updates of overlapping data present in more than one database, and so can be seen as an integration technology.

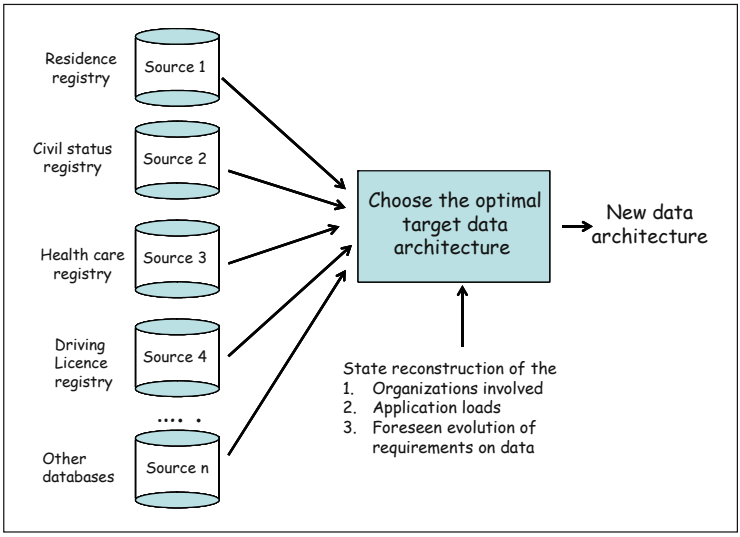

Fig. A.7 Choosing the optimal target database architecture

The problem we want to solve is summarized in Fig. A.7. We have represented in the left-hand side several databases that are involved in the running example, such as the `Residency registry` and the `Driving licence registry`. A decision process is needed that, based on

- the description of the architecture;
- the representation of the organizations and functions of organizational structures;
- the knowledge of the *application load*, namely, the queries and transactions most frequently executed, together with their frequency; and
- the foreseen evolution of databases,

produces the *optimal* mix of target architectures to evolve to.

Next we discuss the concept of "optimal." Our objective, intuitively, is to extract more data by the new architecture. We may formalize this by introducing the concept of *potential information capacity*. The potential information capacity of a database architecture can be roughly defined as the set of all types of data that can be extracted from a (virtually) integrated database schema, which cannot be extracted by considering non-integrated data sources alone. The stated problem is quite complex to solve and many different variables should be considered. Among them, we have to consider the costs of different solutions. Here we provide a simplified heuristics that consists in a decision table, based on nine different decision variables that can be seen as a proxy of the issues considered in Fig. A.7. The nine variables are

1. *autonomy*, the degree of independence between the different database administrators in their design choices;

2. *relevance of historical data*, and consequent need to periodically store new data without deleting the old ones;
3. *query complexity*, in terms of amount of data and tables visited and number of operators on them, and consequent time complexity in query execution;
4. *relevance of currency in queries*, the need for queries to extract current data;
5. *economic value of integration*, the relevance of having integrated information in input for business operational and decisional processes in order to produce effective outputs;
6. *volatility of sources*, frequency of adding or deleting sources, and frequency of change of source schemas;
7. *relevance of queries w.r.t transactions*, relative importance and frequency of queries with respect to changes in data;
8. *management complexity*, the effort to be spent in management activities related to databases and hw – sw infrastructures, due to the corresponding complexity of the organizations using databases;
9. *costs of heterogeneity*, hidden and explicit costs related to business processes that are due to making use of heterogeneous data.

A simple decision table based on [low; high] values of variables is shown in Fig. A.8. The table shows a small number of situations and can be easily extended to a wider set.

The decision table can be applied to the whole set of databases or to one or more subsets and provides a simple yet powerful tool for a problem, the evolution of the data architecture that will be more and more critical in the future in practically every organization, managing in its information system, let us say, more than 10 databases.

Decision criteria									Suggested solution
Autonomy	Relevance of historical data	Query complexity	Relevance of currency in queries	Economic value of integration	Relevance of queries wrt transactions	Volatility of queries	Management complexity	Costs of heterogeneities	Preferred solution
–	High	–	–	–	–	–	–	–	Data warehouse
High	–	–	Low	High	–	–	–	–	Publish – Subscribe
Low	–	–	–	High	–	–	High	High	Consolidation
Low	–	–	–	High	–	–	High	High	Consolidation
Low	–	–	–	High	–	–	High	High	Consolidation
High	–	–	High	High	High	High	–	High	Data integration
High	–	–	–	–	High	–	–	–	Data integration
High	–	High	–	High	–	–	–	–	Data warehouse

Fig. A.8 Decision table for choosing the optimal data integration architectural solution

Appendix B
Business Process Management

This appendix provides a quick overview of business process management (BPM), which is particularly relevant for eGovernment applications. Traditionally, information systems, also in the eGovernment area, used data-driven approaches; however, over the last few years it has become clear that processes are equally important. BPM addresses the topic of process support in a broad perspective and is fueled by technological developments (e.g., service-oriented architectures) triggering standardization efforts (e.g., languages as BPMN and WS-BPEL). After introducing in Sect. B.1 the basic concepts, we describe in Sect. B.2 the business process modeling notation for business process modeling, and in Sect. B.3 the architecture of a business process management system.

B.1 Basic Concepts

Business process management (BPM) is based on the observation that each product/service that an organization provides is the outcome of a number of processes and activities. This is also true for public administrations providing services to citizens and enterprises. Business processes are the key instrument for organizing these activities and for understanding and improving their interrelationships.

A *business process* (or an *administrative process*) consists of a set of activities that are performed in coordination in an organizational and technical environment. These activities jointly realize a *business goal*. Each business process is enacted by a single organization, but it may interact with business processes performed by other organizations [225]. Therefore, BPM includes concepts, methods, and techniques to support the design, administration, configuration, enactment, and analysis of business processes. The basis is the explicit representation of business processes with their activities and the execution constraints between them. To these purposes, different models and languages, more or less formal, have been defined over the years; in this appendix, we quickly outline the business process modeling notation (BPMN).

This appendix is authored by Massimo Mecella.

A business process management system (BPMS) is a software system that is driven by explicit process representations to coordinate the enactment of business processes. A *business process model* consists of a set of activity models and execution constraints between them. A *business process instance* represents a concrete case in the operational business of an organization (e.g., the management of the certificate of Massimo Mecella), consisting of activity instances. Each business process model acts as a blueprint for a set of business process instances and each activity model acts as a blueprint for a set of activity instances [225]. Therefore, business process models are the main artifacts for implementing business processes in a BPMS, which makes sure that all business process instances are executed as specified in the respective business process models.

Typically, the ordering of activities is controlled by the BPMS as a centralized software component, very similar to how a conductor centrally controls the musicians in an orchestra; therefore, business processes are also referred to as *process orchestrations*. Very often multiple organizations interact through their respective business processes (e.g., a buyer, a re-seller, and a shipping agency), through the sending/receiving of messages and/or the transport of physical objects (e.g., ordered products). In such cases, the interactions of a set of business processes are specified in a *process choreography*, which indicates the absence of a central agent controlling the activities of the involved processes; the interaction is only achieved through the exchange of messages agreed (in the common choreography) before starting the interaction.

B.1.1 Process Life Cycle

The typical life cycle of a business process is shown in Fig. B.1, in which phases are organized in a cyclical structure showing their logical dependencies.

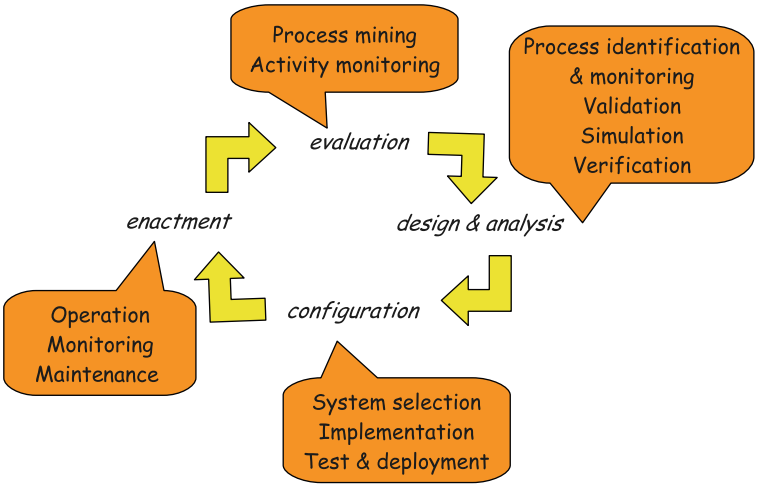

Fig. B.1 Business process life cycle [225]

The life cycle starts in the *design and analysis* phase, in which a business process and its organizational and technical environment is studied: the process is identified, reviewed, validated, and represented by a business process model. The model is validated and simulated, in order to gain confidence on its correctness and appropriateness.

Then the process is implemented. It can be implemented by a set of policies and procedures, which the employees of the organization need to comply with; in this case, the process is realized without any support by a dedicated BPMS. Conversely, if a BPMS is used to realize the process, the configuration includes the definition of interactions of the employees with the system, as well as the integration of the existing software systems. Clearly testing guarantees the correct configuration and deployment.

Once the system configuration is completed, the process instances can be enacted; this phase encompasses the actual run time of the process. Instances are initiated to fulfill the goals of the organization, and initiations typically follow a defined event (e.g., the request for an authorization submitted by a citizen). The BPMS controls the execution of instances as defined in the process model. The BPMS offers a monitoring component for checking and visualizing the status of different instances; in addition, valuable execution data are gathered in the form of log files, over which evaluations can be carried out in order to mine important facts and possibly lead to process improvements.

B.2 BPMN

The *business process modeling notation* (BPMN) is an OMG standard for business process modeling and provides a graphical notation for specifying business processes in a *business process diagram* (BPD) [226]. The objective of BPMN is to support business process management for both technical users and business users by providing a notation that is intuitive to business users, yet is able to represent complex process semantics. The BPMN specification also provides a mapping between the graphics of the notation to the underlying constructs of execution languages, particularly business process execution language (BPEL, a.k.a. WS-BPEL).

BPMN is constrained to support only the concepts of modeling that are applicable to business processes. This means that other types of modeling done by organizations for non-business purposes are out of the scope of BPMN. For example, the modeling of organizational structures and data models is out of the scope of BPMN. In addition, while BPMN shows the flow of data (messages) and the association of data artifacts to activities, it is not a data flow diagram.

The modeling in BPMN is made by simple diagrams with a small set of graphical elements. It should make it easy for business users as well as developers to understand the flow and process. The four basic categories of elements are (cf. Figs. B.2 and B.3)

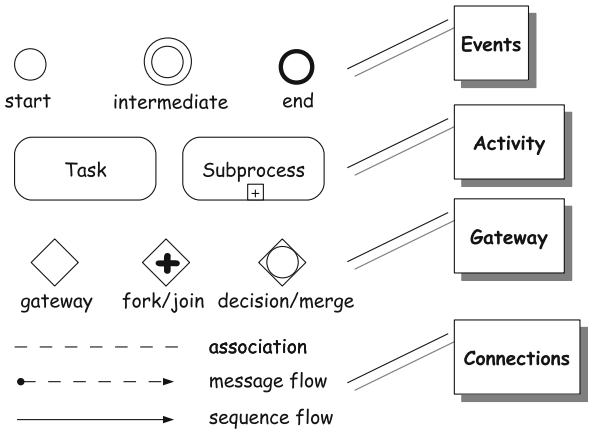

Fig. B.2 BPMN flow and connecting objects

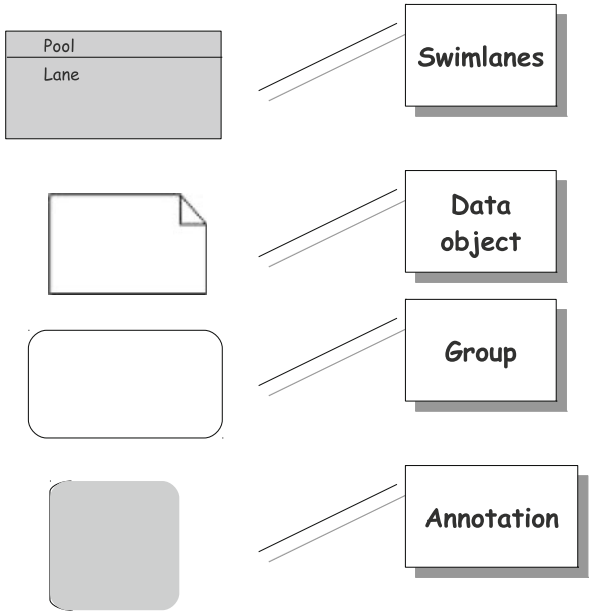

Fig. B.3 BPMN swimlanes and artifacts

- *flow objects*: events, activities, gateways;
- *connecting objects*: sequence flow, message flow, association;
- *swimlanes*: pool, lane;
- *artifacts*: data object, group, annotation.

These four categories of elements give the opportunity to make a simple business process diagram (BPD). It is also allowed in a BPD to make his/her own type of a flow object or an artifact to make the diagram more understandable.

Flow objects are the main describing elements within BPMN and consist of three core elements:

- *Event*: An *event* is represented with a circle and denotes something that happens (rather than activities which are something that is done). Icons within the circle denote the type of event (e.g., envelope for a message, clock for time). Events are also classified as *catching* (i.e., they might catch an incoming message to start the process) or *throwing* (i.e., they might throw a message at the end of the process). A *start event* acts as a trigger for the process, indicated by a single narrow border, and can only be catch, so it is shown with an open (outline) icon. An *end event* represents the result of a process, indicated by a single thick or bold border, and can only throw, so it is shown with a solid icon. An *intermediate event* represents something that happens between the start and end events; it is indicated by a tramline border and can throw or catch (using solid or open icons as appropriate).
- *Activity*: An *activity* is represented with a rounded-corner rectangle and describes the kind of work which must be done. A *task* represents a single unit of work that is not or cannot be broken down to a further level of business process detail without diagramming the steps in a procedure (not the purpose of BPMN). A *subprocess* is used to hide or reveal additional levels of business process detail – when collapsed a subprocess is indicated by a plus sign against the bottom line of the rectangle; when expanded the rounded rectangle expands to show all flow objects, connecting objects, and artifacts. It has its own self-contained start and end events, and sequence flows from the parent process must not cross the boundary. Finally a *transaction* is a form of subprocess in which all contained activities must be treated as a whole, i.e., they must all be completed to meet an objective, and if any one of them fails, they must all be compensated (undone). Transactions are differentiated from expanded subprocesses by being surrounded by a tramline border.
- *Gateway*: A *gateway* is represented with a diamond shape and will determine forking and merging of paths depending on the conditions expressed.

Flow objects are connected to each other using *connecting objects*, which consist of three types, namely sequences, messages, and associations:

- *Sequence flow*: A *sequence flow* is represented with a solid line and arrowhead and shows in which order the activities will be performed. The sequence flow may also have a symbol at its start, a small diamond indicates one of a number of conditional flows from an activity, while a diagonal slash indicates the default flow from a decision or activity with conditional flows.
- *Message flow*: A *message flow* is represented with a dashed line, an open circle at the start, and an open arrowhead at the end. It tells what messages flow across organizational boundaries (i.e., between pools). A message flow can never be used to connect activities or events within the same pool.
- *Association*: An *association* is represented with a dotted line. It is used to associate an artifact or text to a flow object and can indicate some directionality using

an open arrowhead (toward the artifact to represent a result, from the artifact to represent an input, and both to indicate it is read and updated). No directionality would be used when the artifact or text is associated with a sequence or message flow (as that flow already shows the direction).

Swimlanes are a visual mechanism of organizing and categorizing activities, based on cross-functional flowcharting, and in BPMN consist of two types:

- *Pool*: A *pool* represents major participants in a process, typically separating different organizations. A pool contains one or more *lanes* (like a real swimming pool). A pool can be open (i.e., showing internal detail) when it is depicted as a large rectangle showing one or more lanes or collapsed (i.e., hiding internal detail) when it is depicted as an empty rectangle stretching the width or height of the diagram.
- *Lane*: It is used to organize and categorize activities within a pool according to the function or role and depicted as a rectangle stretching the width or height of the pool. A lane contains flow objects, connecting objects, and artifacts.

Artifacts allow developers to bring some more information into the model/diagram. In this way the model/diagram becomes more readable. There are three predefined artifacts and they are as follows:

- *Data objects*: A *data object* shows the reader which data are required or produced in an activity.
- *Group*: A *group* is represented with a rounded-corner rectangle and dashed lines. The group is used to group different activities but does not affect the flow in the diagram.
- *Annotation*: An *annotation* is used to give the reader of the model/diagram an understandable impression.

Business process modeling is used to communicate a wide variety of information to a wide variety of audiences. BPMN is designed to cover this wide range of usage and allows modeling of end-to-end business processes to allow the viewer of the diagram to be able to easily differentiate between sections of a BPMN diagram. There are three basic types of sub-models within an end-to-end BPMN model: private (internal) business processes, abstract (public) processes, and collaboration (global) processes:

- *Private (internal) business processes*: They are those internal to a specific organization and are the type of processes that have been generally called *workflow* or *business processes*. If swimlanes are used, then a private business process will be contained within a single pool. The sequence flow of the process is therefore contained within the pool and cannot cross the boundaries of the pool. Message flow can cross the pool boundary to show the interactions that exist between separate private business processes.
- *Abstract (public) processes*: They represent the interactions between a private business process and another process or participant. Only those activities that communicate outside the private business process are included in the abstract

process. All other internal activities of the private business process are not shown in the abstract process. Thus, the abstract process shows to the outside world the sequence of messages that are required to interact with that business process. Abstract processes are contained within a pool and can be modeled separately or within a larger BPMN diagram to show the message flow between the abstract process activities and other entities. If the abstract process is in the same diagram as its corresponding private business process, then the activities that are common to both processes can be associated.

- *Collaboration (global) processes*: They depict the interactions between two or more business entities. These interactions are defined as a sequence of activities that represent the message exchange patterns between the entities involved. Collaboration processes may be contained within a pool and the different participant business interactions are shown as lanes within the pool. In this situation, each lane would represent two participants and a direction of travel between them. They may also be shown as two or more abstract processes interacting through message flow (as described in the previous section). These processes can be modeled separately or within a larger BPMN diagram to show the associations between the collaboration process activities and other entities. If the collaboration process is in the same diagram as one of its corresponding private business processes, then the activities that are common to both processes can be associated.

B.3 Technologies

The abstract architecture of a BPMS, shown in Fig. B.4, consists of the following:

- The *business process modeling* component is used for creating business process models, containing information on activities, their operations, and the structure of the process. This component can be realized by a process modeling tool used during build time (a.k.a. design time)[1] by the process designer.[2]
- The *business process environment* triggers the instantiation and enactment of process instances based on the models.
- The *business process model repository* holds process models created by the modeling component.

[1] Build time indicates the phase in which a process designer specifies the process model completely, and appropriate software designers specify and realize the implementation of activities. Run time indicates the phase in which process instances are executed. This is similar to traditional programming, where a program is coded in a programming language, compiled to executable code (build time) and later on executed (run time). Process modeling can be seen as a form of "programming in the large."

[2] The process designer is a specific worker with appropriate skills to analyze and model a business process.

- The *process engine* is responsible for instantiating and controlling the execution of processes. It is the core of the BPMS and is triggered by the business process environment. It uses process models, retrieved from the process model repository, to instantiate and control the enactment of process instances. To execute a particular activity instance, it calls entities that act as providers of the required functionality. In a service-oriented architecture, service providers are called to execute individual services that realize business process activities.
- *Service providers* host application services that realize business process activities. They represent an abstract entity that subsumes not only Web service providers but also knowledge workers (process participants) that realize particular activities. The organizational and technical information that the process engine needs in order to determine and access the service provider is also stored in the process model repository.

These components control the enactment of the process instances. To capture the distributed nature of executions, the components and service providers are represented as entities communicating by sending/receiving messages, i.e., they do not share memory, but are distributed. The messages are sent along the arcs shown in Fig. B.4.

Nowadays, service-oriented architectures benefit from a BPMS when composing Web services; in particular, with reference to the eGCSS introduced in Chap. 10, a BPMS can be used in a cooperation domain for realizing the composite services to be offered as external services. In this case, the logic of a composite external service can be modeled by using BPMN, and indeed this is what is proposed in Chap. 11 during the operational planning phase.

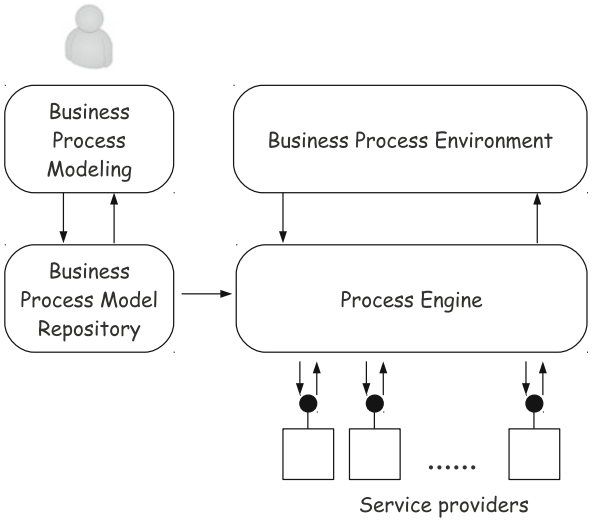

Fig. B.4 Reference architecture of a BPMS

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