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MODEL AND ARCHITECTURE FOR A VIRTUAL ONE-STOP PUBLIC ADMINISTRATION

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ABSTRACT

The goal of this research was to develop a model of architecture for a virtual one-stop public administration. The first part of our work was to collect data during a six-month survey in a Swiss cantonal administration and to conduct an online survey of Internet users in order to discover their expectations. Using this data we identified and classified the different relations or interactions that a public administration can have with its clients. Then we categorized the different functions and departments of an administration, as well as the different types of clients. After having defined this typology we built a model of a one-stop public administration, studying both the structural and the behavioural aspects of such a system. Finally we proposed a component-based architecture for building this system on the Internet, showing how it relates to the conceptual model and why this architecture suits our needs best.

1. INTRODUCTION

The World Wide Web and the Internet/Intranet tools are bringing many changes in most economic sectors. Public administrations are concerned as well because they can provide better services or new services by integrating these technologies and by using modern tools. The quality and the level of service of an administration to its clients (citizens, taxpayers, businesses, associations, other administrations, etc.) are based on the quality and the accuracy of its information. The main roles of a public administration are to provide security, justice and police, to offer a good social and health system and to ensure the quality of education. In order to fulfill these roles, it must obtain, process and store information about citizens. For example a citizen will fill up an official form (obtaining information), a civil servant will provide him a service by following regulations and guidelines (processing information) and once the process is over, a trace will be kept on records (paper archives or electronic databases). In most administrations of developed countries, Information Technology (IT) is used to store information in large, centralized databases. Their access is not always simple and in order to help the civil servants in their tasks and to offer efficient services to the citizens, access to information should be easier and more straightforward. IT allows that and should furthermore be a source of innovation for the public service. IT should not be used only to stabilize and reinforce existing practices and procedures but also to bring real administrative reforms: IT can bring organizational changes and simplifications of services and also develop new types of relations between administrations and their clients by bringing them closer to another (Basquiat, 1999).

In a near future, the clients of an administration will not anymore have to go to different offices and different desks to obtain informational services, in the same way that most people do not go to the farmer, the dairyman and the miller to buy their food, but instead go to a supermarket (Lenk, 1998). There are various ways of naming this kind of unique entry point to administrative services, but the term “one-stop” is common. It has to be noted that this idea of a unique entry point is not new at all: in France there is a government center called “Centre de Formalités des Entreprises” where all the formalities (about fifteen of them) needed to launch a new business can be accomplished and it has been working for over twenty-five years (Basquiat, 1999). What is rather new is the idea of a virtual entry point, developed by using Internet/Intranet technologies. In order to offer this kind of service, an administration has to clearly identify and normalize all its different processes (internal processes, relations with its clients, services, procedures, etc.) before it can begin dematerializing them (Basquiat, 1999). There are thousands of websites of administrations, from the simplest information pages made by a web-amateur to the most complex interactive sites. Many of them have been developed in an ad-hoc manner and could be obsolete rather quickly because they depend too much on specific technologies. Certainly many countries have created general IT strategies, such as (NOIE, 1998), but there is a need for conceptual methodologies. Various researches are being conducted in that field, such as the GAEL project in Switzerland (Chappelet and Le Grand, 2000). We do believe that a conceptual model would be very useful to public administrations and that is why we have developed this model of a virtual one-stop public administration. Indeed a stable model of processes can help public administrations managing the complexity and the rapid evolution of new technologies. It has to be noted that a Swiss working group on e-government appointed by the federal government has made similar remarks (GSCI, 2000). Furthermore this group identifies the definition of patterns for such applications as one of three essential action domains for e-government. To illustrate the use of our model we are currently working on a prototype of such a system.

2. FIELD RESEARCH

In order to build our model we needed to know better the working and the managing processes of an administration, as well as the interactions with its clients. By the term "clients" we mean internal clients (other departments) and external clients (citizens, counties, schools, associations, companies, businesses). We contacted the "Administration Cantonale Vaudoise" (ACV) in Switzerland because it is the biggest of its kind in the French-speaking part of Switzerland. We were able to arrange a part-time practice during six months and during that period we met project managers, domain managers, departmental managers, users representatives, and so on, for a total of 28 formal interviews and we had many casual talks with different civil servants. Our main focus was on processes and data flow and we decided to study mainly the software applications of the ACV. However we did not go too deep into technical details and we did not leave aside the traditional exchanges (on the phone, by mail or fax, at the desk). The ACV employs 12’000 persons and uses more than 300 different software applications so it was not realistic to make a complete inventory and we decided to concentrate on strategic applications. The data we collected was rather heterogeneous since we met various people with very different worries: heads of departments, project managers, end users, etc. At the end we established a report containing our findings and recapitulative tables that presented the data in a standard way, somewhat similar to CRC Cards (Class-Responsibilities-Collaborators). For detailed information on this technique, we recommend (Bellin et al., 1997).

We also wanted to know what the citizens would expect from an administration on the Internet, so we conducted two online surveys of a convenient sample of citizens (autumn 1998 and autumn 2000 in partnership with a Swiss working group called cyberadministration.ch). It has to be noted that the samples were biased since most people who answered were frequent Internet users. However, with this research we were able to identify the expectations of these citizens regarding electronic services delivery in administrations. The questionnaire was divided in several themes: interest for official information and publications, use of public administrations websites, expectations in terms of information, communication and services, general opinions, fears and drawbacks, profile of the participants. We learned that among the services that people would appreciate the most were electronic tax filling, access to regulations and procedures, job offers and bid invitations. We also found out that the main reasons for using online administrative services would be to avoid incompetent or unpleasant civil servants and waiting lines, to gain better access to information, as well as centralization of the data and anonymity. One of the most surprising figure was that 76% of the questioned people would agree to fill in their tax form via the Internet if they had good security and confidentiality guarantees. Complete results are available in (Glassey, 2001).

3. CONCEPTUAL MODEL

Using the input we collected during our field research we worked on the model using an iterative approach to abstract data from the recapitulative tables. We also took into account the feedback from the questionnaire. As we did not want to be too focused on only one administration we tested this typology with data collected by the State of Tennessee (STISP, 1999) and by the English government (CITU, 2000), who both conducted large scale survey on Electronic Services Delivery. We were able to relate almost all of these Electronic Services to our typology. Afterwards we built a model that integrated this typology and that covered both the structural and the behavioural views of a virtual one-stop public administration. The main difficulty we encountered during this iterative process was to find a compromise between the abstraction level of the model and its simplicity of use: it had to be generic enough to enable different types of administration to use it (federal, states, cities, departments, etc.) and it had to be simple enough to be understood not only by developers but also by users and decision-makers. There are different reasons that made this compromise difficult to reach. First of all public administrations offer a wide variety of services of all kinds: the English government identified more than 500 of them (CITU, 2000). Second of all different kinds of clients have very different expectations: citizens, businesses, specialists, institutions, etc. And last, information and existing processes inside administrations are so heterogeneous that it can be very difficult to find a standard framework. We chose the graphical notation language UML (Unified Modelling Language) to create the different parts of our model. This object-oriented notation language has a very wide base of users, is an Object Management Group standard and combines the strengths of various object methods. It offers nine types of diagrams, amongst them the use cases technique that is very useful to formalize users needs. Further explanations on UML can be found in (Booch et al., 1999). Besides this notation has been extended to model Web applications (Conallen, 2000). Going in the details of the model is out of the scope of this paper, but in the future steps of our work we will use it with modern CASE tools to design a prototype, to create the backbone of the system and to do code generation.

3.1. Structural Model

The first diagram is a very simple one, but it is the base for all the class diagrams. It shows how a client can request a service from one provider within the administration (Fig. 1). This provider can call different intermediaries if necessary and then delivers the service on whatever support suits best.

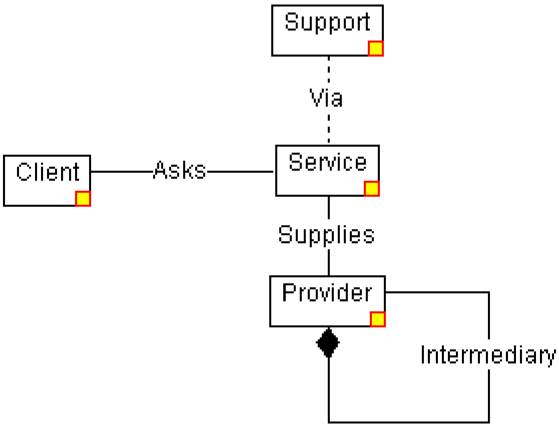

Figure 1: *Client-service class diagram*

Using our findings in the ACV, we defined four stereotypes for Client classes (Fig. 2) and for each of those we created a set of sub-classes. The first stereotype is a Private Client and it has 11 sub-classes such as citizen, tax-payer, student, soldier and so-on. The second one is Business Client, in turn divided in two stereotypes: Professional which includes all the self-employed specialists and independent workers (8 sub-classes), and Enterprises which are separated in 9 sub-classes. We also have 4 subdivisions of the Institutional Client class (sports clubs, association, etc.) and 14 types of Administrative or Internal Clients.

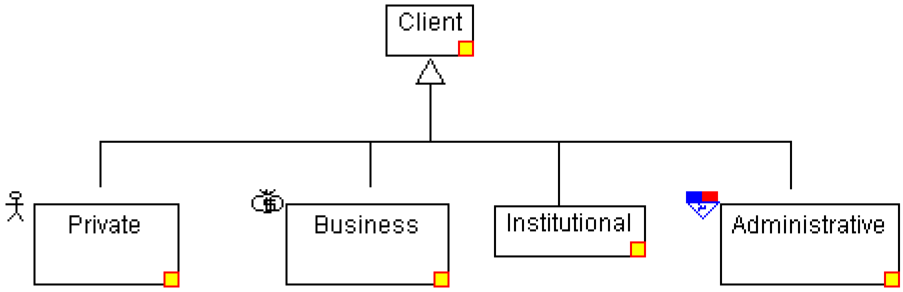

Figure 2: *Client stereotypes*

On the basis of our field research we identified 88 types of services that an administration can deliver to its clients and classified them according to the widely used typology of Information-Communication-Transaction services (Arthur Andersen, 2000). We also identified the providers of these services: as public administrations can have very different organisational structures, we decide to divide them 6 general functions. These are Internal Affairs, Education, Social Affairs, Economy, Finance, Security. We also defined a set of 28 departments or offices which could make for a real administration. At last, we defined the ways services can be provided (synchronous, asynchronous) and the support to be used: mail, fax, electronic delivery, face to face, etc.

What we really want to emphasise is the fact that this class model can be modified or extended at any point, and that one does not either have to use it as a whole. Although we realise this is only a partial representation of the reality and do not think that this is exhaustive, we believe that it does a good job covering what roles a public administration has to play in a modern society and that it constitutes the backbone for creating a system of a virtual one-stop public administration.

3.2. Behavioural Model

The core of our behavioural model is represented by use case diagrams: they describe the behaviour of a system without going into implementation details. We did not create use cases for each of the 88 services identified nor for each client, because it would have been too large a task and because it was not really useful for our model. Rather we developed a set of use cases that should form a good basis for anyone working with our model, thus allowing one to expand it easily by using a generalisation/specialisation hierarchy of services. Below we have a very simple use case diagram (Fig. 3) showing how a Client (either a Private one or a Business one) sends his tax form, which is validated by an Employee of the tax administration, before a Tax Inspector takes a decision and sends it back to the Client.

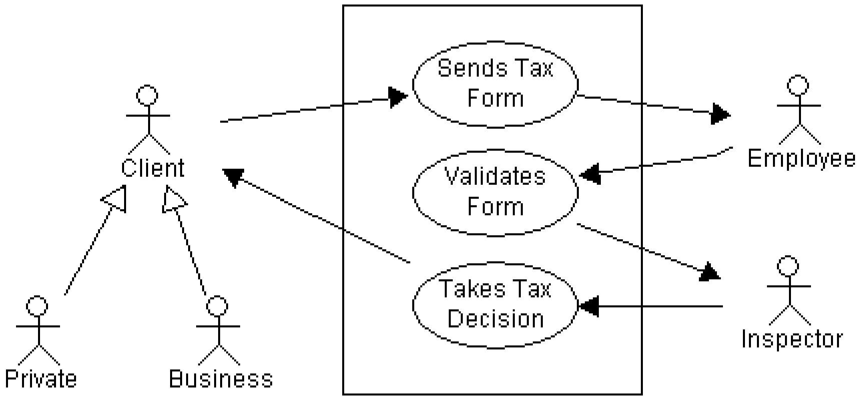

Figure 3: *Use case diagram*

The use case diagrams not only describe the behaviour of a system but also provide a common understanding of a problem between end users and domain experts. This common understanding is a very important condition to be able to develop, refine and validate the architecture of a system. Having defined the behaviour of a subsystem with use cases, a specialist will specify the dynamic aspects of a model, represented by interaction diagrams. These allow a developer to make the functional specifications of a system application, by defining its objects and their roles, the messages passed between them and the sequencing in which the messages are passed. Interaction diagrams are of two forms: sequence diagrams that show the time ordering of messages and collaboration diagrams that emphasise the structural organisation of the objects. Both forms are semantically equivalent and it is possible to convert from one form to the other. Staying with our simple example of a client filling in his tax form, we created a sequence diagram (Fig. 4).

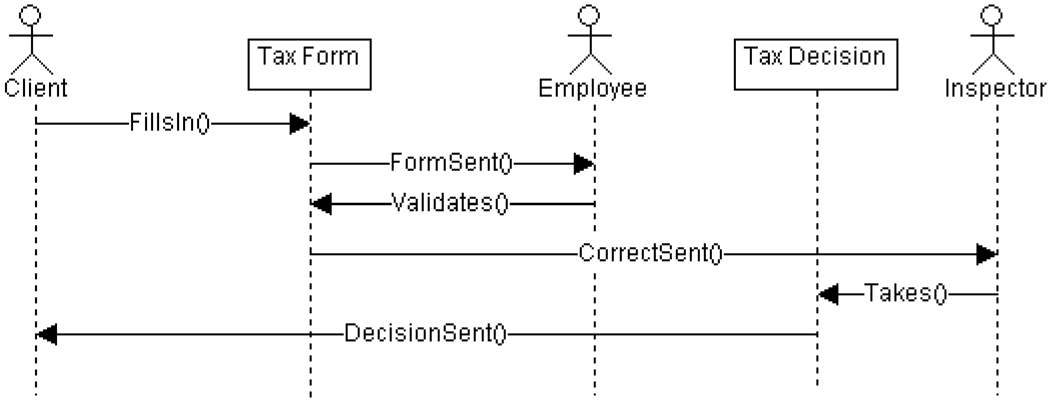

Figure 4: *Sequence diagram*

3.3 Validation of the Model

So far we provided a conceptual framework for developing a functional model. Our current work is to design a complete architecture for a system of a virtual one-stop public administration. Therefore we need to define a functional model: we have to specify what objects (or class instances) are created and what information is passed between objects. We also have to model the different steps of computational processes and the flow of objects as they move from state to state. To do that we use activity diagrams that allow us to visualize the flow of control of operations. Based on this functional model and using RAD tools such as Rational Rose, we will build the backbone of the prototype for such a system. During that development work, we want to test the model and to improve it. Furthermore we are collaborating with a working group called cyberadministration.ch and we use their feedback on the model. Once the prototype will be done, we would like to test the model with real applications in public administrations, in order to see its potential applications and to modify it if necessary. We actually believe that it could be really useful in implementing and maintaining a one-stop public administration. It will provide the users with a modular and extensible basis for their development and it can be integrated with the CASE tool that suits them best. This model does however have limitations: it is not a step by step methodology and it does not cover the various phases of a development cycle, although it could be used in combination with such techniques. It might also be too general for practitioners that have to face concrete and day-to-day technical issues.

4. PROTOTYPE ARCHITECTURE

In order to build a virtual one-stop public administration prototype, we have to take into accounts several constraints. First of all we want the users of this system to be able to access it from a standard browser, such as Netscape or Internet Explorer. Then, most public administrations have large legacy systems and large legacy databases and it is impossible for them to build a new system from scratch, as opposed to a company starting a new business application for e-commerce. That is we must have a way to interface with these legacy systems and to access legacy databases that are in general very heterogeneous.

We chose to use a component-based architecture and there are three main models available on the market: COM+ (Component Object Model) from Microsoft, which is in the process of being extended into a new model called .NET, EJB (Enterprise Java Beans) from Sun Microsystems and CORBA (Common Object Request Broker Architecture) from the Object Management Group. There are many Web Application Server solutions that support one or several of these models. For example IBM WebSphere offers support for EJB and CORBA, when SilverStream Application Server integrates well with CORBA and COM+. All those components can be called from a Web browser, using for example an Active Server Pages (ASP) script to interface with a COM+ component or a Java Server Pages (JSP) script to call an EJB component. These different models are well documented on the Internet and there is plenty of information available for those who want to have a deeper understanding of that matter (www.corba.org, java.sun.com/products/ejb, www.microsoft.com/com).

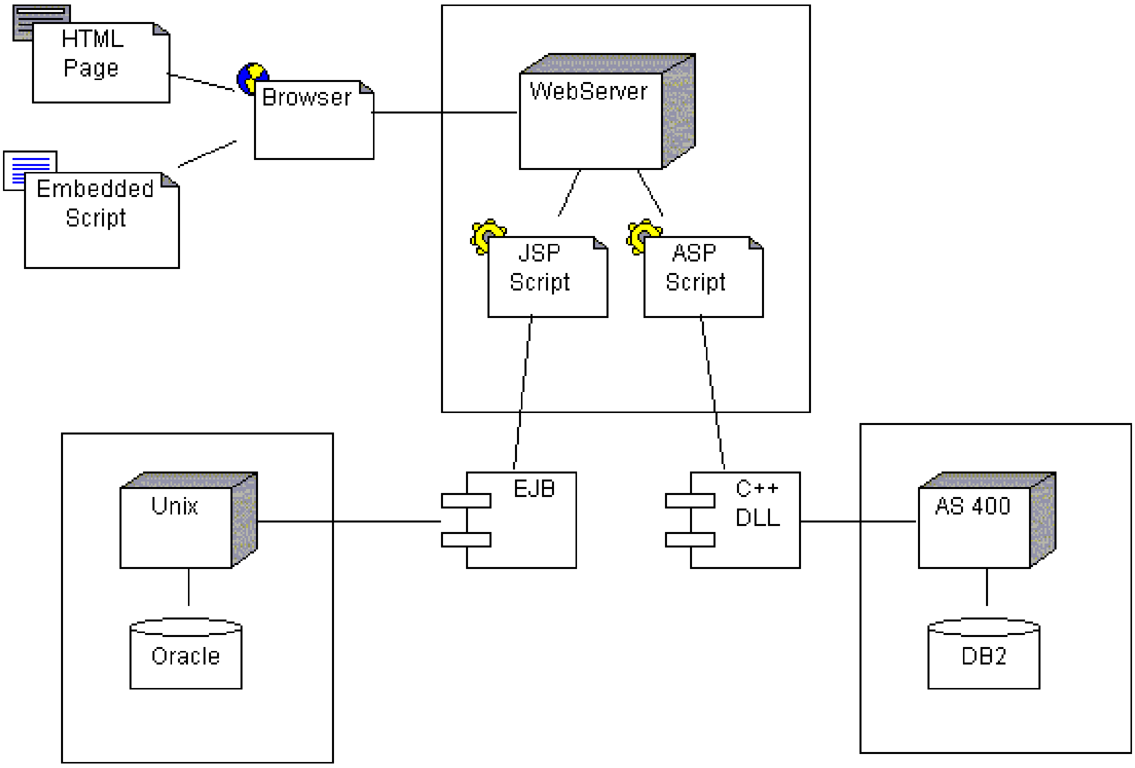

Figure 5: *An example of system architecture*

Each of these systems has its strengths and its weaknesses and we will not enter in the never-ending debate over which one is the best. The advantages and disadvantages of each system really depend on the requirements and of the existing environment. On top of that there are middle-tiers that allow these different components to interoperate. In our example (Fig. 5), we have an embedded script in a HTML page on the client machine. From the client browser this embedded script calls a server script on the Web server. In the first case we have a JSP script that compiles into a servlet, calls an EJB and accesses an Oracle database on a Unix system. In the second case we have an ASP script that calls a dynamic library written in C++ which gives access to a DB2 database on a AS/400 machine. In both cases an output is processed and sent back to the client navigator.

The system components are objects or objects packages, with their interfaces of published methods and attributes. The use of a conceptual model in UML is very useful for the creation and the maintenance of such objects because there are many CASE tools available on the market that can generate code in C++, Java, Delphi or IDL from UML diagrams. Most of them also have reverse engineering functionalities, as well as different analysis and reporting tools. Using the conceptual model, we are able to define a precise functional model, covering the structural view of a system with object diagrams and the behavioural view with interaction and activity diagrams. With these functional specifications we will be able to generate the backbone of the system and to insure its maintenance.

We are currently working on a prototype of a virtual one-stop public administration, using the Microsoft COM+ architecture to implement some representative services that we defined in the conceptual model.

5. CONCLUSION

The model of a virtual one-stop public administration we developed has been derived from a broad investigation and takes into account what services administrations can offer and what expectations the clients have. Based on the data collected during our field research we defined the conceptual model in UML, after various iterations. We believe that the strength of this model is the fact that it provides a stable conceptual framework to create detailed and practical functional models. Using these functional specifications in conjunction with modern CASE tools, the users will be able to generate the backbone of their system and to facilitate its maintenance and we are therefore currently building a prototype to illustrate and validate the model. We also think that the conceptual model is generic enough to be used in different types of public administrations and to describe a wide range of Electronic Services.

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