An Architecture for a Flexible Public Sector Collaborative Environment based on Business Process Modeling

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Abstract

e-Government today is focused on the electronic delivery of existing public services (e.g. social services, etc.) and, in general, on offering to citizens/enterprises the capability to transact electronically with Public Administration (e.g. declarations, applications, etc.), mainly over the Internet. In this sense modern e-Government, only to a small extent, exploits the huge capabilities of the Information and Communication Technologies for supporting and transforming the whole lifecycle of public policies, programmes and services design, production, delivery and evaluation. This paper examines the exploitation of Computer Supported Collaborative Work (CSCW) methodologies and technologies for supporting and transforming G2G collaboration concerning interorganizational processes, public policies/programmes/services design, monitoring and evaluation, as well as decision-making for difficult and complex social problems. An architecture of a flexible Public Sector Collaborative Environment for the above purposes is described, which has been developed, based on a detailed user requirements analysis, as part of the ICTE-PAN (Methodologies and Tools for Building Intelligent Collaboration and Transaction Environments in Public Administration Networks) Project of the European Union IST (Information Society Technologies) Programme. In order to provide the required flexibility for supporting the huge variety of G2G collaboration typologies of modern Public Administration, this Collaborative Environment should consist of a set of adaptable and customisable modules. In order to support the users-centred and participative customisation of this Collaborative Environment for a specific collaborative process, a Collaborative Processes Modeling Methodology has been developed. This Methodology also incorporates an Ontology of the domains of Public Sector Collaborative Decision Making and Public Policies/Programmes Design and Management, consisting of the main concepts-elements used in these domains and the main associations among them.

Keywords

G2G e-Government, Computer Supported Collaborative Work, Argumentation, Collaborative Business Process Modeling, Ontologies

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1 Introduction

Information and Communication Technologies (ICT) have a huge potential for supporting and transforming the whole lifecycle of public policies, programmes and services, i.e. all the processes in which they are designed, produced, delivered and evaluated ([14], [23]). However, most of the current activity of researchers and practitioners in the area of e-Government is focused on the electronic delivery of existing public services (e.g. social services, etc.), and in general on offering to citizens and enterprises the capability to electronically perform their transactions with the Public Administration (e.g. declarations, applications, etc.), mainly over the Internet ([12], [15], [16]). The ICT-enabled innovation in this area is limited mainly to the development of 'Virtual Public Agencies' or 'One-Stop e-Government', i.e. of single points of access (e.g. portals) to many related electronic transactions and services, usually to all the electronic transactions and services required in a particular life event or by a particular target group (of citizens or enterprises), which are usually offered and managed by several different Public Organizations ([6], [7], [14], [26]).

Therefore our research effort should also be directed towards exploiting ICT in other areas of Public Administration as well; one of the most important areas are the 'high level' functions of Public Administration ([14], [15], [16]) :

- the design of public policies, programmes and services, as well as their management, monitoring and evaluation,
- the decision-making for difficult and complex social problems, or for granting licenses and permissions with high social impact.

These 'high level' functions are of critical importance for the Public Administration and for the society in general. At the same time they are highly difficult and complex; they usually require close collaboration among many Public Organizations (POs) and very often participation of citizens, enterprises and their associations as well. In particular, social problems today are complex, multidimensional and cross many regions and states. The continuously growing international economic cooperation and interdependence give rise to new complex problems of an international nature. Therefore the design of effective public policies, programmes and services for coping with such big and complex problems requires close collaboration among many POs, usually from many regions or even countries (e.g. central governments, regional authorities, prefectures, municipalities, local development organizations, employment organizations, social security organizations, education organizations, environment organizations, etc.). Each of these POs possesses one small, but valuable, piece of information, experience, knowledge and competence about the problem. Also, public sector decision-making for difficult and complex social problems, or for granting licenses and permissions with high social impact, is characterized by similar difficulties and complexities.

The present paper examines the exploitation of methodologies and technologies of Computer Supported Collaborative Work (CSCW) for supporting these 'high level' functions of Public Administration. All the research work described in this paper has been conducted as part of the ICTE-PAN (Methodologies and Tools for Building Intelligent Collaboration and Transaction Environments in Public Administration Networks) Project, which is implemented in the context of the European Union IST (Information Society Technologies) R&D Programme. The main objectives of this Project are:

i) to develop an electronic Collaborative Environment for supporting the various G2G collaboration typologies of modern Public Administration, with main emphasis on supporting collaborative public policies/programmes/services design, monitoring and evaluation, as well as collaborative decision-making for difficult and complex social problems

ii) to develop a collaborative process modeling methodology, for modeling the various G2G collaboration processes, for redesigning them based on ICT, and finally for supporting the corresponding customization of this Collaborative Environment.

The Project is implemented by a Consortium of technology providers and POs-users, consisting of European Dynamics (Greece), University of the Aegean (Greece), TXT Solutions (Italy), National Environ-

ment Research Institute (Denmark), Ministry of Environment of Lower Saxony (Germany) and Province of Genoa (Italy).

The paper consists of seven Sections. Section 2 is a short literature review concerning CSCW and Virtual Teams. Then in Section 3 are described the results of the requirements analysis, which has been performed concerning electronic support of G2G collaboration. Based on these results, the architecture a flexible G2G collaborative environment has been designed, which is described in Section 4. Section 5 is dealing with the use of business process modeling techniques for configuring and customizing such a flexible G2G Collaborative Environment to a specific collaborative process; the Collaborative Processes Modeling Methodology, which has been developed for this purpose, is presented and its advantages are analysed. As a supplement to it, an Ontology of the domains of Public Sector Collaborative Decision Making and Public Policies & Programmes Design and Management has also been developed, which is presented in Section 6. It is followed by discussion and conclusions in the final Section 7.

2 Computer Supported Collaborative Work – Virtual Teams

In the past two decades the concept of working in teams has been extensively used by public and private organizations in order to cope with complex problems, to harness diverse human resources, to achieve better coordination and higher performance and also to promote interaction and innovation ([5], [18], [21]). The traditional hierarchical structures are gradually transformed to much flatter structures with less hierarchical levels, which rely more and more on empowered teams. This trend has also forced organizations to use ICTs not only for increasing the personal productivity of their individual employees, which previously was the traditional approach concerning ICTs usage, but also for enhancing the collaboration among the individual employees, and especially among the members of the various teams.

'Teams' are defined ([1], [5], [19], [25]) as collections of co-located or remote individuals working for a common goal, who must extensively interact in order to achieve this goal. The teams can be divided into 'colocated' and 'virtual' ones. As 'colocated' are defined those teams, whose members are within close proximity of each other and for whom the dominant mode of communication is Face-to-Face (FTF) Communication. Members of co-located teams typically work in the same location or come together regularly and frequently to meet in the same location. On the contrary as 'virtual' (or 'remote') are defined those teams, whose members are geographically dispersed (=work in geographically distant locations, e.g. in different countries), and in many cases organizationally dispersed (=belonging to different organizations), and who cooperate using a combination of ICT to accomplish a common task.

There are many ICTs which can support teamwork in both colocated and virtual (remote) teams. There are various categories of software that can support synchronous or asynchronous collaborative work in various kinds of teams, which are collectively referred to as 'Groupware', while the whole organization of collaboration among individuals based on Groupware is referred to as 'Computer Supported Cooperative (Collaborative) Work' (CSCW) ([1], [2], [17], [19], [25]).

The most widely used categories of Groupware are shown in the Figure 1 ([21]), organized in four groups, according to whether they support participants at the same place (colocated) or at different places (remote), and also whether the participants cooperate at the same time (synchronously) or at different times (asynchronously).

In the following paragraphs of this Section are reviewed three very important categories of Groupware, which have a high potential for supporting G2G collaboration:

- The Workflow Management Systems
- The Group Decision Support Systems
- The Argumentative Discourse Support Systems.

The Workflow Management Systems (WFMSs) support more structured forms of collaboration among individuals belonging to the same organization or even to different organizations ([1], [22], [27], [28], [29], [30], [31]). According to the Workflow Management Coalition ([27]) a WFMS is defined as a system that defines, manages and executes workflow processes through the execution of software, whose order of execution is driven by a computer representation of the workflow process logic. A typical work-

flow process consists of a predefined sequence of steps (called 'activities'); each of them is in general executed by one or more human individuals (called 'actors') supported by one or more software applications. The WFMSs in general offer the following categories of functionality :
i) Build-time functions, which concern the definition and modeling of the specific workflow process that we intend to support with the WFMS. In particular, these functions enable building a computerised representation of the workflow process, consisting of its discrete steps (activities), rules concerning the transition from one activity to one or more other activities, the human individual(s) (actor(s)) that execute each activity, the software applications used for each activity, etc. The resulting workflow process model is usually expressed as an XML document, which follows a standardised process definition language that has been developed by the WFMC, named XPDL (XML Process Definition Language) ([31]).
ii) Run-time control functions, which concern the management of the workflow process for each individual workcase, and the sequencing of the workflow process activities. They are based on the above mentioned workflow definition – model.
iii) Run-time interaction functions, which concern the interaction with human individuals and software applications for each individual workcase.

	Same Place (Colocated)	Different Place (Remote)
Same Time (Synchronous)	Electronic Meetings Systems Team Rooms Group Decision Support Systems Electronic Whiteboards	Videoconferencing Teleconferencing Document Sharing Electronic Whiteboards
Different Time (Asynchronous)	Internal Mailboxes Electronic Bulletin Boards Virtual Rooms Document Management Systems Shared Containers	E-Mail Workflow Management Systems Formflow Management Systems Messaging Systems Routing & Notification Systems

Figure 1. Basic categories of Groupware

Group Decision Support Systems (GDSSs) and Argumentative Discourse Support Systems (ADSSs) support less structured forms of collaboration. GDSS is defines an ICT-based collaborative environment, which supports group meeting and decision making processes, aiming at improving the productivity and effectiveness of decision-making, by speeding up the decision-making process, by improving the quality of the resulting decisions, or both ([19], [25]). GDSSs attempt to increase the advantages and benefits of group decision making (usually referred to as 'gains') and to decrease its inherent disadvantages and dysfunctions (usually referred to as 'losses'). The main functionalities they usually offer are: issues analysis, stakeholders analysis, topics commentary, electronic brainstorming, organization of ideas, evaluation of alternatives, policy formation, voting - preference indication, surveys and questionnaires creation and administration, enterprise analysis of alternative impact, session management, etc. In general GDSSs can facilitate and support the whole cycle of group decision making: the generation of ideas and then their discussion, analysis, organization, prioritization and consensus building.

As ADSS is defined as an ICT-based collaborative environment that supports argumentative discourse, in which several participants express different opinions, positions and solutions about an issue or problem ([3], [4], [9], [10], [11]). The main objective of an ADSS is to improve the effectiveness of the discourse by: a) removing communication impediments, b) providing techniques for structuring the discourse and systematically directing its pattern, timing, or content, and c) manipulating contradictions that arise during the discourse. An ADSS in general allows the participating agents (either human participants, or software agents) to perform some predefined kinds of communicative acts (e.g. enter a positive or negative comment on an alternative that has been suggested), in order to establish a common belief, e.g. on the most important dimensions of a problem, on the existing alternatives for solving a problem, on their advantages and disadvantages, etc. Usually an ADSS allows each of the participating agents to enter

some predefined elements, e.g. issues, alternatives, positions, etc., which all the other agents can immediately see, and also can express on them some predefined elements, etc. For example, in an ADSS each participating agent might be allowed to enter three kinds of elements: alternatives for solving a specific problem, and positive and negative comments on any alternative that has been entered by the same agent or by other agents; all the elements entered by an agent are immediately visible by the other participating agents as well, who can express their positive or negative comments on them. In this way, a high level of interaction and collaboration among the participating agents is achieved.

However, the integration of the above three basic categories of Groupware, i.e. Workflow Management Systems, Group Decision Support Systems and Argumentative Discourse Support Systems, has not been adequately investigated by researchers and practitioners. Therefore, further research is required in this direction, towards the design of collaborative environments that combine and integrate these categories, and also the application and evaluation of such environments in real life situations.

Also the Synchronous Collaboration Environments ([1], [20], [21]) have a high potential for supporting G2G collaboration; they offer a variety of tools for supporting synchronous on-line communication and collaboration among several participants, such as:

- Shared Whiteboard
- Synchronous Text Exchange (Text Chat)
- Synchronous Audio and Video Conference
- Shared Applications (e.g. Wordprocessor, Spreadsheet, CAD)
- File Sharing

The Synchronous Collaboration Environments can be very useful for achieving increased collaboration awareness, speed and immediate discussion of ad-hoc issues that arise, collaborative creation or review of documents, etc. Synchronous collaborative environments have been successfully used for New Product Development (NPD) ([20], [21]), which is a highly collaborative function; it requires extensive collaboration among many geographically distributed engineers (e.g. from various plants of the manufacturing company, from its subcontractors, from customers, etc.), exchanging drawing, faxes, measurements data, etc. The experience and knowledge gained in this domain can be exploited (with proper adaptations) in Public Administration for collaboratively developing legal documents, contracts, etc.

The effectiveness of ICT-supported teamwork and its critical success factors, especially in the case of virtual teams with remote participants, has been a critical question and therefore has been extensively researched ([5], [8], [13], [18], [20], [21]). The main conclusion of this research is that the effectiveness of ICT-supported teamwork depends both on the appropriateness of the utilized ICT, and also on organizational, structural, processual and human factors. The most important of these 'non-technological' factors are the design of the team, the organizational context in which it works, the synergy that will be developed among its members, the processes that will be followed by the team and the material resources available to it.

3 Requirements Analysis

In order to identify and analyse the requirements concerning electronic support of G2G collaboration in Public Administration, the following four tasks were carried out:

I) Initially analysed in detail were the specific requirements of the following four pilots, which had been defined from the beginning of the Project to be implemented (i.e. fully supported electronically) based on the new electronic Collaborative Environment under development, in order to validate its capabilities:

- Emission Licencing Procedure for industrial plants (Ministry of Environment of Lower Saxony - Germany)
- Documents Review Process of the European Environment Information and Observation Network (National Environment Research Institute –Denmark)
- Public Tendering Procedure (Province of Genoa - Italy)
- Operation and Management of the Career Offices Network (University of the Aegean - Greece)

II) Also analysed, in less detail, were the requirements of 150 collaboration processes from various Public Administrations of European Union member states
III) A wide range of recommendations, standards and specifications of many European Commission Programmes (e.g. the ones of the 'Interchange of Data between Administrations' (IDA) Programme) were studied as well, in order to determine the additional requirements they create
IV) Finally the results of tasks I to III were unified, in order to determine the total requirements that the Collaborative Environment under development should fulfil.

From this requirements analysis it was concluded that there is a big variety of G2G collaboration typologies in modern Public Administration. Therefore the most appropriate architecture for a Collaborative Environment that should be capable of supporting this big variety of G2G collaboration typologies is a set of generic customisable modules-building blocks with high level of integration. The main modules-building blocks which are required according to the above requirements analysis are shown in Figure 2. Such a generic Collaborative Environment has to be configured and customised for each specific G2G collaboration process we intend to support with it: initially we have to select the appropriate modules-building blocks of it, which are needed for supporting the specific process, and then to customise and integrate the selected modules-building blocks according to the specific needs of the process. In order to support and assist this necessary configuration and customisation of such a Collaborative Environment, in a users-centered and participative manner and with minimal involvement of technical experts, a Collaborative Process Modeling Methodology is of critical importance, as analysed in more detail in Section 5.

'Extended' Workflow Management System
Electronic Consultation/Argumentation Tool
Document Management System
Content Management System
Electronic Forms System
Notification System (via Internet, SMS, etc.)
Intelligent Agents (for search, meetings, planning, scheduling, etc.)
Billing and Payment System
Statistical Analysis Tool
Database Management System
Knowledgebase Management System
Users and Security Management System
Collaborative Process Modeling Tool

Figure 2. Basic modules-building blocks of a G2G Collaborative Environment

The most important of these modules-building blocks is the 'Extended Workflow Management System', which constitutes the 'backbone' of the Collaborative Environment. It is customised according to the output of the Collaborative Process Modeling Tool (described in Section 5), and activates most of the other modules-building blocks. This 'Extended Workflow Management System' should manage workflows:

- crossing more than one POs, i.e. workflows with some Activities executed by one PO, some other Activities executed by another PO, etc.,
- and also consisting of both 'Single Person Activities' and 'Collaborative Activities'.

An Activity is defined as a 'Single Person Activity' (SPA), if for each particular case this Activity is executed by only one person, e.g. in the workflow followed for 'Processing an application for issuing license A' the Activity 'Checking if the certificates B, C, D have been submitted with the application' is a SPA, because for each case (i.e. for each application) only one public servant is executing this Activity (i.e. doing this check). An Activity is defined as a 'Collaborative Activity' (CA), if for each case a number of individuals have to be involved, contribute, collaborate and interact for executing this Activity, e.g.

in the same workflow followed for 'Processing an application for issuing license A' the Activity 'Final Consultation among Directors D1, D2, D3 of the involved Public Organizations PO1, PO2, PO3 in order to decide whether the license will be issued' is a CA, because for each case (i.e. for each application) the 3 Directors D1, D2, D3 have to be involved in the final decision, collaborate and interact; each of them has to contribute in this consultation proposals and arguments, which will be taken into account by the others; also each of them listens to the proposals and the arguments of the others, and probably based on them expresses some more proposals and arguments, etc. (interaction). In general public sector decision making and also the design/ monitoring/management of public policies, programmes and services usually includes a sequence of CAs. In these CAs representatives of several POs (and in some cases also citizens, enterprises and their associations as well) interact and collaborate for understanding the public problems and various relevant situations, for generating and discussing alternatives, for designing public policies, programmes and services, etc.

Therefore, in order to support G2G collaboration, the 'classical' Workflow Model ([1], [27], [31]) and Wide Area Workflow Model ([22], [28], [29], [30]), which includes only SPAs, should be extended towards an 'Extended Workflow Model', which includes both SPAs and CAs.

From the analysis of the collaboration processes and requirements of the Public Administration, it was also concluded that for the design, monitoring, management and evaluation of public policies, programmes and services, and also for public sector decision making concerning difficult and complex social problems, or for granting licenses and permissions with high social impact, a big variety of CA types are required. However we can distinguish eight basic types of CAs, which are the most usual ones :

- *Problem/Goal Understanding*: understanding better a social problem, or a particular situation, or a potential goal, by collaboratively elucidating its main dimensions and components.
- *Strategic Analysis*: conducting collaboratively a Strategic SWOT (Strengths, Weakness, Opportunities and Threats) analysis, e.g. of a public organization or geographic region, etc.
- *Alternatives Generation and Unstructured Evaluation*: collaborative generation of alternatives for a problem or issue, and also first-level elaboration and unstructured evaluation of them, in order to elucidate their advantages and disadvantages.
- *Evaluation Criteria Generation*: collaborative generation of evaluation criteria (based on the requirements, values and interests of the participants) for evaluating alternatives, which have been proposed for a problem or issue.
- *Structured Multicriteria Evaluation of Alternatives*: collaborative structured multicriteria evaluation of alternatives, which have been proposed for a problem or issue.
- *Design of Public Policies and Programmes*: for each of the selected alternatives, collaborative design of public policies and programmes for implementing it, in the required analysis level, e.g. up to subprogrammes, measures, etc.
- *Design of Projects*: for each of the above lower level programmes, collaborative design of projects for implementing it, and for each of these projects design of its internal structure, e.g. tasks, subtasks, deliverables, etc.
- *Project Monitoring and Evaluation*: collaboratively monitoring of these projects, concerning both physical implementation and financial management, and evaluation

Finally from this analysis of requirements it was also concluded that the integration of the above required modules of Figure 2 is of critical importance for supporting effectively G2G collaboration, e.g. one module should have the capability to invoke another module, and these two modules to share data and knowledge, etc. For example in the pilot of the Ministry of Environment of Lower Saxony (Germany), which aims at supporting their Emission Licencing Procedure for industrial plants, for each application submitted for issuing such a licence the Extended Workflow Management System should be invoked and a new workflow instance initiated. Then for each activity of the workflow:

- its actor(s) should be notified, by invoking the Notification System,
- if this activity is a CA, an appropriate Electronic Consultation should be set-up, by invoking the Electronic Consultation/Argumentation Tool,

- the results/decisions from this activity should be entered by the actor(s) in an electronic form, which is opened by invoking the Electronic Forms System,
- usually a document has to be downloaded or uploaded, therefore the Document Management System has to be invoked,
- if the applicant has to pay some money, then the Billing and Payment System should be invoked,

while all the activities should share data and knowledge for this application, by invoking the Database Management System and the Knowledgebase Management System, etc.

4 G2G Collaborative Environment Architecture

Based on the results of the above users requirements analysis, the architecture of the G2G Collaborative Environment was designed. It consists of a set of generic customisable modules-building blocks, in order to have a high level of flexibility and adaptability for supporting a big variety of G2G collaboration typologies; these modules-building blocks are characterized by a high level of integration. Therefore for each specific collaborative process we want to support with this Collaborative Environment, it is necessary to configure and customise it appropriately. The structure of this Collaborative Environment is shown in Figure 3, while the description of its modules-building blocks is given in the following paragraphs of this Section; it can accessed over any kind of network, e.g. over LAN, WAN, Internet, etc.

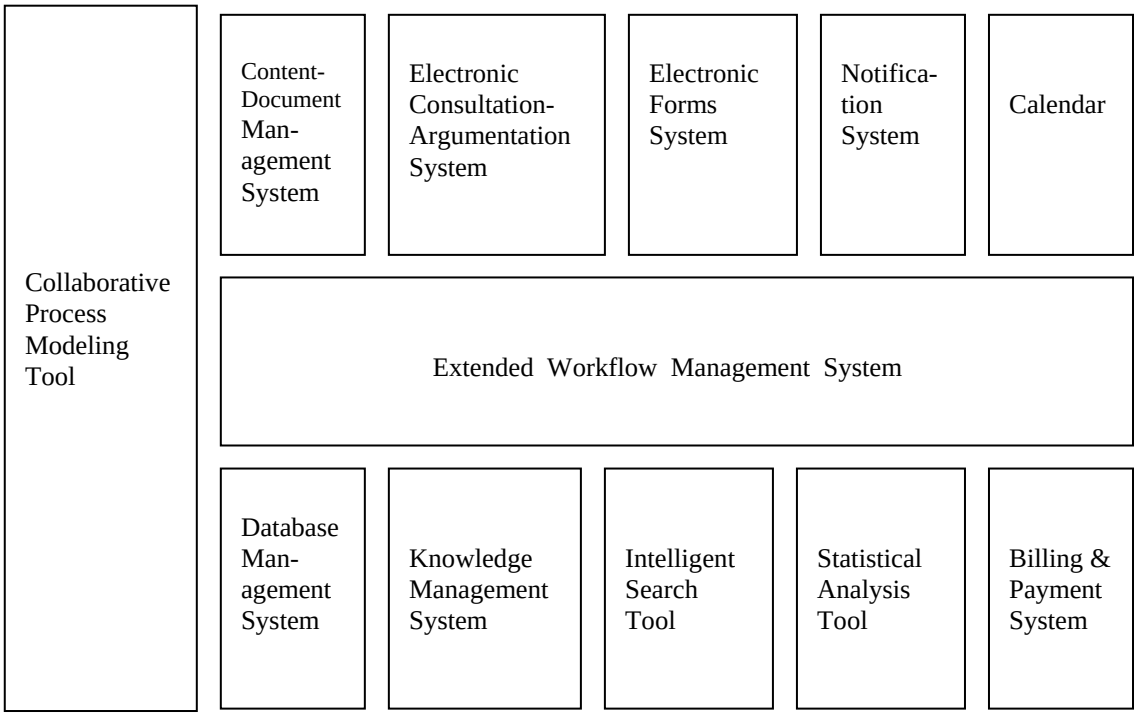


Figure 3. Structure - modules of the Collaborative Environment

The basic module of the Collaborative Environment is the 'Users and Security Management System'. It offers the capability to create Communities, and in each of them to create Workgroups. For each Workgroup we can define its members/users, and also allocate a Web-Space with various Services, which support the remote electronic collaboration among its members/users (who can belong either to the same

PO or to different POs). These Services are highly integrated, i.e. one Service can access and use other Services, etc. For each member/user we can define his/her Access Rights on these Services.

The most important of these Services we can have for each Workgroup, which are implemented via corresponding modules-building blocks, are :

i) Content Management System - Document Management System

They offer to the members/users of the Workgroup the capability to upload, share, download and manage in a tree-like structure of folders various kinds of Documents, which should be taken into account by the Workgroup, and constitute its 'Information Context', e.g., Laws, Regulations, Guidelines, Policy Papers, Administrative Decisions, Terms of Reference, Datasheets, Graphs, e.t.c.

ii) Electronic Consultation/Argumentation System

It supports the remote electronic argumentative discourse and interaction among members/users of the Workgroup ([4], [9], [10], [11]) in synchronous or asynchronous mode. In particular it offers the capability to set-up one or more Electronic Consultations in the Workgroup. For each of them we can define the members/users of the Workgroup, who will participate in it (Internal Participants), also other Participants, who are not members/users of the Workgroup (External Participants), their corresponding Access Rights, the start time and the end time, etc. When an Electronic Consultation is started, a corresponding Electronic Consultation Space is created for it, which is usually a web-page, where each Participant can enter and share some predefined kinds of elements concerning the Topic of the Electronic Consultation (e.g. issues-problems, alternatives, arguments (positive or negative), etc). Also each Participant can read the elements (issues-problems, alternatives, arguments (positive or negative), etc.) that have been entered by the other Participants, and on any of them can add new elements (e.g. on any of the issues-problems, alternatives, arguments, etc., entered by the other Participants, can add an argument (positive or negative)), etc. In this way, a high level of interaction among the remote Participants can be achieved, which results in the collaborative creation of a tree-like structure on the Electronic Consultation Space, similar to the one shown in Figure 4, which incorporates the experience, the knowledge, the values, etc. of all the Participants, and facilitates the synthesis of them and the collaborative decision making and production of new knowledge, policies, programmes, etc.

Issue1 (USER1)
- Alternative11 (USER4)
  - Argument111(+) (USER2)
  - Argument112(+) (USER1)
    - Argument1121(-) (USER5)
- Alternative12 (USER2)
- ……

Issue2 (USER5)
- Alternative21 (USER5)
- Alternative22 (USER3)
  - Argument211(+) (USER1)
- …….

Figure 4. Tree-like structure of an Electronic Consultation

During an Electronic Consultation, in order to have 'structure', focus and effectiveness, it is necessary to control and restrict (like every experienced and efficient Chairman of a Team or a Discussion is usually doing) the following :

a) What elements can each Participant contribute, e.g. issues-problems, alternatives, arguments (positive or negative), proposed programmes, proposed projects, proposed tasks, etc. Usually an Electronic Consultation (and in general any 'physical' or 'electronic' discussion) is effective only if the Participants focus on not more than 2-3 kinds of elements, e.g. we can define that in an G2G Electronic Consultation

the Participants are allowed to express only issues-problems, alternatives and arguments concerning a specific Topic, e.g. for a specific licence application, or for the economic development of a region, etc.
b) What relations will be allowed among the above kinds of elements, e.g. in the above example we can define that an alternative that is entered by a Participant can be related to an issue-problem (that has been entered by the same Participant or by another Participant), being proposed as a solution for this issue-problem, and also that an argument can be related to an alternative, being a positive or negative argument supporting or objecting this alternative. So, in this example the above allowed relations are :
- Relation 'Resolves' between an 'Alternative' and an 'Issue'
- Relation 'Supports' between an 'Argument' and an 'Alternative'
- Relation 'Objects' between an 'Argument' and an 'Alternative'

Therefore it is necessary during the set-up of an Electronic Consultation to define this significant aspect of it as well: it is necessary to define the (usually few) kinds of elements which can be contributed-proposed by the Participants, and also the relations which are allowed among these elements. These kinds of elements and relations allowed in an Electronic Consultation constitute its 'Specific Ontology'. In Figure 5 we can see the Specific Ontology of the Electronic Consultation of the above example, using the notation of the IDEF5 Ontology Capture Method (http://www.idef.com/idef5.html).

The tree-like structure of elements, which are contributed in an Electronic Consultation (Figure 4) by its Participants constitutes the knowledge that is collectively created. This knowledge has to be stored in an appropriate Knowledgebase, which has to be structured according to the Specific Ontology of the Electronic Consultation, e.g. the required Knowledgebase for storing the knowledge that will be created during the Electronic Consultation of the above example has to be structured according to the Specific Ontology of this Electronic Consultation shown in Figure 5.

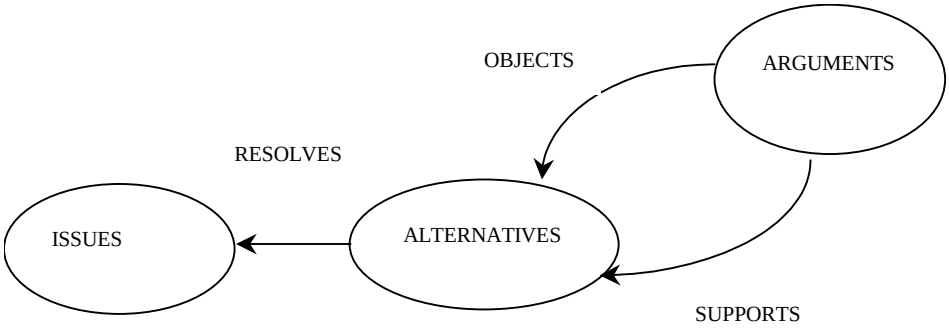


Figure 5. Specific Ontology of an Electronic Consultation, and also structure of the corresponding knowledgebase that will store the knowledge that will be collectively created by its Participants

The Electronic Consultation/Argumentation System is integrated with the Content Management System and the Document Management System: we can associate an Electronic Consultation with one or more Documents from the Content Management System and/or the Document Management System. These associated Documents should be taken into account by the Participants of this Electronic Consultation and constitute its 'Information Context', therefore they will be directly and easily accessible from the corresponding Electronic Consultation Space (e.g. via a simple click) by all the Participants.

iii) Extended Workflow Management System

It executes 'Extended Workflows', consisting of both SPAs and CAs. This Service is the most important and useful of all the Services of the Collaborative Environment, since according to results of the users requirements analysis (Section 3) most G2G collaboration processes in modern Public Administra-

tion have the structure of an 'Extended Workflow' with several SPAs and CAs. It offers the capability initially to import from the Collaborative Process Modeling Tool (described in the next Section 5) the definitions (models) of one or more Extended Workflows. Then it offers the capability to activate any of these Extended Workflows whenever a new case (e.g. application) arrives for it: initially for this new case is activated the first Activity of the Extended Workflow (according to its imported definition/model), when it is finished is activated the second Activity, etc.

For each CA that is activated for this case, an appropriate Electronic Consultation is set-up for it and the corresponding Electronic Consultation Space is created. The 'Specific Ontology' of this Electronic Consultation (i.e. the kinds of elements which are allowed to be entered by the Participants and also the kinds of relations allowed among these elements) depends on the nature of the corresponding CA: actually it is the 'Specific Ontology' of this CA. Therefore in the definition (modeling) of an Extended Workflow, it is necessary for each CA to define(model) its 'Specific Ontology': so a Collaborative Process Modeling Methodology (Section 5) should necessarily offer this capability. The knowledge created collectively in a CA by its Participants has also a tree-like structure: for each case, in the corresponcing Electronic Consultation that is set-up for it, is created one tree-like structure, similar to the one shown in Fig.3. This knowledge has to be stored in an appropriate Knowledgebase, which has to be structured according to the Specific Ontology of the CA.

Alternatively, instead of having a separate Knowledgebase for each CA, which is not integrated with the Knowledgebases of the other CAs of the same collaborative process, we can have a Knowledgebase for the whole process. Then a subset of this Knowledgebase (some kinds of elements and relations) will be created by the first CA of the process, referred to as the Knowledgebase View for this CA. In the second CA this subset of the Knowledgebase will be accessed in a 'read-only' mode, and, based on it, another subset of the Knowledgebase (some other kinds of elements and relations) will be created, which is the Knowledgebase View of this second CA, etc. If we adopt this 'integrated' approach, we should define a 'Process Specific Ontology' for the whole collaborative process, which will consist of the kinds of elements which should be produced during the whole process by its Participants and also of the relations allowed among these elements, and will determine the structure of the above Knowledgebase. Then for each CA we should define a part of this 'Process Specific Ontology' as the Specific Ontology of this CA, that will determine the corresponding Knowledgebase View for the CA.

This approach gives us the capability to subdivide difficult and complex collaborative tasks, which aim at producing collectively many different kinds of elements and relations, into several CAs, each of them focusing on and producing collectively only a few kinds of elements and relations; in this way higher effectiveness can achieved in performing difficult and complex collaborative tasks. For example, if we want to organise in an underdeveloped geographic region an electronic web-based collaboration, in order to:

a) analyse its developmental 'problems',
b) define 'strategic directions' for solving these 'problems', and
c) for each of these 'strategic directions', define the specific 'projects' that should be undertaken for implementing it,

we can follow a collaborative process, consisting of three CAs, each of them corresponding to one of the above three aimed kinds of elements ('problems', 'strategic directions', 'projects').

Also for each SPA or CA that is activated for a case, the required Applications and/or Electronic Forms will be invoked, and also the Participants in this SPA or CA will be notified (via the 'Notification System' mentioned in the final paragraph of this Section). Furthermore, the Participants will be given direct and easy access (e.g. via a simple click) to the necessary Documents from the Content Management System and the Document Management System (e.g., Laws, Regulations, Guidelines, Policy Papers, Administrative Decisions, Terms of Reference, Datasheets, Graphs, e.t.c.) and also to the outcomes of previous SPAs and CAs for the same case, which have to be taken into account for executing this Activity and constitute its 'Information Context'.

From the above it is also concluded that a Collaborative Process Modeling Methodology (Section 5), in order to support this Extended Workflow Management System, and in general the whole Collaborative Environment, should offer us the following capabilities:

- for each Extended Workflow the capability to define the sequence of its Activities (SPAs and CAs),
- for each of these Activities (SPA or CA) the capability to define its Participants, and also the Applications, Electronic Forms and Documents which are required for executing this Activity,
- and also for each CA the capability to define (model) its 'Specific Ontology'.

These required capabilities have been taken into account for developing the Collaborative Process Modeling Methodology that is described in Section 5.

Therefore the Extended Workflow Management System is the most important and useful module-building block of the Collaborative Environment, that integrates and activates most of the other modules-building blocks: in particular the Extended Workflow Management System is integrated with the Collaborative Process Modeling Tool, the Electronic Consultation/Argumentation System, the Users and Security Management System, the Document Management System, the Content Management System, the Notification Systems, the Electronic Forms System, and possibly with other necessary Applications.

The Collaborative Environment includes also the following modules-building blocks:

- Notification System (offers capabilities for notifying users/members of the Workgroup, or even non-members/users, via e-mail, SMS, etc., for various events, which can be predefined; these events may be aasociated with the other moduled-building blocks, e.g. with the starting of an Electronic Consultation, the uploading of a new Document on the Dodument Management System, etc.)
- Electronic Forms System (offers capabilities for designing Electronic Forms, which can then be used for gathering various kinds of data from the users/members of the Workgroup, or even from non-members/users, e.g. for evaluations, voting, etc., and then for storing these data in the Database Management System, with which the Electronic Forms System is integrated)
- Database Management System (offers the capability to store and manage various kinds of data, which are related to the Workgroup and the Services, e.g. to the Document and Content Management Systems, the Extended Workflow Management System, etc.),
- Knowledge Management System (offers the capability to store and manage various kinds of knowledge, which are related to the Workgroup and its Services, e.g. the tree-like structured knowledge which is created collaboratively during an Electronic Consultation, etc.),
- Calendar (offers the capability to schedule a Meeting among some of the users/members of the Workgroup, with possible participation of non-members/users as well, which can be a 'Physical' Meeting or an 'Electronic' Meeting – Electronic Consultation, and also to notify the Participants; also it shows to each user/member of the Workgroup a Calendar with all his/her scheduled Meetings of the current month or of any future month)
- Billing and Payment System (for Public Administration processes, in which citizens or enterprises are billed and pay),
- Intelligent Search Tools,
- Statistical Analysis Tool (e.g. for the statistical processing of data stored in the Database Management System),

and also the Collaborative Process Modeling Tool , which is described in the next Section 5.

5 Collaborative Process Modeling Methodology

5.1. Objective

As described in Sections 3 and 4, due to the big variety of G2G collaboration typologies in modern Public Administration, it is necessary that the architecture of the Collaborative Environment consists of a set of generic customisable modules-building blocks with a high level of integration. This approach offers very important advantages, but at the same time has an inherent disadvantage: configuration and customisation of the Collaborative Environment is necessary for every specific G2G collaborative process we want to support with it. In particular, initially we have to select the appropriate modules-building blocks, which are needed for supporting this process, and then customise and integrate them according to the needs of the process. In order to support this extensive configuration and customisation of the Collaborative Environment for a specific process, in a users-centred and participative manner with minimal involvement of technical experts, a Collaborative Process Modeling Methodology is required. The main objective of this Collaborative Process Modeling Methodology is to enable the users to describe their specific collaborative process, not in technical terms and concepts, but in their own 'language', based on Public Administration business terms and concepts (e.g. process, activity, case, participant, stakeholder, law, regulation, organisational unit, issue, alternative, etc.), which are familiar to them. This process description should then be easily usable for supporting and automating to a large extent the required configuration and customisation of the Collaborative Environment.

In particular this Collaborative Process Modeling Methodology should offer the capability :
a) initially to build an 'As-Is' model of the process, which is useful for understanding all the important perspectives of it,
b) then to redesign the process, based on the capabilities offered by the Collaborative Environment, and to build its 'To-Be' model,
c) and finally, based on the above 'To-Be' model of the process, to support and automate to a large extent the required configuration and customisation of the Collaborative Environment for this process.

Initially it was examined whether we could use any of the existing Business Process Modeling Methodologies for this purpose. However, none of the existing Business Process Modeling Methodologies could meet all our needs and offer all the required capabilities. For this reason, the optimal solution was to develop a new Collaborative Process Modeling Methodology, which was named 'Public Administration Operation Modeling Integrated Methodology' (PA-OMIM).

5.2. Innovative Features

The main innovative features of PA-OMIM are the following:
- It enables modeling complex Collaborative Processes, consisting of both 'Single Person Activities' (SPAs) and 'Collaborative Activities' (CAs).
- It enables modeling the 'Specific Ontology' of each CA, i.e. defining what kinds of elements each Participant in the CA can contribute (e.g. issues-problems, alternatives, positions, programmes, actions, etc.), and also which are the allowed relations among these elements, (e.g. an alternative should be related with a problem, etc.). The Specific Ontology of a CA is used as the Specific Ontology of the Electronic Consultation Space, which is created for this CA every time it is activated for a specific case.
- It includes a 'General Ontology' for the domains of Public Sector Collaborative Decision Making and Policy/Programmes/Services Design and Management, which is described in the next Section 6. It consists of the main kinds of concepts-elements used in these domains and the main kinds of relations among them. This General Ontology has been developed in order to assist and support the above modeling of the Specific Ontology of a CA. In particular, for the definition of the Specific Ontology of a CA, i.e. of the allowed kinds of elements and relations in this CA, we can use the kinds of concepts-elements and relations of the above General Ontology, either as they are or with modifications.

- It has been designed with a focus on the specific needs of the Public Administration, which is characterised by complex and highly sophisticated administrative processes, which very often cross several POs, follow a complex legal/regulatory framework, have many 'internal' and 'external' stakeholders, etc.
- It covers all the important 'hard' elements (activities, participants, organizational structures, resources, information/knowledge, etc.) and 'soft' elements' (environment, stakeholders, etc.) of the G2G collaborative processes, following therefore a socio-technical approach. This feature is of critical importance, because for building successful G2G collaborative environments, which are expected to support the collaboration among several POs (from the same country or even from different countries) with different needs, objectives and interests, it is necessary to take into account many 'hard' and 'soft' elements of the corresponding collaborative processes.

Some other significant features of PA-OMIM are:
- It provides an intuitive graphical notation that makes it user-friendly. Also collaborative process modeling is not based technical terms and concepts, but on business terms and concepts (process, activity, actor, stakeholder, law, regulation, organisational unit, issue, alternative, etc.), which are familiar to the users. These two features minimise the need for involvement of technical experts, and enable users to assume a leading role.
- It is compatible with the state-of-the-art Workflow Processes Description Language XPDL (XML Process Description Language) published by the Workflow Management Coalition, and it extends XPDL so that it can model 'Extended Workflows', which include not only 'Single Person Activities' (SPAs), but also 'Collaborative Activities' (CAs) as well.
- It offers the capability, after building the model of a collaborative process, to store it in an 'Extended XPDL' file, which then can be exported into the 'Extended Workflow Management System' of the Collaborative Environment, in order to automate to a large extent its configuration and customisation.

5.3. Description

In PA-OMIM a G2G collaboration process is modeled in five Views, each of them modeling a different perspective of the process. These five Views are:

I. Environment View
II. Process View
III. Organization View
IV. Resource View
V. Information/Knowledge View

This multiple Views approach allows us to manage the inherent high complexity of modeling the modern G2G collaborative processes, which are characterised by numerous activities, participants, stakeholders, resources, information and knowledge elements, legal/regulatory frameworks, etc. These five Views are interconnected, in the sense that an element of one View can be associated with an element of another View, e.g. an element of the Process View (e.g. an Activity) can be associated with an element of the Organization View (e.g. a Department, which is responsible for implementing this Activity).

In general, when using PA-OM we start from the following point: there are one or more collaborative G2G processes, in which several POs are involved (participate), and we have to develop a customised Collaborative Environment for supporting these processes and give to all their participants the capability to participate electronically, e.g. via Internet. For this purpose initially we have to build a composite 'As-Is Model' of these processes, with all the above Views, and then to build their redesigned 'To-Be Model'. The steps we have to follow for building any of these two models are:

I) Initially the Environment View is built. In this high level View we describe :
- The scope and the boundary of the customised Collaborative Environment we are going to develop, i.e. the processes that will be supported by it.
- Their external environment, i.e. other processes which are associated with them (i.e. affect the processes that will be supported or are affected by them), stakeholders affecting them or being affected by them, and also laws, regulations, policy frameworks, guidelines, etc., that have an influence on them.

In particular, in the Environment View initially we add, within the Boundary of the Collaborative Environment under development, all the processes, which we have decided to support with it. As a second step, we add the existing associations between these processes: one process A can be associated with another process B in various ways, e.g. process A may produce some data, decisions, directions, etc. that influence the implementation of process B, etc. Finally, for each of the processes within the Boundary, we add (out of the Boundary) various elements of the external environment which are associated with it:

a) other processes, that will not be supported by the collaborative environment under development, but have an influence on it,

b) its legal/regulatory context, e.g. laws, regulations, policy frameworks, guidelines, etc., that have an influence and/or place some constraints on it,

c) its stakeholders, i.e. individuals, groups, organisations who affect it or are affected by it, and their relevant interests and concerns

The identification of the main stakeholders, and for each of them the identification of the main interests/concerns, is of critical importance for the success of the Collaborative Environment. Therefore a systematic Stakeholders Analysis has to be performed for building the Environment View. In Figure 6 we can see an example: the Environment View of the University budget preparation and monitoring processes.

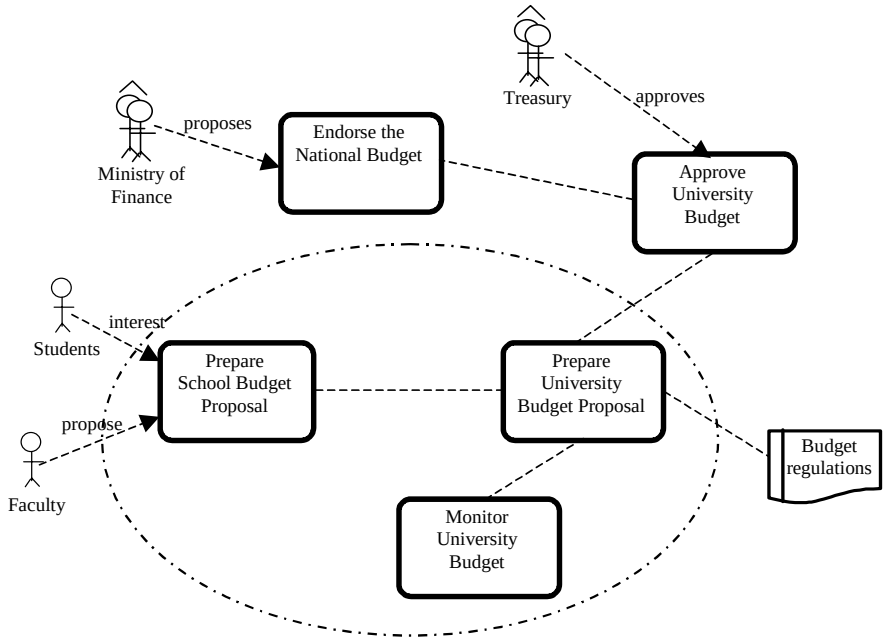


Figure 6. Environment View of the University budget preparation and monitoring processes

II) Then the Process View is built, which is the basic view. In the Process View, for each of the processes within the boundaries of the Collaborative Environment under development, are defined its constituent activities and the sequence of them. In particular for each process :

a) Initially we add-define the activities it consists of (both SPAs and CAs).

b) Then we add-define the sequence of them, which is expressed via sequence flow arrows: each of them in general denotes that 'From' an activity A (i.e. after completing it) we proceed 'To' another activity B.

c) We can add-define splitting points, where the process is split into two or more paths, which can be either parallel paths (AND-Split), or alternative paths (OR-Split or XOR-Split). We can also add-define join points, where two or more paths of the process join into a single path; we can have AND-Join points (the condition for joining is of AND type, meaning that all processes before the

AND-Join should be finished before proceeding further) and OR-Join or XOR-Join points (the condition for joining is of OR or XOR type respectively).

d) We can also add-define 'events': an event is a happening that affects the course of activities in a process. An event can trigger the start of the process, e.g. a citizen submits an application for being granted licence A (start event), or signal its end (end event), or appear in the course of the process (intermediate event) and influence an activity, a splitting point, a join point, etc.

e) We can also add-define 'Legal/Regulatory Constraints' as separate objects, and then we can associate (link) each of them with the activity(ies) it concerns.

III) The third step is to build the Organization View, which describes, for each of the POs involved in the above processes, at least the part of its organisational structure (from the level of the public organization down to the level of organisational units, positions, roles, teams and individual employees), which participates in these processes (i.e. organisational units and employees participating in the implementation of some of their activities). After building this Organization View, its associations with the Process View are built: elements of the Organization View (e.g. organisational units or individual employees), which are participating in the implementation of activities of the processes shown in the Process View, are associated (linked) with the corresponding activities.

IV) The fourth step is to build the Resource View, which describes the various resources that are used for the implementation of the activities of the above processes shown in the Process View, e.g. software applications, documents, databases, database views, knowledgebases, knowledgebase views, material objects, etc. Our main emphasis is put mainly on the resources, which are of interest concerning the development of the Collaborative Environment, e.g. the financial resources that are used for these processes are out of the scope of this View. After building this Resource View, its associations with the Process View are built; each of the resources shown in the Resource View (e.g. software applications, documents, databases, etc.), is associated (linked) with the corresponding activities using it. Especially for some of the electronic resources, e.g. for electronic databases or documents, it is necessary to define the type of this association: it can be read-only (i.e. this electronic database or document is only read during the implementation of the activity), or read-write (i.e. this electronic database or document is both read and written, i.e. information is both inserted and updated, during the implementation of the activity). In general any SPA or CA may be associated in 'read-only' mode with several databases, database views, knowledgebases, knowledgebase views, so that the corresponding data and knowledge can be taken into account during the execution of this SPA or CA and constitute its 'Information/Knowledge Context'. Also any CA should be associated in 'read-write' mode with at least one knowledgebase or knowledgebase view, where all the knowledge created collectively by its participants will be stored. It should be noted that for each of the above databases, database views, knowledgebases and knowledgebase views that are used in these processes, in these View are defined only some basic attributes, while its structure is defined in the Information/Knowledge View.

V) Finally, the Information/Knowledge View is built, which describes, for each of the above databases, database views, knowledgebases and knowledge views defined in the Resource View, its internal structure model. In particular :

a) For each database or database view, we build a model of its information structure, which has the form of an 'Entities-Relationships Model' (it shows the entities, e.g. categories of persons, things, actions, etc., about which data exist in this database or database view, and the relationships among them), extended with the Generalization/Specialization relation to allow for the creation of richer Information Models.

b) For each knowledgebase or knowledgebase view, we build a model of its knowledge structure, which has the form of an 'Elements-Relations Model', described in Section 4 (similar to the one of Figure 5); it shows the kinds of elements and relations it includes, coinciding with the Specific Ontology of the corresponding collaborative process or CA.

6 Ontology

As described in Sections 4 and 5, for each CA it is necessary to define-model its Specific Ontology. As an assistance for performing this task, a 'General Ontology' has been developed for the domains of Public Sector Collaborative Decision Making and Policy/Programmes/Services Design and Management, which is shown in Figure 7, using the notation of the IDEF5 Ontology Capture Method (http://www.idef.com/idef5.html). It consists of the main kinds of concepts-elements used in the above domains and the main kinds of relations existing among them: most 'physical' or 'electronic' discussions concerning these domains use mainly these kinds of elements and relations, or some variations of them.

In order to develop this General Ontology, the existing research literature in this area ([3], [4], [9], [10], [11]) has been extensively studied. Initially we examined whether we could use Ontologies of existing collaborative environments (e.g. gIBIS, HERMES, etc.); however we came to the conclusion that they they were not 'rich' enough: they included only a limited number of concepts-elements and relations, and could not cover the big variety of concepts-elements and relations used in the above domains of Public Sector Collaborative Decision Making and Policy/Programmes/Services Design and Management. For this reason it was decide to develop a new General Ontology of these domains, taking into account:

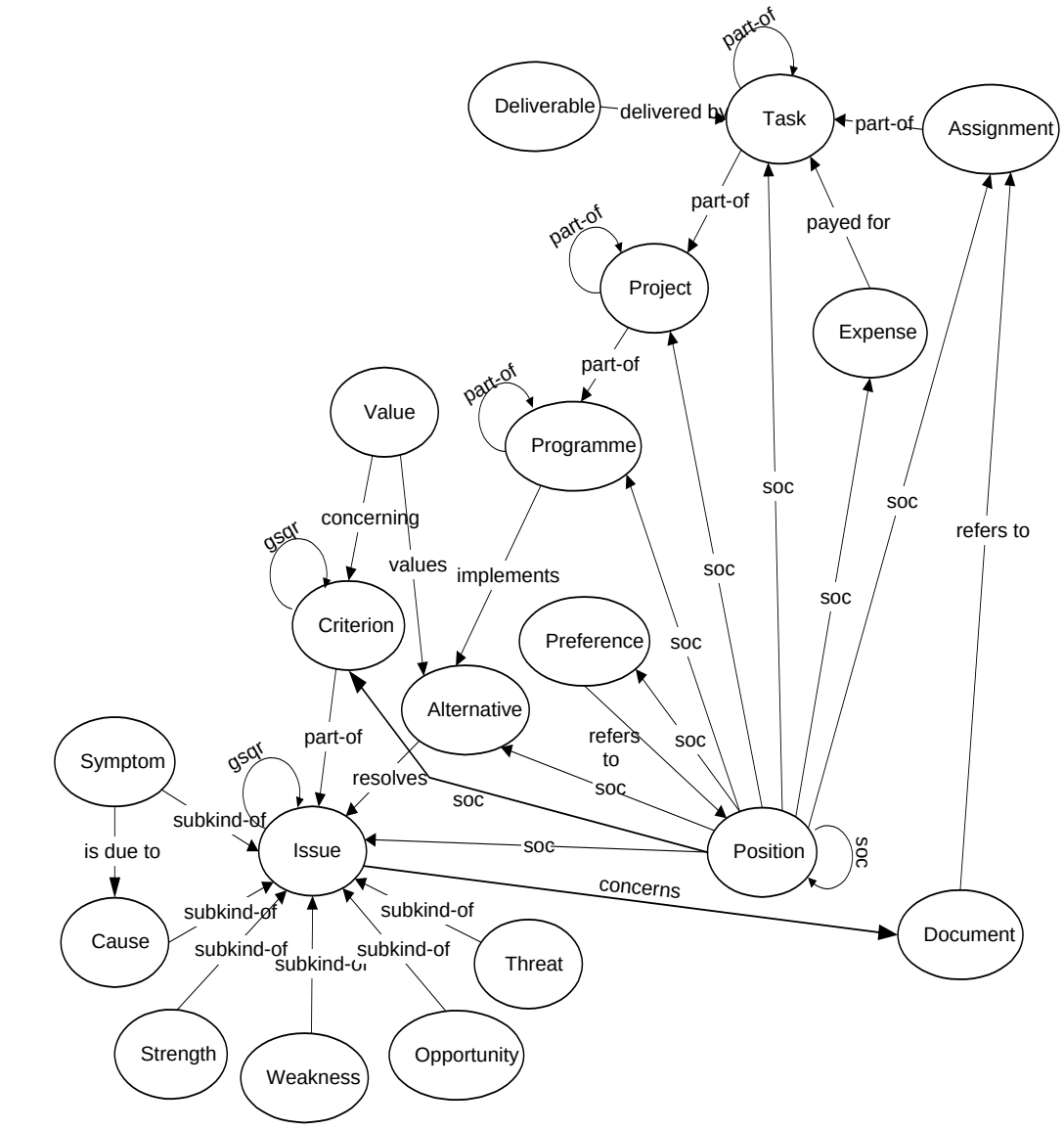
- the abovementioned relevant research literature,
- the results of the users requirements analysis reported in Section 3, which were based on the analysis of the four pilots of the ICTE-PAN Project and additionally of 150 collaboration processes of various Public Administrations of European Union member states,
- and also relevant discussions with Officers from POs of the four participating countries in the ICTE-PAN Project (Greece, Italy, Denmark and Germany).

The above General Ontology is quite useful for the definition of the Specific Ontology (=allowed kinds of elements and relations) of any CA: we can use some (usually a few) of the kinds of elements and relations of this General Ontology, if we find them appropriate and suitable for this CA, or even some variations of them (e.g. with different name and/or meaning). Also we can use them in combination with some additional kinds of elements and relations, which might be appropriate for this CA. In this way, a high level of flexibility and adaptability to particular requirements can be achieved, and a large variety of CA typologies can be supported.

Also eight basic CA 'templates' have been defined, corresponding to the eight basic CA types which have been mentioned in the end of Section 3. Each of them corresponds to a specific subset of the kinds of elements and relations of the above Ontology. We can use these templates both as typical examples of CAs in modern Public Administration, and also for the quick definition-modeling of the Specific Ontology of a CA. In particular the Specific Ontology of a CA can be based on any of these templates: in this way all the kinds of elements and the relations of the template are automatically inherited by this CA.

7 Discussion - Conclusions

In the previous Sections the architecture of a flexible Government to Government (G2G) Collaborative Environment has been described, which aims at supporting the collaborative performance of the 'high level' functions of Public Administration, e.g. the collaborative decision-making for difficult and complex social problems, or for granting licenses and permissions with high social impact, the collaborative design, monitoring and management of public policies/programmes/services, etc. It consists of a set of generic customisable modules-building blocks, in order to provide the required flexibility for supporting the huge variety of G2G collaboration typologies of modern Public Administration. It is based



Legend
gsqr = generalise, specialise, question-replace
soc = supports, objects-to, comments-on

Figure 7. A General Ontology for the domains of Public Sector Collaborative Decision Making and Policy/Programmes/Services Design and Management

on an extension of the classical Workflow Model, which supports both 'Single Person Activities' and 'Collaborative Activities'. In order to support and assist the rapid and low cost configuration and customisation of this Collaborative Environment for any specific collaborative process, in a users-centred and participative manner, process modeling and ontologies have been used.

The above architecture has been implemented and is under evaluation. In particular, a G2G Collaborative Environment named MERMIG was developed, according to this architecture; it includes the modules-building blocks that have been described in Section 4. In Figure 8 we can see a screen of MERMIG, as it has been customized for the pilot of the Ministry of Environment of Lower Saxony (Niedersächsisches Umweltministerium) - Germany. On the right-upper part of the screen there is a list of all the Workgroups available to the user (i.e. of all the Workgroups of which the user is member); also we can see that, from all these Workgroups, the Workgroup 'Petitions' is currently activated. On the upper part of the screen we can see a bar with the services, which are available to the user, as member of the activated Workgroup. These available services are: the Web Manager (it gives access to the 'web-site' of the Workgroup, which consists of web pages and links useful to the members of the Workgroup and should be taken into account by them), the Document Manager, the Group Manager (for defining the members of the Workgroup and their access rights), the Calendar, the Forum (it gives access to Electronic Consultations/Argumentations), the e-Mail, the Search Tool, the Workflow and the Help. We can see that, from all these available services, the Workflow is currently activated. All the remaining part of the screen is named 'Main Contents Section' and contains information about the currently activated service (i.e. Workflow) and also buttons for invoking various relevant actions.

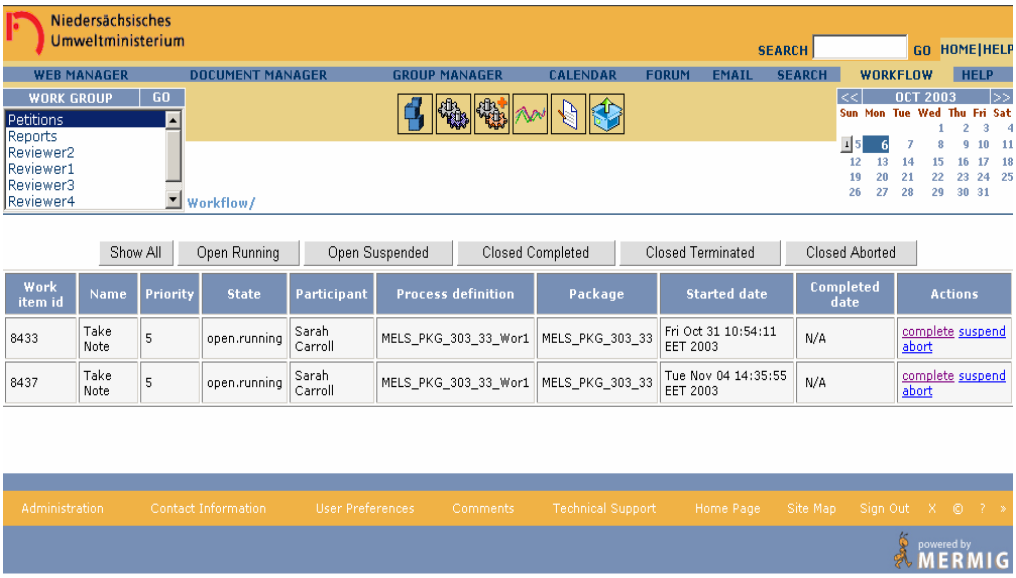


Figure 8. A screen of the MERMIG Collaborative Environment

A basic evaluation of the MERMIG Collaborative Environment has already been made by the partners of the ICTE-PAN Project: 2-3 persons from each partner tested the above services of MERMIG; for each of these services, all its functionalities were tested, as to their correcteness and usability, and also as to their integration. Also MERMIG has been presented to Officers from POs of the four participating countries (Greece, Italy, Denmark and Germany), who were afterwards given access to MERMIG via Internet, in order to test it. Furthermore, in order to test the Collaborative Process Modeling Tool, all the processes of the four pilots of the ICTE-PAN Project (mentioned in Section 3) have been modeled by the corresponding partners. The results of this basic evaluation were positive and encouraging: the functionalities of all services are complete, correct, user-friendly and well-integrated.

However the most important part of the evaluation of the MERMIG Collaborative Environment will be made during the next year in 'real-life' situations, where it will be used for supporting 'real-life' G2G collaborative processes in full production mode, in order to determine its strengths and weaknesses, and also possible needs for modifications, elaboration and extensions of it. Initially we plan to proceed in this direction with the implementation (i.e. via full electronic support) of the four pilots of the ICTE-PAN Project (mentioned in Section 3). A complete Evaluation Plan has already been prepared, which describes in detail the whole evaluation methodology: the evaluation process, the detailed test scenarios, the quality model, and also the evaluation criteria, metrics and questionnaires that will be used. The above Evaluation Plan is based on the international standards series ISO/IEC 14598 (Software Product Evaluation) and ISO/IEC 9126 (Software Product Quality). According to these standards, fourteen (14) evaluation criteria will be used, which are grouped into three (3) categories:

i) Functionality criteria: suitability, accuracy, interoperability, security, functionality compliance to standards and regulations

ii) Reliability criteria: maturity, fault tolerance, recoverability, reliability compliance to standards and regulations

iii) Usability criteria: understandability, learnability, operability, attractiveness, usability compliance to standards and regulations

Taking into account that the MERMIG Collaborative Environment has been developed based on an extensive analysis of user requirements concerning electronic support of G2G collaboration, and also the positive evaluation we had from the users so far, and the extensive Evaluation Plan we are going to follow, we have every reason to believe that it will be a successful product.

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