iGDSS – Software Framework For Group Decision Support Systems

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Abstract

This paper emphasize an innovative approach within the area of Group Decision Support Systems (GDSS) by using tools based on intelligent agents. It introduces a software platform for business process management, electronic decision support and collaboration implemented within a EU co-founded project (FP6-DiFac) and a national one (research of excellence-CEEX)
On a technical level iGDSS focuses on developing a conceptual tool where any third party can contribute with creative ideas for modeling the decision process. It also focuses on designing and developing an innovative method for distributed collaboration, and realizing a working methodology using a software platform for group decision assistance.
On a social level, it refers to incresing the transparency, creativity and democratization of the decision making process by means of selecting the participants to this kind of processes, delocalization and decentralization.

Keywords: Group Decision Support Systems (GDSS), Multi Agent Systems (MAS), anthropocentric interface, decisional tools, decision support system (DSS)

1. Introduction

Modern globalized economy has forced public and private organizations to use ICT not only for increasing the personal productivity of individual employees (traditional approach), but also for enhancing the collaboration among the members of various kinds of teams (both co-located and remote ones) and for increasing their collective effectiveness. Thus, teams are considered as collections of co-located or remote individuals working for a common goal, who must interact extensively in order to achieve this goal (Loukis and Kokolakis, 2003). Value is created in whatever way is appropriate, no longer dictated by organizational relations and boundaries.
The latest trends in distributed and mobile collaboration technologies allow people to move across organizational boundaries and to collaborate with others within/between organizations and communities. The ability to query the company's distributed knowledge base and to cooperate with co-workers is still a requirement, but new paradigms such as Service-oriented computing (e.g. Web Services), increased pervasiveness and mobility enable new scenarios and lead to higher complexity of systems.
Due to their incompleteness, the rigidity of the actual decisional models employed in GDSS has been criticized on a number of grounds (Whitaker, 1992). The main inconvenience refers to the fact that actual GDSS cannot foresee all the steps required for reaching a consensus, nor can support in a flexible way a wide range of group decisions for the latest emerging organizational phenomena (i.e. work group autonomy, responsibility of professional roles, the flattening out and decentralization of organizations (Zamfirescu, Cândea and Luca, 2001). This can harden their use, leading to the users' rejection. Therefore, it is of major importance

for every organization to be able to customize a decisional-making system so as to map its own needs as well the users' ones (employees, middle and top management).

A GDSS is more than just a single informatic product implementing a certain method for assisting group decisions. It is supposed to integrate both the corresponding software modules for the decisional methods and techniques, as well as other general informatic and communication-related components (Filip, 2004).
In order to accomplish the premises stated above, the system refered to within this paper was built as a decision support framework, where besides the already existing tools any third party member can add its own custom-made ones. The framework enhances the decision assisting tools to run within a context made up by entry data, participant members having certain rights and a repository database for storing the results. At the same time, one can also refer this solution as a MAS (Multi Agent System); this paradigm offers a new dimension with respect to GDSS integration with complementary services, making it easier to build complex and flexible architectures suitable to organizational settings. MAS are software systems composed of several autonomous software agents running in a distributed environment (Zamfirescu, Cândea and Luca, 2001). During a decisional process the participants follow a workflow in which they are guided by the multi-agent system based on the path that they choose through that workflow.
Therefore, few of the main units of the currently described platform are the following: intelligent agents, workflow, collaboration, decision making tools, data storage and security.
The remainder of this paper is organized as follows. Section 2 depicts the main characteristics of the framework and the reasons for which it has designed. It is followed by section 3 which gives a glance upon the anthropocentrism of the system. Section 4 presents the idea of an intelligent workflow composed of decisional steps.

2. The Framework

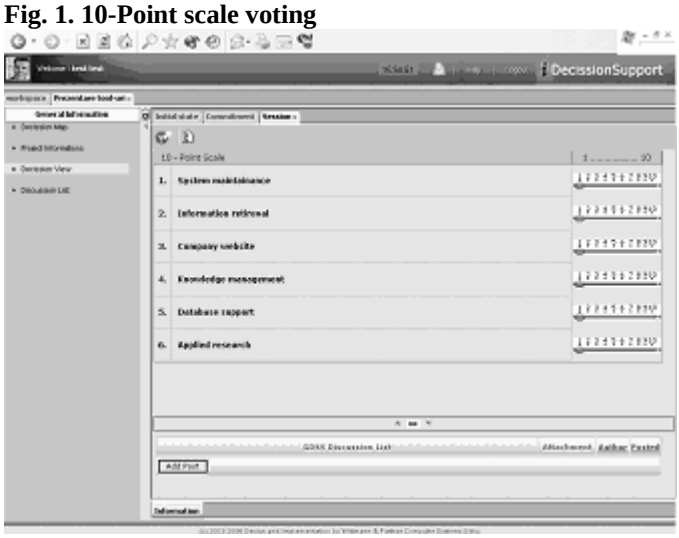
Decision-making is a knowledge-based behavior. iGDSS is designed to be a collaborative decision-making support system with safety, utility, efficiency, effectiveness, and usability. The development of iGDSS is based on the principles of GDSS, interactive software and related development techniques. By taking advantage of abundant information on the Internet, networking and database technologies, iGDSS provides decision-makers: comprehensive information access to internal and external data, communication facility, and friendly interface with multiple-user access. On a higher level, iGDSS focuses on developing a conceptual tool where any third party can contribute with creative ideas for modeling the decision-making processes – "third party" tools.
The main concepts of the framework are: *decisional sessions* or simply *sessions* and *decision assisting tools* or simply *tools*.
Decisional sessions are virtual places through which the decision maker actually participates in the decisional process and basically, they are placeholders for *decision assisting tools.* These *tools* are the pieces of software that support collaborative activities like brainstorming, voting, discussing on certain topics, etc. Thus, decision makers will take part in brainstorming sessions using a brainstorming tool, in voting sessions using a vote tool, and so on.
From the point of view of the decisional process, inside the iGDSS every process is composed of decisional sessions which are well temporaly determinated – including the starting and finishing time as well as the list of participants, the topic and the basic documentation. The session's parameters can be altered by the participant with the necesary

rights as long as it hasn't started yet. After a session is finished, its results can be used as input data for another session. There are a set of rules that have to be respected by all the tools in order to run inside the framework and to be part of a session succession. Section 4 will detail this succession in therms of a workflow.

iGDSS is made up of few initial tools aiming to assist the user in the decision-making process:

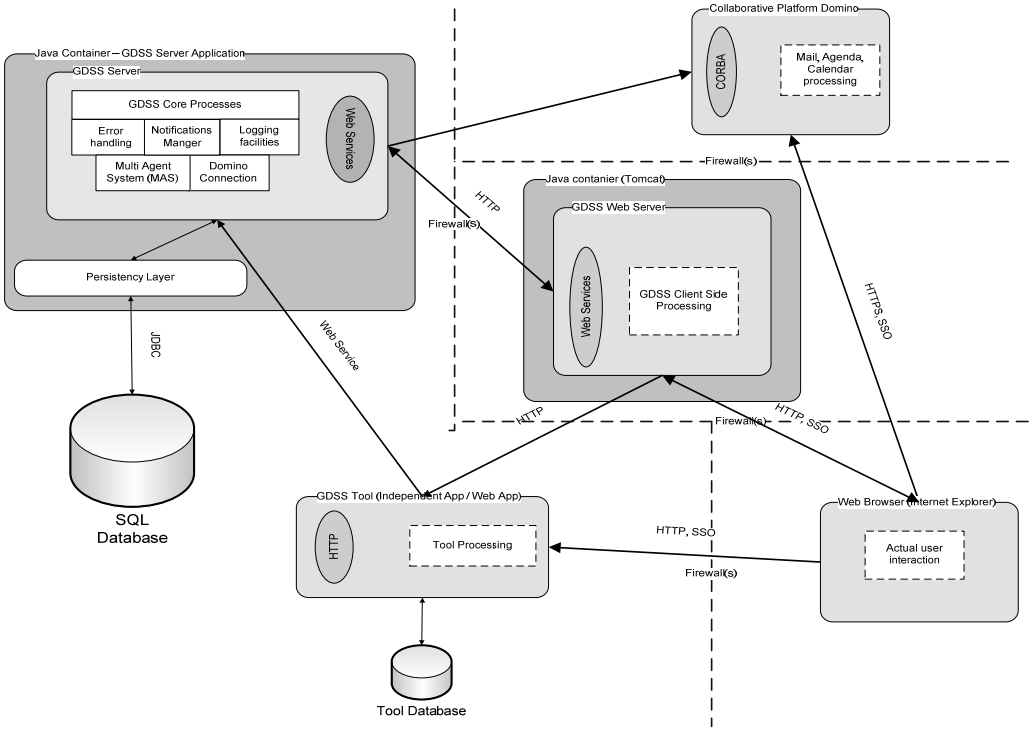
- *Electronic brainstorming* is an idea–generating tool that allows participants to share ideas simultaneously and anonymously on a specific question posed to the group.
- *Categorizer* assists groups in three common group activities: generating lists of ideas, brainstorming comments that elaborate on or support the ideas, and creating categories for the ideas.
- *Group Outliner* help teams generate and / or organize ideas into the familiar hierarchical structure of an outline.
- Topic commenter helps groups comment on a list of topics. Participants can also be given the ability to add topics.
- *Vote* is an evaluation tool capable of providing the basis for a group decision. This tool is also commonly used to determine the degree of group consensus. A vote activity in which users grade different issues with grades on a 1 to 10 scale is shown in Fig. 1.
- *Alternative Analysis* is in many ways similar to vote, but with added power and flexibility. In addition to handling straightforward, single-lists of ballots, this add-in tool allows rating a list of alternatives against a list of criteria.
- *Survey* allows gathering information from a group on any topic at any time.

Fig. 1. 10-Point scale voting



The system was designed and developed so as various decisional processes can easily be implemented without needing any alteration througout the application and can answer the users' requirements and decisional flows. In this way, an open architecture was obtained, which can be integrated with other systems such as a collaborative platform (used for managing the users, user groups, individual or group agenda) or other decisional tools (i.e. ERP finanicial reporting tools.). To facilitate a flexible integration with the collaborative platfrom and with different tools the folowing architecture is proposed. (Fig. 2).

Fig. 2. System's architecture



As depicted in fig. 2. the iGDSS sytems is composed the folowing: a) a main server which supports the basic functions and manages decisional processes logic, b) a relational database (Postgre, MySQL, SQL Server or Oracle) c) the web-server that runs the user interface, d) the collaborative platform (which comunicates with the main server through CORBA) e) the iGDSS tools. The entire solution is build using Java J2EE technology,

The strong side of the framework and it's architecture is the fact that this decision tools can reside on a computer anywere in the world. They do not have to run on the main server. In this way the availability of the whole system is not bound to the availability of any tool. Each tool's results (which are in fact the containg tool's session's results) are stored on the main server so if a certain tool becomes unavailable the system can still use its output. The main reason for choosing this architecure is to enable any third party entity to build it's own customized tool and easily integrate it into the system.

Basically each tool runs inside an iFrame of the main application. It is initiated in a session's context using the tool's specific URL, and afterwards the communication between the tool and the server is done one-way (from the tool to the server) using the webservice that the server exposes for the registred tools. Thus the tool is provided with the entry data and the session participants, enabling at the same time to store the results in XML format. The participants rights during the session are enforced by the server on every results' update.

3. Antropocentrism, E-Acting, Interface

The basic design idea of the product is guided by concepts of Human Computer Interaction and decision support systems. The innovation lays in the way in which the facilitation support is actively assisted by the system based on the users' intentional attitude. Users do not need thorough knowledge about the system in order to use it efficiently. Its goal is to help the decision maker to strongly diminish the effects of its own limits (cognitive, communicative/collaborative, and confidential) and of the enforced restrictions (economic, temporal and implementation) that can be found in the decision elaboration and

implementation. These can be routine limits (the decision maker's tendency to reuse almost the same previously adopted solutions), cognitive limits (one's capacity of storing, processing and creating knowledge and information), economic restrictions (they refer to the costs connected to the employment of decision assistants and external consulting experts and to the coordination and communication within the hierarchical decision team), temporal limits (they refer to the sometimes doubtful quality of some decisions elaborated and adopted under the pressure of the time available for solving some emergency situations or when multiple problems appear simultaneously) (Filip, 2004).

Every independent problem or a certain matter that requires a group of users to take a decision is viewed as a project. It is then divided into decision plans (or a single one) each of them containing one or more decision sessions. As stated in section 2, the participation in the decisional process is done through work sessions, using the tool that supports each session. These are the decision assisting tools mentioned in the previous section and each of them focuses on a specific aspect of group collaboration, such as idea generation, evaluation, organization, exploration.

On a social level iGDSS refers to incresing the transparency, creativity and democratization of the decision making process, means of selecting the participants to this kind of processes, delocalization and decentralization. Therefore, there are three main features that apply to all tools that are already or will be added in the framework:

- *Simultaneous contribution* - meaning that everyone is "speaking" at once, which saves time and increases productivity.
- *Anonymity* - meaning that the identity of each contributor is unknown, so participants tend to feel freer to express their opinions and ideas which are evaluated more objectively.
- *Complete Records* - meaning that at the end of a virtual meeting, there can easily be produced a complete and accurate report of all ideas, comments and vote results in any format. This last task is usually performed by the tool's agent or the tool itself but the user is asked for his' acceptance over the final results.

All these features are considered fundamental characteristics by the framework and are mandatory for the tools' structure.

The system's interface is web-based so users do not need to install a client program in order to use the system. This avoids any inconvenience related to OS incompatibility, network protocol etc, the only necessary thing is to have a computer with a web-browser and connection to the internet. The interface is built using AJAX technology. Most of the time users will attend sessions by selecting URL links received on their e-mail as notifications for any changes or event occurred in a certain work session.

Within a session the participant is met with a help screen which will instruct him if he/she is inexperienced. This help screen is specific for every tool and can be configured by certain users.

Hence, the group is able to appropriate the available technology in their own spirit and not the one imposed by the system designers. This will significantly contribute towards extending the acceptance and understanding of collaborative technology.

4. Inteligent Workflow

In any group decision, the collaborative nature changes as the cooperation moves towards the final outcome and the meeting plan will evolve in time when the group members are able to actively decide the next steps based on the context of the developing action.

In order to accomplish this the framework implements a workflow having decisional sessions as its nodes and uses the Multi Agent System (MAS) to manage them. Because not all actions

belong to a collaborative plan, the workflow and the framework can contain not only group decisions sessions but also individual decisions sessions and simple task sessions. This workflow concept requires that a session's results can be used as input data for another session. Therefore an *iGDSS onlology* is being developed so that each tool/session stores its results in more or less general format and the subsquent session loads them and considers only the fragments that are relevant for it. This fits very well for the default set of tools, mentioned in section 2, because each tool's activity revolves around a list of issues that are discussed upon, voted, categorized etc. If any third party tool has a completly different activity structure (it does not use an item list) and format of storing its results than, in order to be used in a workflow, it must be aware of other tools' result format and provide an set of XSLTs so the server can transform them. In order to easily mantain the system, a XML/XSLT architecture has selected to store and transform the tools' results. If a decisional process has particular aspects in shifting from one session to another, aspects that are not provided by the system, then custom agents can be developed to solve this issues.
The system must adapt to the users requirements and environment evolution (Filip, 2004). Involving methods and tools inspired by the social and behavioral sciences, users have the opportunity to intervene directly in the decisional process, evaluating and learning the consequences of their actions, and improving the practice and knowledge of the group.
The user folows a continous cicle between plan generating (design decizion phases for reaching the common goal) , alternative clasification (posible actions courses' evaluation towards the existing context), plan monitorizing (estimating the new opportunities implicatios as they appear), envolvement, plan development (plan extension and modification) and plan fulfiling (completing the established decision steps). This will encourage a creative use of the system in order to discover new and efficient collaborative models.

5. Implementatin And Future Trends

iGDSS has been developed at Wittmann&Partner Computer Systems and is on process of implementation for public administration and academic areas. In the next period we expect to finish these implementations that suppose decisional tools development, validation with different user groups and for different decisional problems. In academic area iGDSS is used to build a decisional web-portal with propose of supporting the process of elaborating and evaluation of a research work. With this portal all interesting stakeholders of process can collaborate and use the decisional support from idea generation to final work evaluation. One direct usage of this will be implemented to Lucian Blaga University from Sibiu, for diploma work process evaluation.
Within the DiFac (Digital Factory for Human – Oriented Production System, contract no 035079) research project it is being investigated the way that iGDSS can be used as framework for industrial decisional processes - new tools will be developed and new type of processes will be investigated.
In near future we will open for research community our decisional tool architecture and API to develop new and more challenging models. With this we propose iGDSS as a possible framework for testing and future development for a wide range of applications.

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