

IMPROVING TRANSPORT SERVICES ACTIVITY USING A MULTI-AGENT SYSTEM.

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Abstract. *The present paper tries to offer an answer to the following question: how technology can improve the transport service activity (TSA) within some specific areas? In the first part, a description of the TSA role is made within Apuseni mountains area. In the second part, the authors present a multi-agent system based architecture model that aims to improve TSA. The main aspects proposed by the model are: how clients group together by certain common preferences, how the most important preferences may be retrieved, the identification of the agents tasks within the multi-agent system, sequence of the messages communication between agents for obtaining a service packages from the transport company which has the best requirements / prices balance.*

Key words: multi-agent, C2B, data-mining, transport.

1. INTRODUCTION

Within global economy, transport services activity (TSA) is becoming more important every day in the economy because it offers the people possibility to move from one point to another. People mobility depends on many factors like transport service quality, time, whether condition, etc. But, in many cases, the most important factor is the price that the customer has to pay for the service. Many times, for measuring the customer satisfaction, only the price is not enough and that is why the price must be related with the most important criteria for the customer. The problem statement is finding a way that can improve the TSA based on customer requirements for a specific area.

2. THE APUSENI MOUNTAINS AREA – ECONOMIC CONTEXT DESCRIPTION

In Romania has been elaborated the Strategy for the sustainable transport for the period 2007 – 2013, up to 2020, with mission to increase the standards of national system to the European level and for development of a sustainable and efficient transportation system (Rojanschi et al, 2006). The modernization and optimization of the national public and private services transport for passengers represents an aim of strategy. The accessibility of public transportation services within areas with lower population density and with dispersed nucleus, will situate at minimal levels, established with the competent authorities in the 2020 perspective. Increasing the competitiveness of the transport companies, the internal liberalization of this market will be encouraged. Each potential supplier needs to create good traveling conditions for citizens and for tourists, also. The area is extremely attractive because of its natural, ethnographical, cultural potential and resources but these advantages cannot be putted on a good use without a local and strength policy on transport services. In the Table 1 is presented a statistical analysis of the buses number within County Cluj for its main localities.

Year	2004	2005	2006	2007	2008
Number of buses	349	336	331	313	299

Table 1. Buses total number within main localities

3. MODEL ARCHITECTURE BASED ON MULTI-AGENT SYSTEM

3.1 The business model

The business model used in this architecture is C2B. From authors' point of view, this model may take advantage from the internet use and bring together people that are sharing the same expectation from a product/service and hope to obtain a better price. C2B model is not very often used because the cost transaction is high in a normal case (Mogos, 2009). The proposed architecture tries to undertake the cost disadvantage and the difficulty of reunite the clients for obtaining a better offer and choose the best one from a number of transport services companies.

3.2 The collective behavior model for product purchase

The collective behavior and business models made the study subject for other papers like (Fasli, 2007) and (Schneider et al, 2009) The proposed model consists from seven phases: consumer registration, product description, profile discovering using data mining techniques, profile selection, negotiation process (choose the best offer), purchasing and delivering the product (Figure 1). **Consumer registration** – customers must subscribe to a site where personal information is collected. **Product description**– the customer chooses the product/service that he wants to achieve and offer a score to each criteria that he considers of being important for the product/service description. **Profile discovering using data mining techniques**–based on customer personal information and product description a clustering algorithm like Simple K-Means may be used to discover the profile number and their characteristics. **Profile selection** – for every customer profile is created a software agent that will be used to obtain the best offer based on profile characteristics.

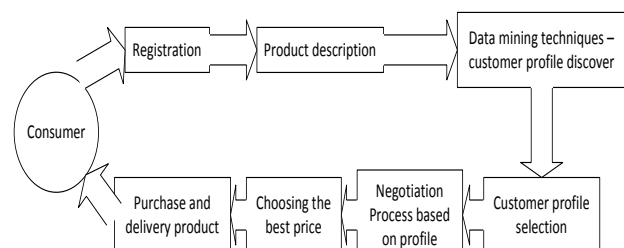


Figure 1. Collective behavior model

Negotiation process – this process will obtain the best offer for each customer profile from all the companies that are participating to negotiation process. **Choose the best offer** –

based on the information send by the companies and customer profile agent the best offer is determined. **Purchasing and delivering product** – after winning company is chosen, the product is purchased and delivered to the customer.

3.3 The multi-agent system

The agent technology is particular important to the proposed model for C2B business model since collective behavior for products/services purchasing by nature has higher transaction and communication costs than normal cases. To realize the model, we develop a multi-agent system framework to support the group purchasing process. In Figure 2 is the overall architecture of the multi-agent system, which consists of the following agents: initiator (AI), negotiator (AN), client agent (CA) and transport agent (TA - that belongs to the transport company). Agents description: **a) IA**: its goal is to transmit to other agents the necessary information for beginning the hole process. Its data source is a database where there are criteria that may used. It information flow is: Database->AI->CA,NA. The messages send: to AC sends – the number of TA, the choice criteria (a parameter list and based on it each AC has to decide); to AN–the number of AC that participates to process, the choice criteria. After transmitting this information, AI will be shut off. **b) CA** – offer the possibility to each customer profile to express his options regarding the criteria. His options are send to AN. From AN receive the auction winner (name and score). After AC receives the final result, it will be shut off. **c) NA** – is the most important agent of the system and is doing the following actions: collects votes from ACs, builds and shows the AHP (Analytic Hierarchy Process) – the method used for structuring the criteria’s importance, builds the offers hierarchy, negotiate with ATs that are not in the first place, will announce the auction winner to all participants (ATs and ACs). **d) transport agent** – receives negotiation demands from AN and respond with a better offer (or not). Also, it receives a notification from AN about auction winner. Interaction mode: the agents may be classified after their interactivity mode. The manual operation (AC and AT): AC because there must be selected the individual options (establish the hierarchy between every two criteria) and in AT for the decision of making a better offer. The second is the automated operation (AI and AN). When the process starts, AI sends the messages and stops. AN collects data, negotiates and transmits the process information to other agents and after that it stops.

3.4 Agent Communication aspect – a case study

Suppose that after data mining techniques were applied, three customers profile where discovered. There are two situations: first, where every customer profile agent is used at a time to obtain a better offer, and the second where all three profiles are used to obtain an offer that pleased all. The scenario is: three customers are trying to obtain a good offer for a transport service. They have to choose between two companies that offer such kind o services. After AN receives the first set of offers from the both companies, it asks the company ranking on the second place to improve its offer. After that, AN announce the auction winner. The actors are: AC1, AC2, AC3, AT1, AT2, AI, AN. Because the simulation was made in Jade, others specific agents also will appear, The communication sequence that results from the second situation is figured in Figure 3.

4. CONCLUSIONS AND FUTURE WORK

Collective behavior (CB) for purchasing products/services is a well-known consumer behavior in traditional business but is quite new to e-commerce market. Also, it is not so spread over the Internet. Furthermore, there is little academic research on its

business model to realize it. In this paper, we try to solve issues theoretically and practically that appear. In the paper first part

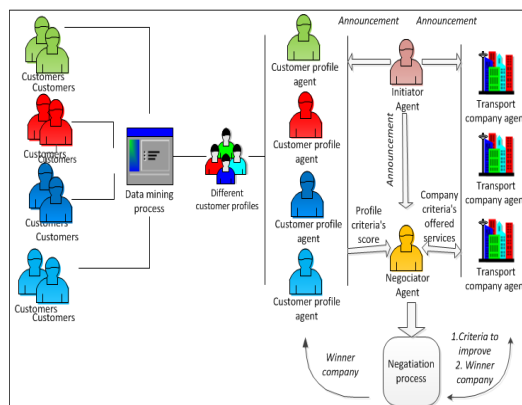


Figure 2. The overall architecture of the multi-agent system

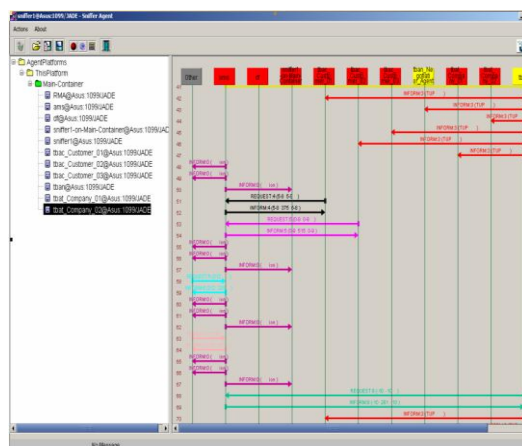


Figure 3. Communication diagram between agents

we described the region that was the starting point to our model and in the second one we defined the BC model and an agent-based architecture for a model that tries to take advantage from the agent technology using a negotiation strategy. For the practical part, we simulate a scenario that may appear in real situations that supports the proposed business model and implement a workable prototype system on Jade platform. By optimizing the mobility aspect for agents more advantages may be taken (Genco, 2007). This paper is just one of the first attempts that tries to promote it to the Internet e-Business and e-Commerce community.

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