A MULTIAGENT MODEL FOR GROUP DECISION SUPPORT

George Rigopoulos
John Psarras
Nikos Karadimas
National Technical University of Athens
School of Electrical & Computer Engineering
E-mail: {grigop, john}@epu.ntua.gr, nkaradim@central.ntua.gr

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ABSTRACT

Decisions in today's demanding business environment often require participation of a group of decision makers. Although decision complexity increases by the number of the participating decision makers, in many cases it is necessary to combine experts' knowledge to minimize risk. Banking sector is a domain where decision makers face decision problems and need appropriate methodologies and tools to support them. However, complexity in tools and methodologies directs them to follow less structured methodologies, mostly heuristic based. Considering the above issues, we present our approach towards a Group Decision Support System, which utilizes multiagent modeling and is oriented towards sorting decisions in the financial sector.

INTRODUCTION

Multiagent modeling has received significant attention from researchers due to its potential application to various domains, which seem to be unrelated at first sight. However, they can be modeled using a multiagent model and thus be studied and simulated as a community of interacting agents. Despite the developments in agent modeling, some domains have not benefited so far. Research in decision support systems is such a domain, which targets towards supplying decision makers with appropriate tools to assist them in optimizing their decisions. Since a decision support system has to reflect decision makers' preferences or decision model, building agents who behave like decision makers is not a straightforward process. Moreover, in the case of group decision support, a number of critical issues have to be considered such as individuals' preference modeling, negotiation protocols and coordination.
In this paper we present our approach towards a group decision support system, which utilizes multicriteria analysis and multiagent modeling to support a collaborative team. The main body of the paper is structured in three sections, starting from relevant background information in multicriteria analysis and group decisions, continuing with model overview and presenting some results. A brief introduction and conclusion summarize the main body.

GROUP DECISIONS AND MULTICRITERIA ANALYSIS

Group decision making has become an essential component of both strategic planning and everyday operations for the majority of today's organizations and enterprises. Since complexity of business environment requires sufficient knowledge from a wide range of domains, contribution of a team of experts with key skills is the only way to achieve efficiency in decisions. In order to support groups' needs, various researchers have been working on developing tools and methodologies, ranging from collaboration technologies to decision support systems. Group decisions are more complex compared to single decision making, since a number of contradicting factors are involved such as individuals' personal opinions, goals and stakes resulting in a social procedure, where negotiation and strategy plays a critical role. Despite the inherent complexity, within a group decision making setting, a member is able to express personal opinions and suggest solutions from a personal perspective. In addition, negotiation and voting advance efficiency of decisions and increment acceptability and adoption since all participants contribute to the result, smoothening thus intrabusiness disputes.
Multicriteria analysis can be incorporated as a method to model preferences and facilitate decision making within a group of decision makers. Modeling under a multicriteria setting can be formulated under two major directions. The first can be based on developing individual multicriteria models, which capture individuals' preferences. In the second direction, multicriteria model is developed for the entire team. Each direction poses some positive and negative aspects. For example, in the first case members' opinions are considered individually and aggregated initially, while in the second direction opinions of more powerful members is dominating.

CASE STUDY

Digital retail payments have evolved during the last years mostly due to technology innovations. New actors

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enter the payments market, increase competition and threaten banks' dominance. Customers of payment services are mainly retail consumers, which use payment instruments for their purchases. In most implementations, merchants accept consumer payments and act as the intermediary between the bank and the customer, since they provide access to the customer at the point of sale, whether it is physical (EFT/POS) or through internet (Rigopoulos et al, 2005).

Within this context, a Greek bank wishes to reorganize its EFT/POS retailers' base in appropriate market segments. The objective is twofold, focusing initially to evaluate retailers' performance and profitability, and finally to reorganize current marketing strategy. In brief, each retailer participates in bank's payment network using a portfolio of channels and services. Since the cost of operating such networks, including annual maintenance fees and operational costs, is considerable, only active users or potential active ones are beneficial for the bank. Retailer evaluation is thus a critical decision problem that affects bank's profits from payment channels (Rigopoulos et al, 2006).

Working in collaboration with the bank, we developed a multicriteria methodology for retailer evaluation, which aims to support the bank's decision makers throughout the entire decision process (Rigopoulos et al, 2006).

We focus on cooperative decisions of relative small groups targeting to provide group support for recurrent sorting decisions. The initial implementation is based on the problem of sorting retailers from a bank's customer base. Since the desirable output of the decision process is the classification of retailers to a number of predefined groups according to specific criteria, we developed a multicriteria methodology based on outranking relations to produce the classification result.

In more details, a number of categories were defined representing market segments. A group of bank's experts was formed and semi-structured questionnaires were used to define experts' decision criteria. A list of criteria for retailer evaluation was formed and grouped into financial and non-financial ones including among others: retailer's past years' revenues per transaction type, estimated future revenues, retailer's supporting cost and installation costs, retailer's location suitability, retailer's loyalty and retailer's availability.

For each segment, a number of merchants are selected according to their performance on the criteria representing the minimum threshold for a retailer to be classified to the specific category. Each retailer is evaluated according to its performance on the criteria and classified on the basis of the comparison result between the retailer and each category's threshold merchant.

Since this problem requires continuous classification decisions from a group of decision makers, we attempt to integrate an intelligent module within the Decision Support System in order to facilitate decision making and reduce time and effort. Based on the above context and incorporating previous experience (Rigopoulos et al, 2005, 2006), we propose a framework for combining multicriteria analysis and multiagent modeling.

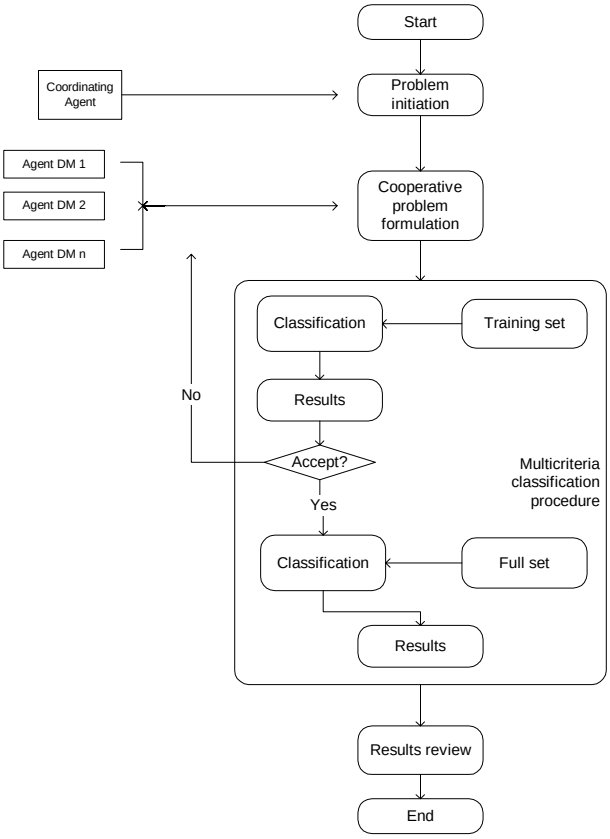

Fig. 1. Model overview

AGENT MODEL

We consider group members as multicriteria decision makers when coming to a classification decision. According to their preferences, they are modeled as intelligent agents and their behavior is formatted according to rules extracted from past decisions and personal preference models. Contributions from experts also refine agents' behavior in order to produce accurate decisions.

Decision makers are modeled as agents and individuals' preferences define agents' behavior. The overall model is under development and the initial implementation prototype is consisted of two major parts (Fig. 1).

- The multicriteria model, which supports group decisions and is actually the core of the decision support system. This is based on a multicriteria classification methodology utilizing outranking relations.
- The agent model, which models decision makers as agents, is based on JADE (Java Agent Development Environment).

JADE is a middleware software framework, based up on peer-to-peer communication architecture, designed to develop distributed multi-agent applications in compliance with the FIPA specifications. It is written

using the Java programming language, exploiting some advanced features such as Java RMI, Java CORBA IDL, Java Serialization, and Java Reflection API. Each JADE agent is identified by a unique name, provides a set of services, and is capable of controlling its own life cycle. JADE also allows each agent to dynamically discover other agents and to communicate with them. In this framework, agents communicate by exchanging asynchronous messages. Each instance of the JADE run-time environment is called a container, in which a set of agents lives. Platform consists of a special container, known as the main container with which other normal containers have to register as soon as they start. Besides this ability, the main container holds the AMS (Agent Management System) agent and the DF (Directory Facilitator) agent. AMS is the authoritative body of the platform which provides the naming service for all the agents residing on that platform.

CONCLUSION

A number of experiments were executed using the existing bank's retailer base. Classification results (Fig. 2,3) from the prototype system were compared with classification deriving from existing decision process with sufficient results. From initial findings multicriteria analysis combined with multi-agent modeling, provides significant results in relevant domains. Moreover, this approach contributes to a better understanding of the individual multicriteria decision making.

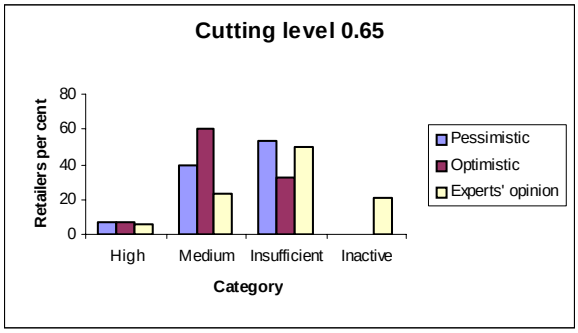

Fig. 2. Results

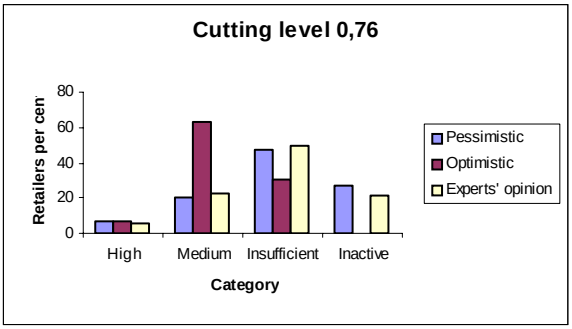

Fig. 3. Results

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AUTHOR BIOGRAPHIES

GEORGE RIGOPOULOS holds a BSc in Physics and an MSc in Decision Sciences with specialization in e-commerce. He is currently a Ph.D candidate in National Technical University of Athens. His research is oriented towards intelligent decision support and multiagent simulation, as well as multicriteria decision making in the business sector. He has wide working experience in IT projects, decision support systems and e-business development. He has also wide teaching experience in IT and e-business related subjects holding a visiting lecturer position in T.E.I. of Athens. His e-mail address is: grigop@epu.ntua.gr.

JOHN PSARRAS is an associate Proffesor at National Technical Universiy of Athens. He is currently supervising the Management and Decision Support Systems Laboratory. His research is oriented towards management, decision support, energy policy analysis, as well as multicriteria decision making in the business sector. He has wide experience in IT projects, decision support systems. He has also wide, international experience in energy policy analysis, national and regional development planning, project management and decision support systems and e-business. His e-mail address is : john@epu.ntua.gr.

NIKOLAOS V. KARADIMAS holds a BSc in Electrical Engineering, a BSc with Honors in Electronic Engineering and an MSc in Computer Science. He has also received an MSc in Distributed and Multimedia Information Systems. Since 2002 he is a Ph.D candidate in National Technical University of Athens. Furthermore, he is teaching Informatics in Hellenic Army Academy, in New York College, in T.E.I. of Chalkida and in Technical NCO Academy, as well. He is a member of the Greek Chamber of Engineers, member of IEEE and member of IEE. His research interests are in the fields of Databases, Optimization Techniques, Geographical Information Systems, Information Retrieval and Multimedia. His e-mail address is: nkaradim@central.ntua.gr.