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EFFICIENCY INCREASE OF REAL ESTATE E-BUSINESS SYSTEMS BY APPLYING MULTIPLE CRITERIA DECISION SUPPORT SYSTEMS

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Abstract. One of the major problems in e-business is to find what you want. The number of alternative products and services on the Internet are in the thousands. How can customers find the rational products and services on the Internet? Once product or service information is found, the customer usually wants to compare alternatives. There are five types of aids to comparison shopping: search on hypertext files by agents, search alternatives on databases, alternative search and tabular comparison, comparison of alternative products and services from multiple malls, search and multiple criteria decision making. The multiple criteria decision making methods and multiple criteria decision support systems are used in this type of e-business comparison shopping. This article is indented to provide how the application of multiple criteria decision support system as developed by authors would increase the efficiency of the e-business of a real estate. The developed by authors Real Estate E-Business System allows performance of functions as follows: search of real estate, finding out of alternatives and making of comparative tables, alternatives multiple criteria analysis (determination of market value, value in use, investment value; multiple criteria analysis of alternatives and selection of most efficient ones, etc.), the after-purchase evaluation.

Keywords: e-business, real estate, multiple criteria decision support systems.

1. INTRODUCTION

With the aim of correctly understanding the role of the e-business and its development prospects, it is necessary to investigate the main environmental factors influencing its existence. Various economic, legal, social, technological and political factors force the traditional business one way or another to transform into e-business. Connected to different changes such as the increased qualifications of the workforce, minimisation of state regulation, reduction of state subsidies, the increased importance of ethic and legal issues, tough competition, global economy, regional trade agreements, cheaper manpower in certain countries, frequent and significant changes within the markets, the increased power of consumers, accelerated moral depreciation of technologies, the increased importance of innovations and modern technologies, it has become necessary to create e-business.

The Internet, information technologies, e-business are being developed rapidly in well-developed countries globally, especially in the United States of America. The huge amount of information is being gathered and knowledge bases are being formed, based on the highly-skilled specialists who are

selling their experience and knowledge through the Internet at a relatively low price. There are a lot of various Internet services on offer such as travel and tourism services, employment placement and the job market, real estate, trading stock online, cyberbanking and personal finance, auctions, online publishing, knowledge dissemination, etc.

Many e-business systems are seeking to find out how to make the most economic decisions, and most of all these decisions are intended only for economic objectives. Alternatives under evaluation have to be evaluated not only from the economic position, but take into consideration qualitative, technical and other characteristics as well. For example, an analysis of real estate is usually performed by taking into account economic, quality such as architectural, aesthetic, comfort, infrastructure, technical, legal, technological, social and other factors. Alternative solutions allow for a more rational and realistic assessment of economic, technical conditions and traditions and for more satisfaction of different customer requirements. The Internet and information technologies application also enables to cut down on project costs.

Competition within different fields of the e-business is becoming stronger and stronger, and involves more and more business people. In order to survive in such tough competition conditions, it is necessary to make every effort and aim at creating and offering something better than your competitors. For example, enhancement of the quality of services and reduction of prices, expansion of markets, flexibility in responding to fluctuations of the demand and supply in the market, extension of the range of commodities and services, strengthening of relations with the manufactures and suppliers of necessary commodities and services, seeking for greater confidence of consumers must be included. This would allow the e-business to satisfy the needs of potential consumers and increase the number of the loyal and regular clients.

2. E-BUSINESS AND COMPARISON SHOPPING

E-business describes the processes of buying and selling of products, services and information, servicing customers, collaborating with business partners, conducting business transactions via the Internet. For example, consumers' shopping activities, on the Internet, can be analysed through the processes of: initial requirement determination, search and comparison of alternative products or services, placing orders, paying bills, deliver items, inspecting quality, and after-sale service support.

Many systems of electronic business are processing and submitting only economic information for decisions, and applying economic models. Alternatives under consideration have to be evaluated not only from the economic position, but take into consideration qualitative, technical and other characteristics. For example, the analysis of real estate is usually being performed by taking into account economic, quality (architectural, aesthetic, comfort), infrastructure, technical, legal, technological, social and other factors. Therefore, the efficiency of e-business may be increased by applying multiple criteria decision support systems.

One of the major problems in e-business is to find what you want. The number of alternative products and services on the Internet are in the thousands. How can customers find the rational products and services on the Internet? Once product or service information is found, the customer usually wants to compare alternatives. There are five types of aids to comparison shopping:
1. Search on hypertext files by agents. Agents can find alternatives with relating information (list prices, and other characteristics), seller's address, and search for minimally priced products.
2. Search alternatives on databases. Many electronic catalogues built using a Dynamic Web-based Database Management system exist today. The software agents are computer programs that help users to conduct routine tasks, search and retrieve information, support decision making, and act as domain experts without human intervention. Software agents can find products and make direct comparisons between products from the database.
3. Alternative search and tabular comparison. Alternatives can be found and carry out tabular multiple criteria comparisons.
4. Comparison of alternative products and services from multiple malls.

5. Search and multiple criteria decision making. The multiple criteria decision making methods and multiple criteria decision support systems are used in this type of e-business comparison shopping.

3. A BRIEF REVIEW OF REAL ESTATE E-BUSINESS SYSTEMS

Today there are a great number of directories, and e-business systems, worldwide, related to real estate: such as www.ired.com, www.cyber-homes.com, www.comspace.com, www.assist2sell.com, www.eloan.com; www.iown.com, www.homescout.com; http://realestate.yahoo.com, www.mapquest.com, http://realestate.yahoo.com, www.datatrac.net, www.realtor.com, www.replace.com, www.bankrate.com, www.eloan.com, www.quickenmortgage.com, www.rent.net, www.arcsystems. com, ASHI, Countrywide, CyberHomes, Digital City, DoItYourself.com, GetSmart, Home Advisor, Homebuyer's Fair.

These systems provide information and partially the following services: purchase, sale and lease of real estate; various consultations and information about purchase, sale and lease of real estate; detailed information on loans; help in searching for, reviewing and comparing alternative creditors, consolidation of debts, insurance services; settling down in a new place; advice of experienced buyers, sellers and leaseholders to inexperienced "rookies"; selection of dwelling-places or rehabilitation facilities such as sanatoriums, rehabilitation centres, old people's homes; acquisition, lease or leasing of pieces of furniture, audio and video equipment and other household items; information about the possibility of moving to a new place of residence; various searches and enquiries such as search real estate on lease on the basis of submitted information, search for a roommate; real estate and facilities management services; various advertisements; educational and instructional information.

A brief description of some of the services and information provided are as follows.

The real estate advertisements provide textual and video information, photographs, plans and maps of a locality. The systems provide potential buyers or leaseholders with the possibility of making a virtual visit to the selected real estate object. There is also information available for the purpose of becoming better acquainted with the analysed object and its surroundings. For example, with the aim of receiving additional information about settling in to a new place, the potential buyer or leaseholder may ask for possibilities of employment, furniture leasing, schools, kindergartens, and polyclinics.

After analysing the provided information, and with the purpose of clarifying certain issues, potential buyers or leaseholders may directly contact the real estate agent or the system employees by e-mail and receive the required information. With the aim of ensuring that the user's information is the latest, advertisements, and notices, are constantly updated.

Systems allow the users to compare loan options offered by different financial institutions. The systems provide conditions for analysing alternative loans during their life cycle and co-ordinate objectives both of the creditor and borrower with the aim of obtaining acceptable loan solutions for both parties.

There are also possibilities to settle accounts via the Internet.

Provision of information about insurance services such as title, hazard, liability, theft, partnership life, and insurance is made. The possibility of becoming acquainted with different types of insurance offered is provided. Explanatory comments about the necessity of the insurance, a description of its constituent parts and the insurance contract's procedure, are also given.

The possibility of becoming acquainted with the information provided by experienced buyers or leaseholders such as the period of time fixed for buying or leasing a flat or house, the fastest and cheapest way of carrying out repairs, basic rules to be learned by a lessor, comparative analysis of the purchase and lease, legal issues, insurance are available on the Internet.

Provision of information about the real estate buying (motives for buying a new flat or house, addresses of real estate agencies, and subsidised loans) and selling (addresses of real estate agencies, information about dependence of the market value of real estate on the status of neighbours, location

of the object, its exterior and condition, infrastructure, air contamination, and prestigious district) issues are provided on the Internet.

Advice and information about lease and planning of the real estate as well as moving and adaptation to a new place of residence, the most efficient way to lease the real estate are found via the Internet. About neighbours in a new place, how to take out a loan, preparations for moving to a new place, arrangements for removing furniture and other items, transport, and related taxes, removal vans and providing transportation services such as furniture, and cars, information about safe and secure furniture transportation, how to lease or purchase furniture, various household appliances, articles of art, how to protect or insure the leased real estate, how to adjust oneself to a new place and find a job may be found via the Internet. Also information is provided about qualification enhancement courses, how to take care of children in a new place such as schools, kindergartens, and other facilities, shopping facilities, leisure-time spending and entertainment opportunities, climate and other information are all available via the Internet.

Provision of various space management services. Systems provide information about various forms of space management: space organisation, workplace analysis, and removals; inventory compilation/updating e.g. space compilation/updating, stock compilation/updating, systems compilation/updating, room log compilation/updating, and disposition/space reserves; central services e.g. building security service, cleaning, snow-clearing service, upkeep of outdoor facilities, garden care, plant care in the building, pest control.

Provision of various technical management services. Systems provide information about various forms of technical management: maintenance, inspection, repair, equipment, emergency service e.g. gas, water, wastewater, heating, water heating, ventilation, cooling, electrical systems; lightning protection, lifts, conveyor and warehousing systems, automatic door and gate, security; central and building control, communication, cable and network, laundry and dry-cleaning systems, general building equipment, other equipment and systems; technical operations management e.g. house technician/caretaker, 24-h service and stand-by service, operation of the technical systems and centres, central control systems energy management .

Information about how to spend one's leisure-time. For example, a lot of information is available about cultural activities taking place in the neighbourhood, e.g. sport facilities, gardening opportunities, and work about the house e.g. facilities and work tools, planning of house repair works, maintenance of lawns and gardens, acquisition of instruments for out-of-door work, purchasing of plants and garden decorations; as well as for the renovation of the interiors is available. Information may be found about surrounding shops and available services, acquainted with prices of commodities and services and ordering them. For example, after entering the name of a certain item or service, the display will provide a list of the required items of services.

The direct presentation of real estate on a Web page does not provide the possibility for quick updating of provided information and hampers the search for the required information. Currently, information is most often stored in some database, e.g. Oracle, and when necessary it can be retrieved from the database and transferred onto a Web page. The storage of information in the database provides the possibility of presenting the data on various Web pages or compact disks and also to issue printed catalogues.

Very often the e-business systems process the received information statistically and present it in a generalised form. These statistical figures are required, for obtaining a general picture by categories of consumers and, if necessary, by efficiently responding to new trends developed within the real estate market.

4. ANALYSIS OF THE PROPOSED REAL ESTATE E-BUSINESS SYSTEM

4.1. Practical capabilities of the Real Estate E-Business System

Following the mentioned and other ideas the authors have developed Real Estate E-Business (REEB) System. Proposed REEB System can create value in next important ways: help customers

assess their needs, identify suitable real estate to fulfil needs, compare and evaluate real estate, help customers evaluate the usefulness of the real estate in the after-purchase evaluation stage. In sum, proposed REEB System create greater convenience and better choices for buyers in the purchase process.

At present moment the developed REEB System allows performance of functions as follows:

1. Search of real estate. A consumer may perform a search of alternatives from databases of different brokers. It is possible since the forms of data submission are standardized in a specific level. Such standardization creates the conditions to use the special intelligent agents performing search of the required real estate in various databases, and gathering information about them.

2. Finding out of alternatives and making of comparative tables. Consumers specify requirements and constraints and the system queries the information of a specific real estate from a number of online brokers. The system performs the tedious, time-consuming, and repetitive tasks of searching databases, retrieving and filtering information, and delivering it back to the user. Results of search of a specific real estate are submitted in tables, which may include direct links to a Web page of a brokers. By submission such a display, the multiple criteria comparisons can become more effectively supported.

3. Alternatives multiple criteria analysis stage. While going through the purchasing decision process a customer must examine a large number of alternatives, each of which is surrounded by considerable amount of information (economic, quality (architectural, aesthetic, comfort), infrastructure, technical, legal, technological, and other factors). Following on the gathered information the multiple criteria analysis are being caried out. Capabilities to use the Real Estate E-Business System in alternatives multiple criteria analysis stage are:

?? Real estate valuation from various aspects (i.e. determination of market value, value in use, and investment value).

?? Multiple criteria analysis of alternatives and selection of most efficient ones.

?? Valuation of factors affecting the value of real estate (for example, valuation of real estate location, real estate and depreciation).

4. The after-purchase evaluation stage. A consumer evaluates the usefulness of the real estate in the after-purchase evaluation stage.

As an example, solving the problem of determining the market value which include the highest price estimated in terms of money which the real estate would bring if exposed for sale in the open market, with reasonable time allowed in which to find a purchaser, buying with knowledge of all of the uses and purposes to which it was adapted and for which it was capable of being used of a real estate being valuated that would make it equally competitive on the market in comparison with the real estate already sold, a module of defining the utility degree and market value of a real estate was created. This was based on a complex analysis of all benefits and drawbacks of the considered real estate. In order to demonstrate the application of the above module and database, farmer's homestead estates were considered below, as a sample. Solving the problem of determining the market value of a farmstead a_1 being valuated, which would make it equally competitive on the market compared with the farmstead a_2 and farmstead a_3 already sold, a particular module and database of defining the utility degree and market value of a farmstead were created. The study was based on a complex analysis of all the benefits and drawbacks of the farmsteads considered. According to this module, the real estate utility degree and the market value of a real estate being estimated are directly proportional to the system of the criteria, adequately describing them and the values and significance of these criteria.

4.2. Database

Presentation of information in commercial real estate, dwellings, farmer's homestead estates and other types of real estate Web pages may be in conceptual (digital, textual, graphical, photographic, video) and quantitative forms. Quantitative information presented involves criteria systems and subsystems, units of measurement, values and initial significance fully defining the variants provided. Quantitative information of real estate is submitted in the form of grouped decision making matrix,

where the columns mean *n* real estate under valuation, and rows include quantitative information. Conceptual information means a conceptual description of the real estate, the criteria and ways of determining their values and significance. Conceptual information is needed to make more complete and accurate valuation of the real estate considered. In this way, the system enables the decision maker to receive various conceptual and quantitative information on real estate from a database and a model-base allowing him/her to analyze the above factors and form an efficient solution.

A database was developed providing a multiple criteria analysis of real estate from economical, legislative, infrastructure, social, qualitative (architectural, aesthetic, comfort), technical, technological and other perspectives. This information is provided in a user-oriented way. To design the structure of a database and perform its completion, storage, editing, navigation, searching, and browsing, a database management system was used. Real Estate E-Business System can use a number of interested parties (appraisers, vendors, brokers, real estate agents, investors, various organisations, enterprises, banks, other financial institutions and other creditors, insurance companies, buyers, courts, local authorities, state and their respective institutions) pursuing their specific needs as well as having different financial situations, educational levels and experiences.

The system of criteria is determined and the values and initial significance of criteria are calculated by experts. All this information can be corrected by interested parties, taking into consideration their goals and existing capabilities. The users striving to express his/her attitude towards these issues numerically may ascribe various significance values to them, which eventually will affect the general estimation of a real estate. Though this assessment may seem biased and even quite subjective, the solution finally made may exactly meet the requirements, aims and affordability of the user.

4.3. Model-base

Since the analysis of real estate is usually performed by taking into account economic, quality, technical, legal, social and other factors, a model-base should include models which enable will a decision maker to carry out a comprehensive analysis of the variants available and make a proper choice. The following methods developed by authors (models) are aimed at performing the next functions:

?? A method and model for criteria significance establishment. A new method of complex determination of the significance of the criteria, taking into account their quantitative and qualitative characteristics was developed. This method allows calculation and co-ordination of the significance of quantitative and qualitative criteria according to the above characteristics.

?? A method and model for multiple criteria analysis and setting priorities. A new method of multiple criteria complex proportional evaluation of the real estate, enabling the user to obtain a reduced criterion determining complex (overall) efficiency of the real estate was suggested. This general criterion is directly proportional to the relative effect of the values and significance of the criteria considered of real estate's efficiency.

?? A method and model for the determination of real estate utility degree and market value. In order to find the price that will make a value real estate competitive on the market, a method of determining the utility degree and market value of real estate based on the complex analysis of all their benefits and drawbacks was suggested. According to this method the real estate utility degree and the market value of a real estate being estimated, are directly proportional to the system of the criteria, adequately describing them and the values and significance of criteria.

According to the user's needs, various models may be provided by a model-base management system. When a certain model (i.e. determining the initial significance of the criteria) is used the results of the calculations obtained become the initial data for other models (i.e. a model for multiple criteria analysis and setting the priorities). Results of the latter, in turn, may be taken as the initial data for other models (i.e. determining real estate utility degree, determining real estate market value) without human interference.

A management system of the model base provides the user with a model base allowing him/her to modify the models available, eliminating those which are no longer needed and adding some new models linked with the existing ones.

In order to check the accuracy of the suggested system, the whole of its solution process has been more than once checked manually. The results of manual and computer calculations must match. All separate working stages of the system as well as all complex calculations have been co-ordinated with experts in this field - i.e. the essence of the calculations has been found to be in conformity with their logical reasoning. Owing to suggestions from these experts, useful changes have been introduced into the system. Checking by the experts is bound to the fact that universal decision making methods are not always suitable for specific tasks and can lead to gross errors or to bad results.

5. CONCLUSIONS

The suggested system is a better online system to others, because the intelligent agents here compared a number of alternatives and different parameters. By applying this Real Estate E-Business System it is possible to obtain quantitative and conceptual information that describes real estate from various aspects. The more alternatives investigated the greater the possibility to achieve a more rational end result. Strong and weak sides of investigated alternatives are given in the analysis. Facts of why and by what degree one version is better than another are also established. All this is done basing oneself on conceptual and quantitative information. For example, following such information and with the assistance of the Real Estate E-Business System, the user is able to perform the following: real estate valuation in different aspects e.g. determination of market value, value in use, investment value, the valuation of special factors affecting value of real estate (for example, valuation of real estate location, and real estate depreciation) and the multiple criteria analysis of alternatives and selection of most efficient ones.

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