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BUSINESS PARTNERS ASSOCIATING PLATFORM BASED ON ARTIFICIAL INTELLIGENCE TOOLS

Abstract: In the article, the conceptual model of artificial intelligence-based platform for business partners matching and associating is presented. Proposed solution is meant to be an alternative to traditional electronic trading B2B model offering automated heuristic approach to knowledge-based business partners selection problem. The key component of the model can be any artificial intelligence tool like genetics algorithm or neural network as it is presented in the paper.

Key words: B2B platforms, business partners selection, neural networks.

1. Introduction

The most important problem in electronic economy is reaching purposes. From here comes a conception of virtual organization that is a temporary network of independent enterprises: organization or physical persons, which are sharing abilities for getting e.g. new markets. The virtual organization is formed on the principle of freedom, without civil-legislative contracts and its components are entering with themselves in different type dynamically changeable connections. So a need for the appropriate selection of business partners grows. Particularly now, when the majority of enterprises are acting in the environment of the information overload, also an unreliable information. Nowadays an effective and non-excess selection is an essential problem. An idea appears to back this process up with intelligent mechanisms, like matching up partners with the use of neural networks which are able to copy general knowledge about process, during learning, or, like genetic algorithms and their consequences, for groups classification or for the optimization of selections. Still universally commercial solutions are not in this area.

2. Analysis of existing applications

Business practitioners are convinced that nothing can replace interpersonal trade contacts, negotiations and, above all, the knowledge of the seasoned expert. There are enterprises for which business partners' selection constitutes the principal area of their professional activity. One of them is EIC – Euro Info Centre[1] (the others are listed in Table 1). Their web sites rarely offer the possibility of direct business contacts by using transaction forms. Most commonly they propose only telephone or postal contact. Organizations and firms that are backed by EU programs support the pairing of business partners (Table 2). Almost every technical or trade portal (e.g. the portal for energy renewable resources: www.synergy-project.org) has catalogues of firms which are involved in specific business activities. However this has nothing to do with the task of business partners' selection [Gajda 2007].

Table 1. Some of professional services dealing with business partner selection

Name of the institution	Links
BRE (Bureau de Raprochement des Entreprises)	www.dirigeant-pme.com
Business Information Cork Euro Info Centre	www.signpost.ie
World Economic Forum	www.weforum.org, www.dgmarket.com
Euro Info Centre – VANS[1]	www.eic.tarr.org.pl
Progress and Business Foundation	www.pbf.pl
Economic Information Centre	www.cig.pl
The Polish Chamber of Commerce	www.kig.pl
Foregin Trade Research Institute, system PARTNER	www.ikchz.warszawa.pl
Foreign Trade Promotion Institute	www.polandexport.pl

Table 2. Organizations that support business partners activities by using supporting EU programs

Name of the institution	Links
ASM – Market Research and Analysis Centre	www.asm-poland.com.pl/
De Ruiter Consultancy BV Holland	www.deruiter-consultancy.com
Commerce Foundation	www.fungo.com.pl
Lower Silesian Chamber of Commerce	www.dig.wroc.pl
Lower Silesian Regional Developing Agency	www.darr.pl
Integration GmbH	www.integration.org
Intercontact	www.intercontact.hu
Ecopol Cosult Germany	www.ecopol.com.pl

In contrast, the development of contemporary IT tools such as database wholesales, digital knowledge repositories, intelligent agents, etc. can support the process of associating business partners and to a large extent make it much easier. Not only

[1] In 2002 about 200 EIC proposals were received monthly in Poland from Wałbrzych, Kalisz, Lublin, Warsaw, Gdańsk, Białystok, Szczecin, Rzeszów, Kielce and Katowice.

can the process be facilitated but it can also be automated, accelerated and enhanced utilizing the availability of global access to information and knowledge via the Internet.

Electronic Exchange Pools, Web Auctions and services facilitating searches for business collaboration have been in operation for several years (XTrade, MarketPlanet). However the existing systems of electronic markets are based on simple models of associating and extracting data and defining features.

Enterprises which are interested in commercial cooperation can be sought via the Internet in a number of ways. The most popular are the database offers of enterprises where a portfolio of their area of activity and their willingness to cooperate is presented according to a breakdown of industries, regions, countries or continents where they operate. Access to these databases, often for a fee, is available to private individuals, enterprises and public organizations. These are vertical or horizontal portals, i.e. information databases supported by search engines that present a list of potential candidates for cooperation when the searcher inputs basic criteria such as the country, industry, commodity, etc. Searched offers are sometimes inaccurate, as they often turn out to be old, lacking details of the range of cooperation as well as the date of the last update of their databases. As a result, the interested entity may only obtain an address, name of the enterprise, brief activity description and a web site link.

Table 3. Services and offers databases with search engines for cognizable cooperators

Name of the institution	Links
Polish Agency for Enterprise Development	www.parp.gov.pl
UE Market Access Database for Commerce with Third Countries	http://mkaccdb.eu.int
Euro Info Centre – VANS	www.eic.tarr.org.pl
Database of Enterprises Portfolios from Łodz Region	www.businesslodz.com
Delivers Database for Commerce with NZ	www.ungm.org
Search engine for branches and enterprises	www.export-import.pl/
Worldbid International Trade Leads Import-Export B2B Marketplace	www.worldbid.com
Corporate Information	www.corporateinformation.com
Open Contact search engine	www.opencontact.com
Efekt – Enterprises' database	http://efekt.pcm.com.pl
Proodle – information database for B2B	www.hbi.pl
Yellow Pages	www.yellowpages.pl
Enterprises' Central Registration	www.crf.pl
Polish-Ukrainian Chamber of Commerce	www.chamber.pl

The web sites of institutions such as the Polish Agency for Enterprise Development (PARP) contain links to foreign and national organizations providing access to data on business cooperation offers (available in German, English, Hungarian, Romanian versions). Simultaneously each such site enables the submission of individu-

al offers through Internet interactive forms, online, or offline by fax (for e.g. WebBusiness or the German-Business services), though sometimes this is provided at a fee.

As an example, in order to register one's offer with the UNGM database (the UN suppliers database) the following sections have to be filled in:

- enterprise address;
- postal address;
- phone number and/ or fax;
- financial status during the last 3 years;
- bank details;
- activity and industry description (also the legal status and number of employees);
- detailed information about the company, i.e. information on current divisions, branches and subsidiaries abroad (non obligatory);
- information on currently held certificates (non obligatory);
- data regarding the export volume within the last three years, and, optionally, data regarding agreements with UN organizational units as well as information regarding any disputes that might have occurred while dealing with them within this period;
- information regarding membership in any trade or business organization (non-obligatory);
- the name of at least one of the UN agencies listed above, which would constitute a potential recipient of the goods or services provided by the company;
- additional information required by the chosen agency;
- codes of the goods or services offered by the company in accordance with UN code regulations.

This registration enables the registering entity to take part in the public tendering for suppliers seeking contracts with organizations linked with the UN.

In another project, named e-NVISION [e-NVISION 2007], which is being developed by the R&D international consortium in FP6 EU, more sophisticated data, useful for business partners' cooperation, is required[2] (e-nvision is still under construction).

Summarizing, the institutions and Internet services described do not provide useful tools for automated, self-operated and intelligent business partners search and selection processes. There is a need for electronic B2B model development and the application of intelligent systems whose goal is to fully automate or at the very least to greatly enhance the identification of shared features and interests within the marketplace of business partners selection. Such a tool should draw upon an updated and wide database with a high level of data specificity about enterprises from around the world and their offers for cooperation. It should also use professional intelligence mechanisms for selecting partners not only based on basic data such as industry or product, but also localization, language of communication, mobility, output poten-

[2] Repository of remoting services for B2B model.

tial, etc. A very important aspect of data integrity and security is the ability to protect data, especially data connected with business history, turnover volume, liabilities, revenues etc.

3. Conceptual model of intelligent platform

A platform is internally oriented on handling of business partners selection process, externally however, according to SOA technology it is focused on integration and cooperation with other repositories and data resources.

It is dedicated for those managers who are looking for new partners – suppliers of raw materials, products and services. It should be widely and continuously (non-stop) available, therefore it will be placed in the Internet and available for registered users. It will consist of:

– companies database,
– intelligent module, that is activated after any data change,
– searching module,
– interface which enables user to register, access company data base, to modify their own and company data, retrieving and saving results of searching.

All user activities will be saved in the log book. User registration is a prerequisite for using a platform. Data from the form filled by the user on a website will be saved to companies and users database. Of course after logging user is allowed to modify own data and data of the company. Finally he could even delete his company from data base and close his account as a registered user. After series of data base modifications learning module is started. It can be activated automatically or by a system administrator, at the certain time or after reaching appropriate volume of data changes. Therefore the system should be equipped with some tools of capturing changes made at the data base. The main task of learning module is updating the system knowledge.

User is an initiator of selecting business partners process. Searching module is based on current knowledge of the system. The more data about the companies contains repository, the more time it takes the algorithm to select appropriate partners.

After some period of time a user is able to check the status of the process and choose, if the process is finished, the way of presentation of its results. It is assumed that apart from displaying on the screen, the searching results can be printed, send to e-mail or saved in pdf format file.

The user is not obliged to cooperate with suggested partners, but if he accepts the proposal then after at least few months he will be able to evaluate the selection. A special form will be available at the website. Such evaluation is very precious for learning module. Figure 1 presents functionality of the system by UML Use Case Diagram.

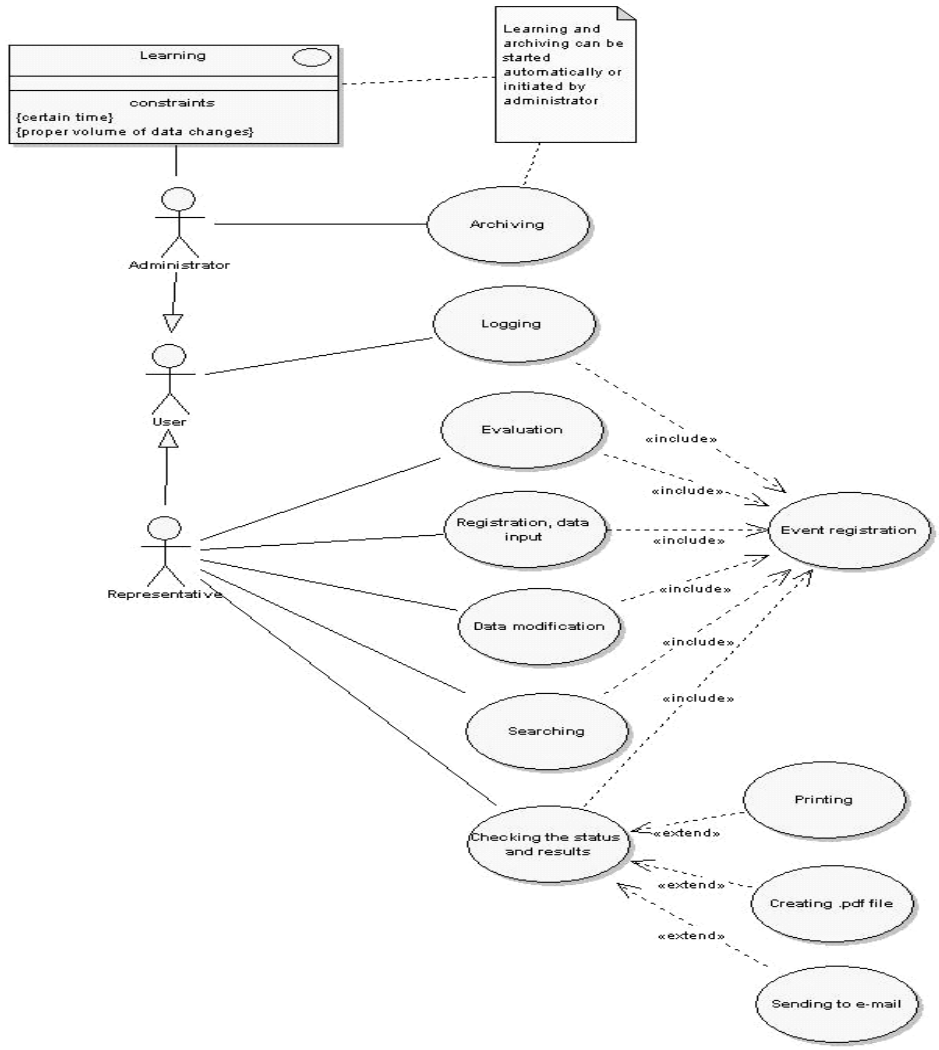

Fig. 1. The Use Case Diagram presenting functionality of a Platform for Intelligent Business Partners

As far as data base is concerned, it will consist following information about enterprises:

– company code,
– trade (branch),
– type of business (final products, services, semi-products etc.),
– town,
– country,
– branch offices and their localization,

– number of employees,
– number of contractors,
– detailed information about three the biggest contractors,
– number of customers,
– number of strategic customers,
– detailed information about the biggest three customers,
– communication language,
– year of establishment,
– structure of employment (education),
– number of cars,
– production level,
– annual profit (last year),
– average profit for last five years,
– turnover.

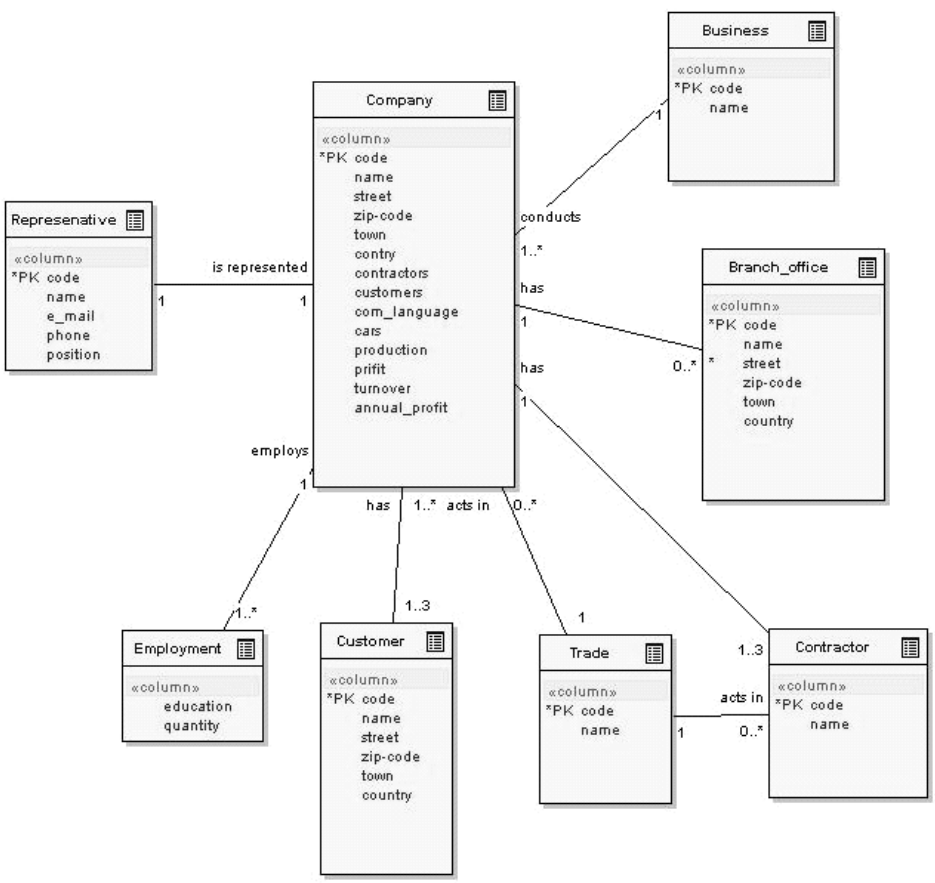

Fig. 2. Data model of a Platform for Intelligent Business Partners Selection

Data model is presented on Fig. 2. It is assumed that representative of the company is also the user of the platform. Table that contains data about representative is necessary for access control. It has no meaning for process of selecting business partners.

It will be very difficult task to complete all mentioned data. During tests the set consists of data about very famous firms, available in economy publications or in the Internet. In further research for data gathering questionnaire surveys will be carried out or the autonomous Internet agents will be used. It is assumed that intelligent modules will not always exploit all fields of records. Therefore one of the future tasks of the platform will be analysis which ones from originally chosen features are really essential.

4. Artificial intelligence tool

For project purposes, neural network [Hertz et al. 1991] based module was developed to solve the problem of seeking partners match. System input data consist of set of multi-component vectors that represent subjects being search as a match. Each of vector component corresponds to the feature characterizing the company. The simplest way of finding the match is to use the supervised trained neural network using back-propagation algorithm [Hertz et al. 1991]. In such case, the network input vector should consist of two vector components $\mathbf{x}'$ and $\mathbf{x}''$ representing two companies. Continuous network output quantity represents the level of matching regarding the ability to cooperate (Fig. 3). Level of matching is meant to be understood as a probability **p** that two subjects can cooperate as business partners. For such data representation, training set must consist of input vector pairs describing companies and set of corresponding values determining that cooperation was fixed (probability equal to 1) or not (probability equal to 0).

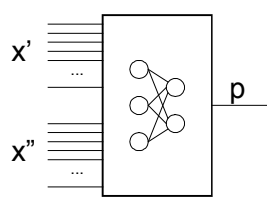

Fig. 3. Neural network with input vector divided into subcomponents

Due to relatively high order of input data space, training process is able to provide satisfying results only in case when the number of training vectors is large. In most cases, fulfilling this condition might be very difficult. Though the data representing situation in which cooperation is not fixed can be artificially generated, but such training data will be unbalanced and characterized by gravity center excessively moved to the one of the sides, what must lead to undesirable effect of attenuating

the vectors representing matched partners during the learning process. Another disadvantage of using multidimensional input spaces and large networks is very slow and unstable teaching process.

The solution of the problem is dividing learning input vector components into groups representing features which are functionally related and using separated neural network to learn each group respectively (Fig. 4). Such grouping must be done the way to make each of group to be responsible for arbitrary chosen search criteria. For example company localization can be combined with its mobility and contract realization time. Such approach improves stability of learning process and can also significantly decrease overall process time by using more advanced quasi-Newton training methods such as Lavenberg-Marquardt [Hagan, Menhaj 1995] that turns out to be very efficient for moderate-sized networks. The method of grouping allows also to stress some chosen matching criteria search and limit partnership investigation to chosen categories.

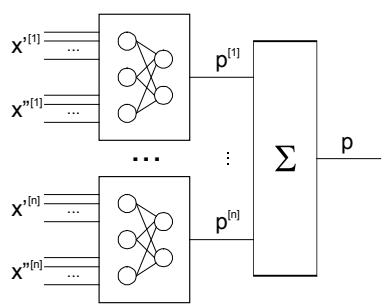

Fig. 4. Neural system consisted of separate networks responsible for feature group each

Having more than one network evaluated probability of cooperation results in sets of values representing partial probability related to each group. To obtain single answer, arithmetic average can be applied to the networks outputs, or weighed average what allows to favor chosen feature groups (Fig. 4). In such case, single neuron can be used with weights fixed to stiff values or weights calculated on the basis of training process that determines the significance of each group.

4.1. Learning process

Learning process is performed using training set that consists of following patterns:

– input vectors representing pairs of partners that were known to be involved in business cooperation, expected network output – 1,
– input vectors representing pairs of partners that tried to cooperate and did not succeed, expected network output – 0.

Preliminary simulation results showed that the number of training vectors corresponding to unsuccessful cooperation attempts should be approximately twice as big as vectors corresponding to opposite situation. When the following criteria cannot be fulfilled, additional data must be generated artificially in way to evenly cover input data space.

4.2. Operational phase

During the work phase, the set of input data vectors is formed using data of company that seeks the partner and all other companies in database. Presenting each combination to the network results in set of probabilities that points out the best match for a given company.

Partner searching process can be excessively time consuming if the size of company's database is very large. It is possible to limit the number of neural network queries by preliminary grouping of companies into exclusive clusters. Each cluster should contain companies that are potential market competitors, what makes the probability of cooperation very low. The criteria of grouping can be fixed arbitrary or determined on the basis of heuristic paradigm using for example non-supervised neural network. For such purpose Winner-Takes-All or vector quantization (LVQ) networks can be used [Kohonen 2001]. Especially LVQ network, that consists of competitive and linear neuron layers, offers efficient and flexible approach due to its ability to group complex, non-convex clusters in multidimensional input space. Each of the companies added to the database should be analyzed and assigned as a member to one of predefined clusters (during the network adapting process). In work phase, when probability of cooperation is determined, only companies that do not belong to the same cluster should be considered as potential partners what can significantly decrease the number of system queries. If there is no match outside the cluster, the search criteria must be extended to the same cluster the company belongs to.

5. Conclusions

The realization of the described project will not be a simple task mainly on account of the problem in collecting the planned database. The size of the training set, its quality and completeness will have influence on accuracy of decisions taken in the future. The analysis which ones from originally chosen features are really essential and whether the another important factor was not omitted, will also be one of future tasks of the project.

At present very advanced specialist computer tools supporting different decision-making processes are launched. As it noticed, there are no commercial platforms of automatic and self-service seeking business partners, in which artificial intelligence methods are being used of. And so the described project of the intelligent platform has the chance to fill a market gap of the business software.

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