Shared services for supporting online public service delivery in rural areas

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Abstract: Online public services provide small and medium-sized enterprises with new opportunities for adding value to their business activities. Owing to limited resources, authorities in rural areas have serious obstacles to provide suitable online services. This paper proposes a shared services environment to support rural authorities to deliver digital public services. The proposed environment involves suitable Information and Communication Technology (ICT) facilities and expertises and a collaborative architecture for supporting the rural community needs. This results in the needed critical mass to avoid the exclusion of rural authorities from innovation processes because of their difficulties to get proper funds and suitable skills.

Keywords: e-government; rural authorities; shared services; business processes.


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1 Introduction

The introduction of online public services may hold new opportunities for small- and medium-sized enterprises creating new value in their everyday business activities. A key element in guaranteeing equal opportunities for all is making these services better, more accessible and more cost-effective. Owing to limited resources, rural authorities are hampered in their efforts to provide suitable online services. In Italy, for instance, there are 6000 municipalities that cover a specific geographic region serving less than 5000 citizens usually located in rural or isolated area. These small authorities risk to be out from the actuation of many e-government initiatives for (at least) three main reasons:

- the impossibility to get proper funds for the realisation of innovative processes
- the lack of adequate skills to support innovation
- the lack of proper technological infrastructures.

The primary aim of this research is to support rural authorities in confronting these demanding challenges concerning their ability to provide next generation of online public services. In particular, we introduce a Shared Service Centre (SSC) to achieve operational efficiency among rural authorities in a cost-effective way. SSC is a collaborative strategy in which a subset of existing functions are concentrated into a new, semi-autonomous unit that has a management structure designed to promote efficiency, value generation, cost savings and improved service for the internal consumers of the parent corporation (Bergeron, 2003). Our work uses an SSC to provide support functions across rural authorities. In this way, each authority can focus on its core activities and improve organisational competences. The result is the delivering of more citizen- and business-centric services.

In this work, each single authority separates the core competences services from the supporting ones that are instead shared among different organisations. This allows rural authorities to develop their strategic functions while optimising investments by sharing services and resources of common interest. These services are concentrated and supplied by means of a modular architecture based on reusable building blocks.

This paper concentrates on the concept of SSC as a useful tool that let various rural authorities to share those functionalities that are in common and that is of difficult realisation and management. These functionalities are physically located in some organisational structure that is able to:
• allow all organisations to take part to the digital government, even those that are not able to interoperate
• allow the access of final users to services through a unique interface, possibly without considering whether these services are provided by a single or several organisations (Tambouris and Wimmer, 2004).

Our contribution is currently under experimentation and involves around 80% of rural authorities of Le Marche region (in the middle of Italy). The regional authority, Regione Marche, has a coordination role because it has the authority to manage the cooperation among underlying authorities (such as municipal districts). It is also able to plan and detect proper strategies within its territory. The Regione Marche, as SSC, enforces the territorial competencies of the region authority itself by allowing a significant cost-effective use of technologies.

The remaining part of the paper is organised as follows. Section 2 discusses background and motivations behind a Shared Service approach. Section 3 describes the proposed SSC architecture whereas Section 4 shows our business process design for the proposed Shared Services Environment. Sections 5 and 6 present future work and concluding remarks, respectively.

2 Motivation and background

Public or private organisations are now facing a very complex renewing process of their organisational structures to improve internal working modalities and the quality of the provided services. The role of technology in developing services offered by public authorities and its effect on both citizens and local economies is well known and widely diffused. The ICT market is now ready to offer technical solutions that support the everyday activities of citizens and enterprises. This increases accessibility by the final users and improves the use of services provided by the local authorities.

Technological infrastructures as well as ICT applications constitute an essential prerequisite for the creation of any model of ICT-based public authority. However, the management and the development of ICT products can be very difficult and expensive for the organisations, particularly if small in size, and can distract from the strategic activities of core competencies. To face these problems, some organisations resort to outsourcing by committing parts of the services to external partners (Dibbern et al., 2004). This allows to optimise the use of resources and to speed up the distribution of online public services and the information for citizens and enterprises.

While in the past considerations about costs were in favour of ICT outsourcing, in these last years it is becoming more and more significant. The external partners are not only service providers but can also be directly integrated into the value chain. This results in an integrated framework that allows organisations both to evaluate the social impact of innovation and to detect new strategies. Independently from the choice make-or-buy, potentially convenient, the main aim is to find a proper partnership between the authority and the external offer that, in turn, means to optimise management, costs and the quality of the involved organisations.

Outsourcing is more than cost-effective. For public authorities, function delegation has allowed, and actually allows, to have a unique interface for the solution of a number of complex problems and to directly handle exceptions. This allows to continuously
improve the services standardisation and to reach a low level of bureaucracy connected with the given functions.

A Shared Service environment can be seen as a particular kind of outsourcing between several clients and a single provider (Bergeron, 2003). In particular, an SSC is defined as a concentration of resources, detected as activities that are typically distributed across organisational units with the main aim to serve different users at low costs and with a high level of service. This has a direct consequence to satisfy external users and increase the corporative image of public administration. Hence, we can further distinguish between ICT outsourcing and Shared Services: the former provides services as a third independent party, whereas the latter provides services within a corporate group.

The Shared Service environment is a feasible approach to manage the highly fragmented nature of e-government initiatives and to enhance the cooperation and coordination of joint efforts among public authorities (Janssen and Wagenaar, 2004). The main motivation behind SSC adoption is then to gain from the investments in the domain of e-government by sharing common elements present in each public authority. The SSC approach makes the management of ICT resources more straightforward, clearer and easier. Any methodology that supports a Shared Services environment allows us to detect two communities with different competencies: the SSC experts and the local ones. The SSC experts provide experience in technology, project management and they are responsible for the design, realisation and maintenance of the SSC. The local experts provide the needed knowledge of administrative process and user requests. The interactions between these communities enable cross-organisational knowledge sharing supporting the reuse of best practices and experiences in terms of project development process. Moreover, an SSC provides a one-stop shop for all ICT aspects, because it can be a synthesis of several solutions for rural authorities, such as help desk, web hosting, system integration support and office automation.

However, few studies have been conducted to investigate the Shared Service adoption in the e-government domain. Janssen and Wagenaar (2003) identified and prioritised the importance of generic services that can be shared among public authorities. Related works analyse the motives for applying a Shared Service approach (Janssen and Wagenaar, 2004) and investigate the management issues and relationships that determinate the successful implementation of a Shared Service environment (Janssen, 2005; Janssen and Anton, 2004). Moreover, the number of documented works on implemented SSCs in the public sector is very small.

3 SSC architectural approach

Over the past few years, several e-government initiatives have appeared and their unification is inevitable so that the use of the technology can be effective. Each rural authority has developed its own information systems rather in isolation. This implies the overlapping of functions and contents across public authorities such as authentication and authorisation. The crucial point is to develop a general architecture to integrate systems that have been designed to support vertical applications. An architecture coordinates the exchange of information among the various information systems by leaving full autonomy to each authority and avoiding redundant activities.
Rural authorities need to work together in a loosely coupled structure, where the overall progress depends on their being in the right balance. Our SSC Architectural approach aims at supporting organisational and technical aspects of management, integration and distribution of online public services. The SSC is composed by a set of rural authorities; however, the number of stakeholders might increase in membership not only in local
level, but also including several public or private organisations as shown in Figure 1. The regional authority (Regione Marche) has a coordination role because it has the authority to manage the cooperation among underlying entities such as municipal districts. The merging of the rural authorities with a regional one is proposed to counter redundant resources and achieve economies of scale through a regional plan of online public service delivery. SSC experts are responsible to interact with the local ones for programming regional plan proposals. Each expert must be involved in the implementation of the Shared Services and communication is relevant for promoting SSC activities in the rural authorities.

In this approach, each rural authority externalises its core services by providing them to outside organisations in term of separate functional modules. The SSC is responsible for service provision and for handling interactions among administrative units. In this way, authorities cooperate to fulfills service requests from citizens and enterprises. The SSC increases the corporate image of public sector allowing access to online public services through a unique interface, without considering whether these services are provided by a single or several authorities. Figure 2 shows the Tecut portal homepage (www.tecut.it) that provides a unified access to public online services provided by rural authorities in Le Marche Region. Nevertheless, at this state of art, more than 600 organisations are involved at the national level.

3.1 Architecture description

A Cooperative Information System is usually defined as a set of systems distributed in a network of communication. These systems are able to collaborate between them in an effective and efficient way sharing resources, bonds and objectives. The paradigm of Service-Oriented Computing (SOC) (Singh and Huhns, 2005) is gaining consensus regarding the integration of heterogeneous information systems as they can be realised independently each other and then interconnected through appropriate middleware solutions. Several proposals of the SOC are now under evaluation for standardisation. They have led to several description languages such as OWL-S (Martin et al., 2004), WS-BPEL (Alves et al., 2007) and WS-CDL (Kavantzas et al., 2004). The increasing attention towards these categories of standards reflects the basic connections that exist between the Business Process Management (BPM) and the Service-Oriented Architecture (SOA) (Leymann et al., 2002). The emergent technologies of BPM rely on SOA as a model for the management of resources (particularly for the software resources) by describing the steps of process or capturing the interactions between business processes and entities. On the other hand, a service can also be used as a point of access to the fruition of business processes, inducing an intrinsic connection between the service model and the process model.

A shared services environment provides an ICT support of the technical aspects of management and distribution of public services. It manages a significant amount of heterogeneous data, knowledge and services, provided by the different authorities. Our approach supports the realisation and put forward administrative services for citizens and enterprises, in particular for those entities that cannot manage, in full autonomy, the distribution via telematic means by a lack of both economic resources and planning skills. For this issue, the infrastructure includes an SSC (see Figure 3) that provides a series of solutions for complex problems and a set of shared and standardised services that can be used according to the usual mechanisms of web service technologies.
In particular, the SSC provides services for applicative cooperation, for security and the Single Sign On (SSO) and for content management. This last aspect allows a significant rationalisation of the content management platforms usage, the relative access modalities and information updating, the management and maintainability of informative services. The Shared Services are provided by means of a modular architecture that is based on ‘building blocks’ reuse. The services are exposed via web services and through a modality of non-invasive interaction with back-office systems. The possibility to develop services among the different rural authorities allows to increase efficiency in administrative procedures and to reach the objective to present the different rural authorities to citizens and enterprises in a more and more global and unique perspective. While the presentation of services can be suitably differentiated and personalised in function of the access typology on the user side, the given services, instead, remain a shared patrimony controlled in the access modality and checked via the services catalogue.

The framework is logically located between the front-office and back-office as part of the infrastructure of the applicative cooperation and located in the middle in the distribution of services based on interaction between delegated and applicative ports in the front-end and back-end systems. This mediation plays a role when the interaction relies on some asynchronous mechanism of applicative cooperation as, for instance, those based on Publish&Subscribe and process orchestration.

We can now give a list of services needed for the above-mentioned functions:

- Internal Services for the management of the technological infrastructure. These are centralised and demanded to specific operative points that also monitor the systems and the applications, control the security conditions and, in general, the operative and administrative applications needed for the correct operability of the informative system.
• Services for the applicative cooperation based on synchronous and asynchronous collaboration profiles for the exchange of the informative flows between domain gateways coherently to the model of the e-Government envelop.

• Business Process Orchestration, via a central engine able to manage instances of registered models and patterns in a suitable repository; significant knowledge base for the diffusion of process logics and for the reduction of analysis time.

• Event notification systems, based on Publish&Subscribe that guarantee a strong decoupling between the parts in terms of distribution, timing and flows of events.

• Workflow services, for automation of documental flows and the management of complex processes that require, for the completion of one or more steps, also the interference of ‘real’ users and not only applicative.

• Security Infrastructure, to guarantee attributes as integrity, confidentiality and non-repudiation of exchanged messages between domain gateways.

• Registry Service, for registration and consulting. The services catalogue must be able to host in their archives the information that concern the given applicative services and the tools that let them available to the community.

• Logging service, for the traceability of services requests, with accounting of the orchestration state or of the workflow processes and, in general, for the management of generic applicative events, including errors and exceptions.

• Authentication and authorisation services, for the centralised management of the accesses to the reserved areas of the portals exposed in the framework.

• Single Sign On, for the transfer of user’s credentials between distributed systems; the authentication on the framework is possible via weak and strong registration, or via the use of a card for the digital signature or via services cards,

• Profiling systems, for the coordinated management of information on the users with credentials, logically divided into a static subsystem (extended registry) and a dynamic one, containing a series of attributes able to indicate preferences of the user when accessing the services rather than informative areas on portals.

• Content Management services, able to manage in a centralised manner the contents on access portals and their automatised distribution on external servers.

• Front-End Services, for the integrated management of both static sites and personalised templates, populated by contents and services filtered with respect to the preferences in the user profile.

• Community services, for the simplified management of the News and Forum areas of informative portals.

• Business Rule Management service, for the definition, development, management and support of the business rules to extract business policies out of source code.
4 Case study: business process design

In this section, we show our business process design in a shared service scenario. Although business process reengineering is not a requirement of engaging in shared services, business process redesign is a requirement at some point in the journey to a fully operational shared services environment for public or private organisations (Schulman et al., 1999). In this journey, an organisation must be aware of the organisational knowledge about itself and what it would like to become. The development of a coherent view of Public Sector provides a clear understanding of rural authority relationships and supports the alignment between organisational perspective and technical one.

Let us consider an example in which a rural authority needs to provide a new online public service to pay tax. In general, this authority must know exactly what knowledge and capabilities are required for the specific service. Moreover, it needs to understand the complex nature of competencies to identify where is the lack of available in-house resources and expertises for the specific problem. In our approach, the authority analyses the development of the ‘tax payment service’ involving the centre of expertise located in the SSC.

In this setting, an SSC approach allows a better business process design support both at cooperative level and at coordinative one. As already said in Section 2, indeed, an SSC relies on a federated community that is the result of the collaboration and communication between experts coming from different levels.

The local experts provide the user requirements for the new service. The SSC experts provide skills in business process development. In this context, the federated community has the following main issues: first, improve and document the knowledge regarding the current and the desirable situation of the service, second reach a clear and structured set of documents on goals and concepts of the future service, and third develop a basis for designing an adequate business process to reach desired goals.

Experts focus on the development of models at different abstraction layers allowing a careful analysis of business rules that govern the processes. In our approach, business rule management has a certain importance because business rules can differentiate authorities reducing overlapping. A lot of organisations actually create a peculiar business rule set, permitting a clear distinction among them. Business rules are defined as statements that represent the knowledge that an organisation has about its business; with regard to this, they can express strategies, contracts and they can influence not only staff relation, but also final user relations (The Business Rules Group, 2000). Therefore, rules represent the mechanism by which organisation evolves. For this reason in our SSC architectural approach, business rules are separated from the other components of the system. Extracting rules from business logic implies more flexibility and maintenance across the time of the system, in which they are included. For a more detailed discussion on business rules see Ross (2003), Herbst (1997), Morgan (2002) and von Halle (2002).

To provide a coherent service model, experts define the following views:

- Business Goal View aims at describing explicitly in a hierarchical manner the underlying goals of the new process. A goal model describes a problem as a composition hierarchy of goals and subgoals and implies many conditions, for example in a sequence a goal has the condition that the previous goal has been fulfilled.
• Business Process View aims at providing a full description of process in terms of activities and information flow and determines its overall structure (temporal order of activities, cross references among information). The model describes the processes that allow the achievement of authority goals or subgoals.

• Actor View consists of identifying, analysing and describing the actors of processes. It describes how different actors are related to each other and how they are related to goals and processes.

• Service View describes the interaction behaviour of a service. It provides the capacity to seize the requirements and the logic base facilitating the reuse of services authorities.

• Message View describes the content, structure and constraints of information exchanged among services.

To manage rules separately, it is necessary to individualise them for each view because rules are crosscutting and can be deduced by all above-mentioned models. It is also needed to capture and to map the relationships among models and to understand “What affects What”. In this way, we are able to estimate the impact of changes in the whole rural authority network. After this analysis phase, we have created a unique and unambiguous model for the new service (Table 1).

**Table 1 Model formalisation**

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<thead>
<tr>
<th>Model</th>
<th>Tool</th>
<th>Formalisation</th>
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<td>Business goal</td>
<td>And/or diagrams</td>
<td>RuleML</td>
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<tr>
<td>Business process</td>
<td>Activity diagrams</td>
<td>WS-BPEL</td>
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<tr>
<td>Actor</td>
<td>Activity diagrams</td>
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<td>Use Case diagrams</td>
<td>WSDL</td>
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<td></td>
<td>Class diagrams</td>
<td>RuleML</td>
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<td>Service</td>
<td>State diagrams</td>
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<td>Sequence diagrams</td>
<td>RuleML</td>
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<tr>
<td>Message</td>
<td>BNF grammars</td>
<td>XML schema</td>
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<td>ER models for XML</td>
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The implementation phase focuses on translating the model specifications of each service to an implementation. The various service modules of the modelling are coded into a set of business units. In other words, implementation is the process that takes a model and transforms it into actual code, ensuring conformity that is judged against the modelling phase. The product of this phase is a set of correct and independent services, which will then be composed to obtain more complex and more sophisticated functionalities. Obviously, the SSC approach ensures that design and development efforts can be reused across rural authorities by documenting project-specific experience and including reusable elements of code, designs and specification.
4.1 A tax payment scenario

To better understand the benefits of previous approach, we show a ‘Tax Payment’ scenario and propose a methodology to reach business goals using our ‘rule-driven’ service composition.

Modelling of this process requires many different steps to offer such a full service to citizens and enterprises. We only use a very simple example with annotations representing the business rules for the different activities. The scenario consists of the following participants (as shown in Figure 4):

- The Consumer (Citizen or Enterprise) orders the payment
- The Financial Institution receives the payment order from a consumer
- The Rural Authority is the receiver of the payment.

Figure 4 Tax payment scenario

4.2 Tax payment process

In this subsection, a rule-driven workflow modelling is presented. Workflow models present a simplified procedural view of a business process. To drive the business process development, we have distinguished three types of rules:

- **Behaviour Process Rule** is a complete statement that specifies a temporal constraint among the task events for achieving goals. For example, a business rule may express that if the authentication is performed, then the payment can follow.

- **Discovery Rule** is a complete statement that enables the selection of the suitable service provider. For example, a service provider is appropriate if it can fulfil the request within a period of 2 h.

- **Constrain Rule** is a complete statement that tests conditions and upon finding them true, initiates another business event. For example, if a request is valid, then the citizen is notified.

Rules are described by Rule Mark-up Language (RuleML) (www.ruleml.org) and are managed by the Business Rule Management service. In our methodology, there are three design steps that produce a WS-BPEL compliant process description starting from an abstract workflow model definition.

**Workflow Model Definition.** Figure 5 shows the designer layout, a GUI developed for easing the composition procedure: in this first step, we define an abstract workflow model by combining the use of process patterns (Business Process Orchestration service)
with the logic of behaviour process rules retrieved by the Business Rule Management service. In practice, through a simple selection of goals or subgoals in the composition area, the activity dependencies are analysed and showed according to a correspondence among goals and behaviour process rules. Finally, we can obtain the complete abstract workflow represented as an activity diagram according to selected goals. To simplify the understanding of process, we use a compact representation of activity diagram.

**Figure 5** Designer (see online version for colours)

**WS-BPEL Schema Definition.** This modelling phase concerns the WS-BPEL schema definition. At first, a mapping from Activity Diagram specifications to WS-BPEL activities takes place. In particular, we combine Constraints Rules, which establish mandatory restrictions or conditions on the behaviour of whole workflow. In this way, we obtain an empty structure of a WS-BPEL document, according to the business process behaviour. Finally, the schema generation procedure is characterised by the selection of pre- or post-conditions to be placed among the workflow tasks. In Figure 5, we set a post-condition R2 for the TaxPaymentRequest activity, which performs a credit check. The rule R2 (CheckCitizenAccount) can be interpreted as a ‘reaction rule’ in the sense that it can enable an action or not specifying the invocation of actions in response to an event. The action is only performed when a certain condition is satisfied.

**WS-BPEL process instance definition.** For each communication event in the WS-BPEL Model Schema Definition, a set of appropriate service providers (partnerlinks) will be proposed by the Registry Service, according to discovery rules. For example, in the case study, the payment task can be exploited by invoking a service that can be provided by three possible partner types. Financial institutions are divided into three families
according to their service contract. In this way, we obtain more dynamicity in the run-time phase, because we can change the partnerlink of the same family without the need to redeploy WS-BPEL process. The white activities in Figure 5 have not associated partnerlinks. In this last step, technical specifications of the composition schema can be set (e.g., WS-BPEL activity attributes, input/output variables, etc.) through a WS-BPEL document inspector.

5 Future work

The previous sections show how we can use the SSC to build and support sophisticated business processes. However, the problem that we have encountered in the deployment of the large amount of existing or new business processes is the lack of a uniform understanding about business and technical requirements. Many unsuccessful service-oriented development projects suggest that existing analysis and design methodologies and techniques only cover a part of what is required to support the implementation and deployment of service-oriented applications (Casanave, 1995; Benatallah et al., 2003; Leymann Roller and Schmidt, 2002; von Halle, 2002). Future works need to study a novel approach for shared-service-oriented software development. The idea is to combine methodologies coming from business perspective and technical one. They must be used independently to achieve different and complementing objectives.

When designing a process from the business perspective, the aim is to model and later on to implement business processes that capture the message exchanges, activities and roles that are part of a business. When designing processes from the technical perspective, the focus is to leverage business support by utilising existing services. To develop business processes that provide both business requirements and technical ones, it is important to be aware of how a business process is affected by existing service to solve integration and synchronisation problems among cooperative information systems. Moreover, outsourcing of complex ICT infrastructure to ICT service providers has become increasingly popular in public or private organisations and led to much recent development. To support interoperability, service integration and compositional reasoning on properties, appropriate information has to be given. Current service-based interface models are not appropriate because they include only service signatures. Adding behavioural specifications and quality attributes significantly increases the power of interoperability analysis.

To use third-party services, it is necessary to standardise them. The interface and behaviour of a service must be specified in a consistent and unambiguous way. Specification becomes a key aspect with regard to integration of third-party services, since the specification might be the only available support for a composer who combines authority services implemented by different development teams. Design by Contract methodology offers a good solution to specify service requirements at third-party developers. The concept of design by contract was introduced by Bertrand Meyer in object-oriented engineering (Meyer, 1992). A contract describes, in a standard way, what a service expects from its clients and what it delivers if those requirements are met. They should be described before implementing software, so the programmers have direct representations of the requirements and consequently a clear defined aim to achieve, which is otherwise not obvious in the application development.
6 Conclusion

The Public Sector should be seen as a transparent and efficient organisation and not as an unintelligible organism about its competences, purposes and decisions. Doubtless, the ICTs represent an opportunity to develop any project related to transparency and right of access. This work shows that the introduction of a shared services environment can significantly support the development of new online public services in rural areas. The development of intra- and inter-organisational processes represents one of the most involved problems of the digital government. The aim of our proposal is two-fold. On the one hand, it allows overcoming the deficiencies concerned with the lack of a proper know-how within rural authorities. On the other hand, the Regione Marche as an SSC enforces the territorial competencies of the Region itself by allowing a significant cost-effective use of technologies. The development of public online services is a necessary but not sufficient condition for the use of the services themselves. In fact, it is necessary to move considerable groups of users from the traditional fruition of services to the new modalities of services distribution.

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