The Lifecycle of Transactional Services

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I N T R O D U C T I O N

Electronic government can be defined as the use of information and communication technologies in government for at least three purposes: providing public services, improving managerial effectiveness, and promoting democracy (Gil-Garcia R., 2004). This definition recognizes transactional services, i.e. services that involve filling-in, submission and processing of electronic forms, as a vital component of e-Government, since public service provision and interaction between citizens and government is mainly modeled through such services (eEurope, 2000). It is worth noting that among the 20 public services included in (eEurope, 2000) as "first steps towards "Electronic Government", 18 of them (90%) are transactional services, with the remaining two being informational services (information search and retrieval). Similar ratios hold for electronic services worldwide: for instance, the Government of Dubai analyzed *all* services it offers and has concluded that 1200 of these services are transactional, out of a total of 1500 services (AmeInfo, 2004) (80%; again, the remaining services are informational). Historically, governments have first implemented informational services (provision of information related to the procedures and regulations related to governmental services), then proceeded with downloadable forms which can be filled-in

and submitted manually ("one-way interaction"), subsequently moved to providing the ability to online submit forms whose data were processed later with human intervention ("two way interaction") and finally reached full electronic case handling (Cap Gemini, 2004).

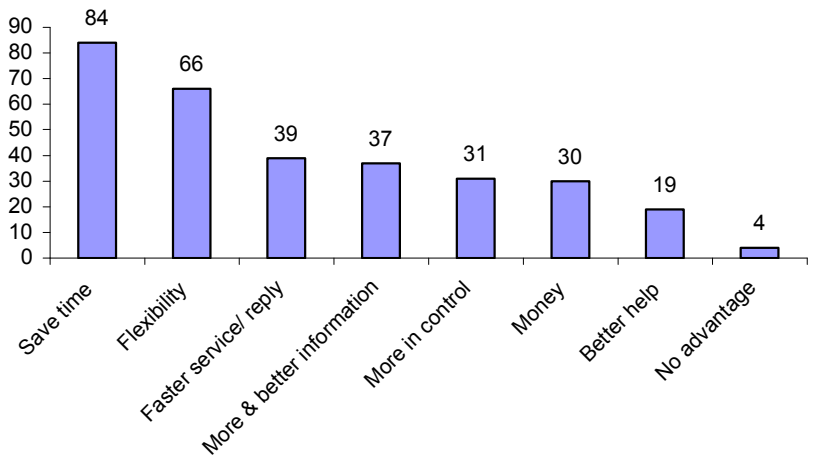

Figure 1 – Expected benefits for electronic service users

In the past few years, governments are systematically working on realizing e-government policies and frameworks, which include the delivery of transactional services for enterprises and citizens. Citizens and enterprises expect that provision of rich spectrum of transactional services will to result to a number of benefits, as reported in (Top of the Web, 2003) and illustrated in Figure 1.

The progress of these works have been quantified and evaluated in reports; notably, the reports (Cap Gemini, 2003) and (Cap Gemini, 2004) have targeted the e-Government development status in the European Union and have produced results showing the developments and trends in the EU countries. Some interesting findings from these reports are shown in Table 1.

Table 1: Development of e-Government in the EU

	Oct 2001	Oct 2002	Oct 2003
Services fully available online	20%	35%	45%
Services available online	45%	60%	67%

Note that "Services available online" includes services a portion of which has been made available online, and some other portion is still carried out manually; "Services fully available online" are fully processed in an on-line fashion and have no manual portion. A similar quantification approach is taken by the UN Global E-government Survey (UN, 2003), which identifies five stages of service delivery, namely emerging presence, enhanced presence, interactive presence, transactional presence and networked presence, with "interactive presence" and "transactional presence" being the counterparts of "online availability" and "full online availability" (networked presence refers to a government-to-citizen framework based on an integrated network of public agencies for the provision of information, knowledge and services). In this report, the average "service online availability" indicator for the top 15 countries is computed to be 63.8%, whereas the average "service full online availability" indicator is 20.2%[1].

The results of the studies presented above clearly indicate that despite the users' high expectations from transactional services and the governments' will and support for their development, the progress achieved insofar lags behind the desired levels. First, in the time frame of approximately one decade (governmental services have appeared on the Web in the mid-nineties), even the "basic" online services are not fully covered;

[1] The indicators in the UN survey appear smaller because (a) they consider a wider range of services and (b) they pertain to the period April-May 2003, giving a 6 month handicap to the Cap Gemini measurements.

moreover, the *growth speed* towards the full coverage is dropping (15% for the period 10/2001 to 10/2002 against a mere 7% for the period 10/2002 to 10/2003). Second, for services that do have a "point of presence" on the Web, full electronic case handling is provided only for the two thirds of them, while the remaining one third includes (at least one) stage that is performed manually. From the users' point of view, some pessimism can be identified in the issue of *better help*.

B A C K G R O U N D

The roots of the shortcomings identified in the previous section can be traced back to a number of challenges and particularities that pertain to the management of transactional services:

1. The domain knowledge needed for development of electronic service is highly complex (e.g. administrative legislation, tax regulations) and in many cases it is possessed by domain experts employed in the pertinent organizations in the form of *tacit knowledge* (Lam, 2000), which cannot be easily communicated to systems analysts that traditionally extract and catalogue the requirements for software systems.
2. The legislation and regulations governing the electronic services are volatile and subject to frequent changes. Such changes impact portions of the electronic services, which must be rapidly identified and adapted to meet the new regulations. Once components are adapted, the service should be redeployed.
3. The front-end accessed by citizens should be connected to the organization's back-office system, in order to provide fully automated services (Jupp, 2001).

4. The task force that is involved in service development is quite large and with diverse skills. This task force will consist (at a minimal basis) of domain experts, systems analysts and developers, user interface experts (necessary because the electronic service is targeted to people with little computer experience), HTML coders and security specialists (citizens and enterprises will be reluctant to use a service if they are not sure that their data will be safe (Vassilakis, 2005)). Cooperation and coordination in such a group is inherently difficult, not only because of the large number of the members, but also because of the "different languages spoken" by its members.
5. The users of the transactional services do not generally possess a high level of domain knowledge regarding the legislation and requirements of the business process that the services model. It is thus imperative that extensive help (explanatory texts, examples and FAQs) is provided, especially for complex transactional services (e.g. tax return forms). It is worth noting that such "help items" are generally produced in the phases of user requirement analysis (while domain experts explain to system analysts the tasks that the software has to carry out), but they remain recorded as "internal project documentation", rather that being made available to users for reference.

Note, that some of these challenges (especially 3-5) may apply in other contexts of transactional services, e.g. business-to-citizen services (including e-commerce), or business-to-business services. In these contexts, however, the situation may be less complicated due to a number of reasons: for example, in e-commerce the required domain knowledge is much simpler, while in business-to-business services the users are

usually trained personnel. In this work, we will limit our discussion to e-government transactional services, which appear to be the most demanding case.

Currently, transactional services are handled as "typical" software artifacts and are developed and managed using traditional software engineering paradigms, including the spiral model (Bohem, 1988), the waterfall model (Schach, 1999) and the rational unified process (Kruchten, 2000). All these paradigms include a user requirements analysis phase followed by software design, development and testing/evaluation before the final deployment. Different methodologies allow for iterative execution of various phases, for the purposes of modifications or refinement due to feedback from subsequent phases.

For the phases of development and deployment, in particular, a number of products have emerged in the past few years, showing that the software industry recognizes both the potential of the transactional services and the challenges related to their lifecycle. Commercial products include Adobe Acrobat e-forms (Adobe, 2004), PureXML E-Form (PureEdge, 2004) and Oracle E-Business Suite 11i™ (Oracle Corporation, 2004). These tools are however mainly addressed to personnel with IT expertise, and their main task is to relieve IT personnel from the burden of writing "routine" code that handles the interaction between the user's browser and the web server delivering the service. Although this is a significant aid to IT personnel, these tools cannot be used to tackle the issues identified above.

In the standards realm, the W3 consortium has published the XForms specification (W3 Consortium, 2002), which standardizes the specification of Web forms. A major contribution of the XForms standard is the separation of content, structure and user, which are modeled as "form purpose", "form presentation", and "form data",

respectively; however browsers have not insofar incorporated support for XForm documents, thus their usage remains limited.

TRANSACTIONAL SERVICE LIFECYCLE

In order to alleviate the challenges identified in the previous section, a *transactional services development environment* has been designed and implemented, which supports all the phases of transactional services lifecycle, which are depicted in Figure 2[2]. Using this development environment, domain experts can directly input their knowledge regarding the transaction service (stemming directly from the analysis phase or pre-existing as individual tacit knowledge). This knowledge is codified into concepts of high levels of abstraction, such as fields, forms or services, which are familiar to all stakeholders. Domain experts also attach to these concepts examples and documentation (usually expressing tacit knowledge) that will directly be used as help for end-users, and define *validation rules*, i.e. restrictions on the field values in the submitted documents, usually stemming from the related legislation. When documents are submitted through the transactional service, the field values should be checked to determine whether all validation rules are satisfied; if some of them are not met, the service user should be prompted to alter the values entered. Finally, domain experts attach *legal information* to the concepts, usually consisting of laws, directives, and regulations, which govern the operation of the service.

[2] This work has been performed in the context of the SmartGov project (Georgiadis et al., 2002; SmartGov Consortium, 2004a), co-funded by the IST framework

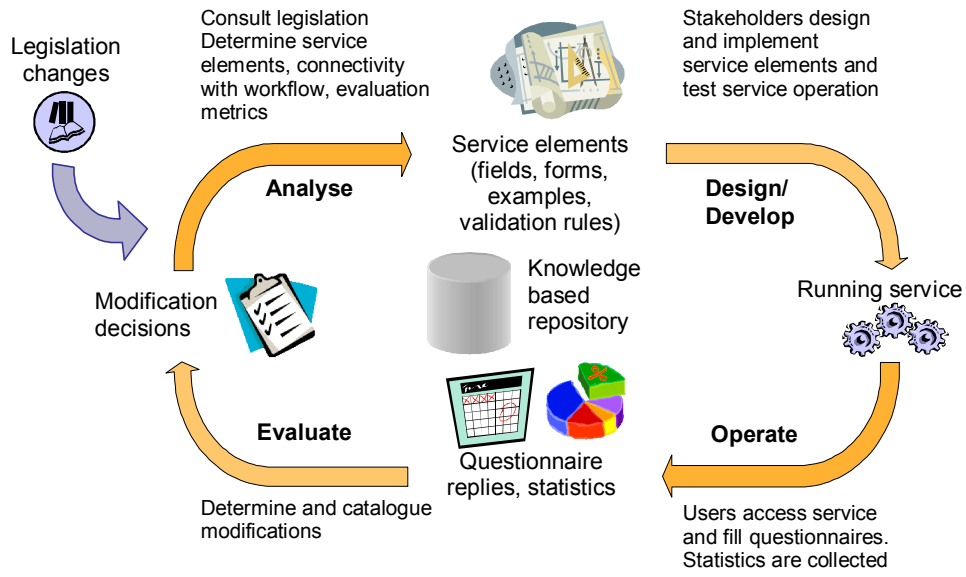

Figure 2 – Supporting the lifecycle of the transactional service

Managers are a second stakeholder group that uses the development environment to define metrics and procedures for facilitating service evaluation. In particular, managers may define on-line questionnaires for service assessment by its users as well as statistics regarding the service usage (number of submitted documents, number of validation rule violations, time taken to fill in documents or document pages etc). Statistics may also be collected at a more fine-grain level, e.g. error rates of specific validation checks, percent of document submissions using specific fields and so forth.

IT staff is the final stakeholder group using the platform in the design and development phase. IT staff complements the information provided by domain experts with elements that are necessary for the operation of the electronic service. For example, users of transactional services should generally authenticate themselves by providing a user name and a password, which should be checked against some repository. Additionally, documents submitted by the users of the transactional service should be

entered in the workflow of the service provider, in order to be processed and formulate the replies that will be returned to the service users. These are typical tasks that require IT expertise in the context of a transactional service. IT expertise may also be required in the design and implementation of the user interaction (HTML forms, active behavior [informational messages and alerts, automatic calculation of sums] etc). IT staff finally may define statistics for technical aspects of service operations (e.g. form download speeds, CPU time needed for various tasks), which can help them fine-tune the service content and/or the platform delivering the service.

The information entered by all stakeholders is stored in an organization-wide knowledge repository (Figure 2). Such a repository is a valuable asset for organizations, since it promotes information sharing and reusability. For example, legislation regarding the authentication requirements for electronic services needs to be entered only once in the platform and will be readily available for all electronic services to use, while examples created by a domain expert for a service after a thorough study of the related legislation will be accessible by other domain experts that only need the "digested" information, without the need to go through the legal documents anew.

Once all elements for a transactional service have been defined, service deployment may commence. Service deployment is realized through a generative programming (Czarnecki, Eisenecker, 2000) engine included in the SmartGov platform, the *Integrator*. The Integrator extracts from the knowledge-based repository the elements of the transactional service and translates them into a collection of files containing the visual (HTML forms) and the business logic (validation checks, data storage/retrieval etc) portions of the service; these files may be directly used for delivering the service to the

public. For example, for each form of a service, the Integrator creates an HTML page containing an appropriate input widget for every form field. Moreover, validation checks that have been entered by domain experts in a high level of abstraction (e.g. "field *Gross Income* should be greater than field *Net Income*") are translated to code that implements these validation checks (e.g. *if (documentField["GrossIncome"].value <= documentField["NetIncome"].value) errorMessage("Gross Income should be greater than Net Income")*).

After its deployment the service is put in its operational phase, with users accessing the service and submitting documents. Throughout the operational phase, the statistics defined in the design/development phase are collected and stored into the knowledge-based repository. Each statistical value is correlated with the concept it applies to, e.g. the time needed to download a form is associated with the specific form, while the number of violations of a validation rule is linked with the particular validation rule (which is in turn linked with the fields it involves). This correlation facilitates the evaluation phase, since it is eases the task of locating service components for which specific statistics exceed a specific threshold or drop below it, giving thus indications that amendments are needed. For example, if the number of violations of a specific validation check is excessively high, more thorough documentation and examples may be provided; if users complain about the form readability (a metric that can be collected through on-line questionnaires), HTML forms can employ bigger font sizes; if portions of the service take long to execute, IT specialists may perform some optimization. The output from the evaluation phase is directed to the analysis phase, although in certain situations the design/implementation

phase can commence immediately, skipping the analysis phase (e.g. a change in the font size only affects the implementation).

Another source of requirements for modification stems from changes in the legislation and regulations governing the electronic services. In such events, the linkage between legal information, entered by domain experts in the design/development phase, and service elements is exploited to locate elements that are affected by the legislation changes. Once the elements have been identified, the necessary maintenance activities can be undertaken; these activities may span across the analysis and the design/development phase, if revisions are major, or be limited to the design/development phase only. Naturally, the legal information should be updated as well, to reflect the current status.

The use of the platform has been evaluated by stakeholders that have participated both in the development and the usage of transactional services and the results are documented (SmartGov consortium, 2004b). The quantitative measurements have demonstrated that various aspects of transactional service lifecycle management improve through the use of the platform, including e.g. reduction of development and deployment time, improved services to the citizens, reduction of development/maintenance costs etc. Moreover, the transactional service stakeholders have shown a very positive attitude against the platform, not only as regards to the platform usability and efficiency, but stating that the introduction of the platform constitutes an improvement to their working conditions as well, since they are "promoted" from mere "information providers" to "active developers". This "promotion" additionally eliminates the "shift of power" barrier identified in (Vassilakis, 2005), according to which domain experts refrain from giving

away their tacit knowledge for fear of losing the power and status associated with it; stakeholders are now accredited for the knowledge they offer, thus their status improved.

F U T U R E T R E N D S

Most of the work, in the context of e-government services, has focused on the development of individual informational and transactional services, with various levels of sophistication. A natural next step in this area will be the promotion of service integration and interoperation, for providing added value to consumers of services, such as the handling of *life events* (Wimmer, 2002). Since the services involved in life events usually span across multiple governmental agencies, technical, methodological and organizational barriers for such interoperations should be addressed. Holistic frameworks for electronic government, encompassing not only the provision of transactional services, but also the aspects of democracy promotion and managerial effectiveness ((Gil-Garcia R., 2004) will be also of essence.

C O N C L U S I O N

Transactional services are an indispensable component of electronic governance, since they are the primary means for delivering on-line public services. Administrations have made considerable progress insofar, but the inherent complexity and the special requirements in the management of the transactional services' lifecycle are not satisfactorily addressed by current practices, leading in sub-optimal results in these efforts. This paper has identified the critical issues in the lifecycle of the transactional services and has proposed a development environment and associated tools that can support organizations in the management of transactional services. With such tools,

organizations can more effectively manage existing services and speed up the development and deployment of new services, bringing the vision of e-government closer.

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T E R M S A N D D E F I N I T I O N S

Transactional services: Electronic services that implement a complete transaction between the service user (citizen or enterprise) and the service provider (government).

Typically, such services include submission of data by the service user, processing by the service provider and return of a reply (results of processing) to the user.

Two-way interaction services: Electronic services that allow the downloading of electronic forms, on-line filling and submission of data. Processing of data and return of replies is performed in an off-line fashion by the organizational back-end.

One-way interaction services: Electronic services that allow the downloading of electronic forms for the purpose of printing and manual submission.

Informational services: Electronic services that provide information related to the procedures and regulations for transactions with the government. The services *per se* are not necessarily provided electronically.

Form field: In the context of transactional services, the electronic counterpart of areas that users fill in data, e.g. name, address, birth date, total income etc. A form field typically has a *label*, describing the data that the user is called to fill in and a *data type*, dictating the set of values that are allowed to be entered (numbers, dates, strings, etc). Some fields may be "closed", i.e. allow the user to choose a value from a list, whereas other fields may be *read-only* and not allow their value to be changed.

Form field group: A collection of individual form fields that model a compound concept. For instance, the fields "street name", "number", "zip code" and "country" can

be combined to the form field group “address”. The counterpart in a paper-based environment is specific areas on document forms.

Validation rule: A business rule applying to the values entered in the form fields of a transactional service, and must be satisfied by all submitted documents. Typical examples of validation rules are “entering a value in field A is mandatory”, “the value of field A should be in some specific range”, “field A should be greater than field B” and “if field A is filled in, field B must/must not be filled in”. More complex validation checks may also appear.

Transactional service stakeholder: A person playing a role in the development, deployment and operation of a transactional service. Typical stakeholders are managers (deciding which transactional services should be implemented and evaluating the operating transactional services), domain experts (who possess the domain knowledge for the modeling of transactional services), IT experts (who provide the technical know-how for the implementation) and end-users of the service.