CroSE - Information management agent for Croatian capital markets

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Abstract: – Increased dynamics of the business environment and financial system represent an additional challenge to the firms in the financial sector. In order to gain competitive advantages financial services firms in Croatia implement business intelligence solutions that improve the quality of business information used in decision-making. These business intelligence solutions can be made more efficient and accurate if financial data published over the Internet is used.

This paper presents a tool for acquisition of financial information about transactions on both stock markets in Croatia over the Internet based on agent technology paradigm. This tool enables financial service firms to improve their quality of service and profitability through improved timeliness and flow of financial information used for investment decisions and projections of financial trends in both Croatian capital markets.

The information management agent for Croatian capital markets, CroSE, is implemented in a brokerage firm and the impact on the performance of the firm is discussed.

Key-Words: – Software agents, Information extraction, Business intelligence, Capital market

1 Introduction

The widespread use of information technology generates tremendous amounts of data within a company's business environment. Some of this data contains information that has the potential to significantly improve the performance of the firm in a dynamic environment. Financial services firms introduce various business intelligence (BI) system tools in order to provide the access of all business users in the firm to this information. These tools can provide quantifiable benefits such as reduced costs and increase revenues. The introduction of intangible benefits like improved communication throughout the company and improved job satisfaction of the empowered users can also be achieved [10]. All these benefits of BI strategies can help a financial service company gain additional advantage over the competition.

Data acquisition and data preparation tasks must assure consistency and timeliness of information in order to make optimal use of implemented BI tools. These tasks can be preformed autonomously for a given purpose (such as financial data acquisition and preparation) through indirect manipulation [11].

In this paper a software agent systems is developed in order to present the approach of autonomous information extraction and preparation. The system can autonomously access the Croatian financial data publicly available on the web sources, validate it and store it in a database of the BI system. First, a brief overview of the Croatian financial markets and data they generate is given in the Section 2. Also information extraction methods that can be used for acquisition of this information are discusses. Then a short introduction to software agents that can automate described information extraction methods is given in Section 3. The resulting agent model, referred to as CroSE agent and its functionalities, are presented in Section 4. Finally, in the Sections 5 and 6 implementation of the developed system in a brokerage firm is described and the impact on the firm's performance results are discussed.

2 Internet publishing and information extraction

2.1 Croatian capital market and financial information

Since its establishment Croatian capital market was underdeveloped and had limited significance in the financial system due to the low volume of transactions. After overcoming the banking crisis that began in 1998, the banking sector was restructured by

opening up the financial system to the foreign capital[4]. In 2002 inflow of foreign capital resulted in increased volume of transactions on the capital markets thus encouraging development of financial institutions and forming steady secondary markets for bonds and securities.

Central points of generating financial data are the securities exchanges. Information about market activities is statistically captured using official market indexes. In the rest of this section a brief background on both Croatian securities exchanges will be given as well as short description of the official market indexes.

Zagreb Stock Exchange
First stock exchange in Croatia was incorporated in Zagreb in 1991 as a joint-stock company with 25 commercial banks and 2 insurance companies. The Zagreb Stock Exchange (ZSE) is the central point of securities trading in Croatia since its founding.

CROBEX is the official Zagreb Stock Exchange share index. It measures the market capitalization of share trading on daily basis. CROBEX is capitalization weighted index with base value 1000 on July 1, 1997. The index is calculated and published since September 1, 1997.
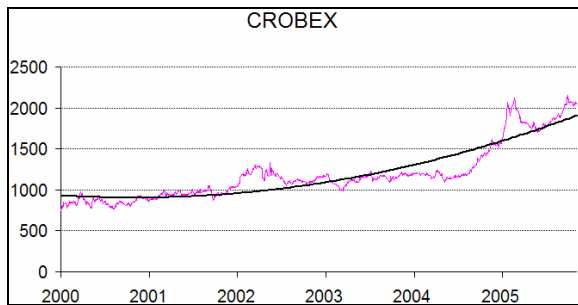
Source: Zagreb Stock Exchange Data - www.zse.hr
Figure 1. CROBEX index during 2000-2005

Index is calculated using closing prices of 23 ordinary company shares that have to meet several criteria (as described on www.zse.hr). Figure 1 shows that the index value is rising as a result of higher volume of share trading on the market and a continuous increase in retail investor's interest since the end of 2002 when the last banking crises was successfully resolved.

CROBIS is the official Zagreb Stock Exchange bond index. It is price index weighted by market capitalization with the base value of 100 established on September 30, 2002. CROBIS index is currently

constituted of 10 bonds that meet several criteria (as described on www.zse.hr).

Varazdin Stock Exchange
The predecessor to the Varazdin Stock Exchange was the Varazdin OTC Market which was founded in 1993. The OTC Market initiative was inaugurated by a group of 23 stakeholders attempting to accommodate the privatization processes of state-owned companies. After Croatian Privatization Fund issued first securities, need for higher liquidity in the resale of securities acquired by the new stockholders emerged. These securities could not be enlisted in the Zagreb Stock exchange quotations as most of these securities did not meet the required criteria. The Varazdin OTC Market provided the stockholders with the requisite infrastructure for the transparent trading of securities. It was an organized market that allowed insight in competitive bid and ask offers combined with formal disclosure of market prices.

Due to afore mentioned positive changes in Croatian financial system in 2002 the Varazdin OTC Market was restructured and transformed into the Varazdin Stock Exchange with several different quotations including the First Quotation that included the best securities listed on the market.

VIN is the official index of the Varazdin Stock Exchange. It is price index weighted by market capitalization based on the Laspeyers Index model. Its base value is 1000 points established on October 1st, 1997. VIN index is currently constituted of 13 shares that meet several criteria for inclusion (as described on www.vse.hr)
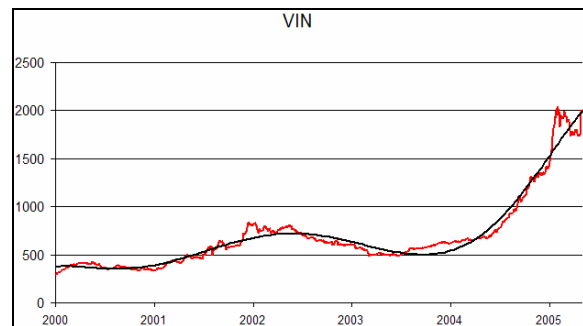
Source: Varazdin Stock Exchange Data - www.vse.hr
Figure 2. VIN index 2000 – 2005

2.2 Financial data publishing in electronic media
The data about closing prices of securities and the value of the market indexes is crucial for decision making in a brokerage firm. Most of the brokerage

firms receive this information from both of the stock exchanges in a format that requires additional transformation of the received data in order to include it into their BI analysis. Both of securities exchanges in Croatia make their financial information available through several different media and specialized services.

ZSE makes all of the trading information available online on the official web site. The information is available to the general public with a minimum time delay of 15 minutes. Market members can receive up-to-date information using a special information system MOSTich for a fee. Investors can also receive information on closing prices and indexes by e-mail on the following day.

Trading information on the VSE is available online in the form of periodical reports on the VSE official web site after the closing of the market. Unlike ZSE there is no information on current prices available during the working hours of the market. This type of information is available only to the market members for a fee.

Trading information is also available through intermediaries such as financial news web sites, and daily electronic press (such as www.poslovni.hr).

Most of the relevant trading data is available on-line in a condensed form through periodical reports and summaries which are not suitable for BI analysis. This data requires a thorough preparation to convert it into form suitable for further analysis within the information system of a particular brokerage firm.

Final pricing data and market indexes are formed after closing of the securities markets, so the publication of the data is done after the brokerage firms close. The analysis of the new information is prepared on the following day and the first results are known at even later time in the day.

Some of the firms try to implement solutions to shorten the time needed to obtain and prepare the financial information from markets in order to place their orders on the market before their competitors. This can be achieved by autonomous information extraction from the official web sites of security exchanges.

2.3 Financial information extraction

The information contained in the daily reports is most suitable for information extraction. This raw data is

published in HTML documents that form a time series of historical data. These documents are dynamically generated using online database and HTML template, so the content of the document is highly structured and therefore suitable for automated information extraction.

All the relevant information is given in the form of tables that are encompassed by the <TABLE> tags in the HTML syntax. This allows extraction of the relevant tables from the HTML source automatically. Scheme in Figure 3 illustrates extraction of 4 tables from the string representing a HTML source. Each table can be given an identification number in order to facilitate the manipulation.
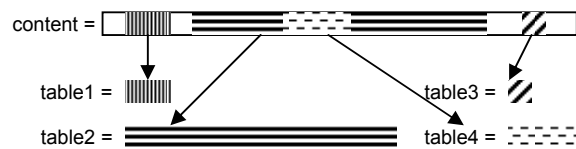

Figure 3. A scheme of the extraction of tables from the HTML source string.

After all of the tables are extracted from the source string, each cell in a table can be accessed row by row. The content of cells can then be validated and stored in a database that is structured for the purpose of data analysis.

All of these processes can be automated by using software agents specialized for tasks in information management.

3 Agent technology and applications

3.1 Software agents

The general definition of software agents points out two key attributes agent have: autonomy of their actions and capability to act on behalf of someone or something. Having these two characteristics common to all agents in mind, software agent can be defined as a computer program capable of independent (autonomous) action on behalf of its user or owner [13].

There are several dimensions to classify existing software agents. Agents may be classified by their mobility, i.e. by their ability to move around a network. This yields the classes of static or mobile agents. Agents can also be classed as either deliberative or reactive. Deliberative agents derive

from the deliberative thinking paradigm which holds that agents possess an internal symbolic reasoning model, and they engage in planning and negotiation with other agents in order to achieve their goals. Reactive do not have any internal symbolic models of their environment, and they act using a stimulus/response type of behavior by responding to the present state of the environment in which they are embedded [12].

Agents may also be classified along several attributes which ideally they should exhibit. Nwana & Ndumu [12] have identified a minimal list of three such attributes: autonomy, learning and cooperation. According to the extent of presence of these characteristics there are seven categories of agents [2]: collaborative agents, interface agents, mobile agents, information/Internet agents, reactive agents, hybrid agents and smart agents.

3.2 Information agents and applications
A specific group of software agents are agents used for information management. These information agents are mostly used to reduce the information overload in their working environments. Currently, most of information agents reside on servers and are used for Internet information tasks such as web search, information filtering, information retrieval, notification and information services[9].

There is a number of information agents developed and implemented in various application areas like personal information management ([11][3]), web information management ([9][5]), entertainment ([3][13]), groupware ([3][2]), e-business ([13][7]), and others.

4 CroSE Agent functionalities
For the purpose of this paper a smart information agent was developed. This agent can retrieve the information form web resources containing updated information on recent transactions on the Zagreb Stock Exchange and Varazdin Stock Exchange autonomously. The agent also ensures consistency of the extracted information, stores it in a local database prepared for further statistical analysis. It also offers notifications if critical information is observed in the process. The resulting system is referred to as the CroSE Agent, a static software agent system used for continuous monitoring of information on both official stock exchange web sites.

CroSE agent is loaded in a local computer with a permanent Internet access. When the changes in information published on the web sites are detected the pages are processed using wrapper induction [8]. Wrappers are predefined procedures designed for information extraction from a specific web resource. Wrapper contains information about locations of required information in tables within the HTML source. The acquired information is verified and stored in the local database (Figure 4).
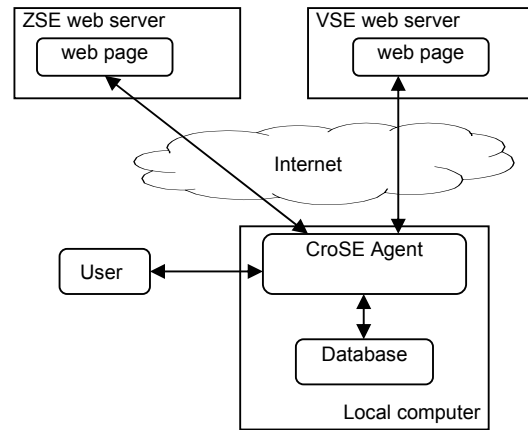

Figure 4. Model of the CroSE agent and its working environment

In order to complete the described functions there are three groups of activities agent can perform: activities for web resource access, data management activities and business intelligence activities.

4.1 Activities for access to the web resource
There are different types of organization of the web pages on the web source. If a web resource is a part of the surface web [1] there is a collection of web pages that do not necessarily have the same structure. If a web resource is a part of the deep web [1] there is a class of web pages that are dynamically generated using the same template. The template ensures the consistent organization of web content in all of the pages of a specific class.

The official web sites of both Croatian securities markets are organized as a class of dynamic web pages where each web page can be accessed using indexing system based on the date of the required report (Figure 5).

a)

http://www.zse.hr/dailyreport_quotelist.php?date=2005-05-30

b)

http://www.vse.hr/reports/daily.asp?dan=30&mjesec=5&godina=2005

Figure 5. Indexing system of the daily report for May 30th, 2005. of a) ZSE and b) VSE.

If the indexing parameters are known to the agent it can use it to browse through all of the historical data available on the web resource and retrieve it as needed.

4.2 Data management activities

After the required page is accessed the agent uses the information from the wrappers to access the tables in the web page and extract information. Some of the information agent is able to extract from the VSE daily report is given in Table 1.

information	table	column
date of the report	1	1
VIN index	2	1
VIN change	2	2
ticker	3	1
% price change	3	3
max price	3	6
min price	3	7
last price	3	8
volume	3	11
buy	3	12
sell	3	13

Table 1. Information on data location in the VSE report contained in the wrapper procedure

The information is verified in order to check for possible errors in the published information. If there are no errors data is stored in a local database. If errors are detected, user is notified. If the error is known to the system (such as wrong data type) data is converted and then stored.

4.3 Business intelligence activities

When the data is stored in a local database, agent can generate simple reports, or export data in another format (such as Excel table).

Agent is content aware so the options displayed for reporting will be available only for the time periods present in the records and the securities that have been traded during selected time frames (Figure 6).
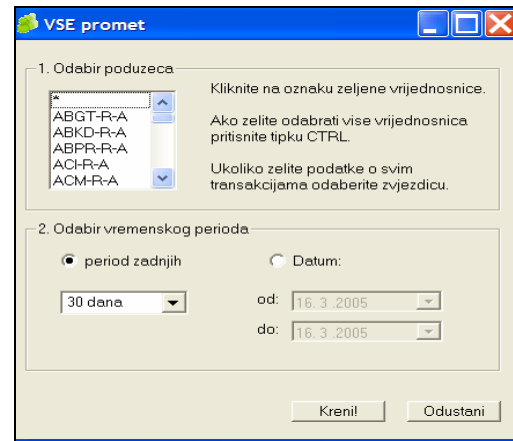

Figure 6. A dialog window for generating reports about selected securities (1) for a certain time period (2).

Agent can also notify the user if prices of certain securities reach a predefined value.

5 Discussion

Management of a brokerage firm AAA estimated that by automating processes of financial data preparation they would be enabled to compete on the securities markets more successfully. The users used the information published on the web sites through direct manipulation. This required extensive interaction of the users with the information system of the firm. The introduced autonomous system was meant to reduce the workload for the users in tasks of data preparation through indirect manipulation.

The CroSE agent system was implemented in May 2005 in brokerage firm AAA. The agent was active 24 hours a day. The reports generated by the agent were structured as the ones management was familiar with before introduction of the CroSE system.

During the one year period agent was able to retrieve all of the financial information as soon as it become available on the web resources, after the working hours were over. Analysis of the data was conducted before the markets opened on the following day, so the brokers of the firm were able to place their ask and bid prices based on latest information. Business processes were shorten and more efficient. Some of the firm's resources were released and made available for more complex business activities.

This enabled firm AAA to become one of most successful brokerage firms in Croatia by their share

in total transactions on ZSE and their share in transactions on VSE.

Firm AAA was reducing the total volume of transactions on the ZSE in period from 2002-2004. In 2005 the firm was ranked first by the volume of transactions of stocks. The increase of activities in the market is higher than the average (show on the Figure 1 by the CROBEX index), which proves that the performance of decision making and management of information was improved after the CroSE agent was introduced.

Year	Rank	Total volume of transactions in Kn[*]	Share of the market volume
2003	3	111.191.268,01	7,90%
2004	11	88.826.749,45	3,27%
2005	9	188.032.453,40	4,19%

Table 2. Performance of brokerage firm AAA on the VSE from 2003 to 2005.

The share in transactions on the VSE was also below average (if compared with the VIN index in Figure 2) until CroSE was introduced. This was the direct result of entrance of competitive firms on the market that started offering on-line services during 2003. The firm AAA changed their trend in 2005 after introduction of CroSE agent (as shown in Table 2).

6 Conclusion

This paper describes a software agent developed for extraction of information about financial transactions and market indexes on both of Croatian stock exchanges. Even though Croatian capital market includes only two security exchanges, and the financial system is still underdeveloped both of the security exchanges publish their financial information on official web sites. These web sites are a valuable resource for the purpose of automating information acquisition and preparation processes for the purpose of business intelligence and decision making. CroSE, a smart software agent system, is developed in order to autonomously monitor information changes on both web resources, and extract new financial data. The information contained in this data is verified and converted into a local database used in further analytical processes in a brokerage firm. The information system of the brokerage firm can produce internal financial reports faster, allowing the management to make their decisions on managing

their portfolio more efficient. The brokerage firm that implemented the CroSE agent proved over a 3 year period that they were able to react to the changes in the markets better than their competitors achieving better performance results.

References:
[1] Bergman MK. The Deep web: Surfacing hidden value. The Jorunal of Electronic Publishing On Line, vol. 7 (1). University of Michigan, 2001.
[2] Bradshaw JM. Software Agents. Menlo Park: AAAI Press/MIT Press, 1997.
[3] Brenner W, Zarnekow R, Wittig H. Intelligent Software Agents. Berlin: Springer-Verlag, 1998.
[4] Croatia Debt Market Assessment, Deloitte Touche Tohmatsu Emergin Markets, Ltd., May 2003.
[5] Crowder R, Hughes G, Hall W. An Agent Based Approach To Finding Expertise In The Engineering Design Environment. Proceedings of the International Conference On Engineering Design ICED03. Stockholm: August 19-21, 2003.
[6] Capital Market in the Republic of Croatia, Croatian Chamber of Economy: Banking and Finance Department, Zagreb, July 2005.
[7] Dignum F, Cortés U. Agent-Mediated Electronic Commerce III. LNCS-2003, Berlin: Springer-Verlag, 2003.
[8] Eikvil L. Information Extraction from World Wide Web: a Survey. Report No. 495, Norwegian Computer Center, 1999.
[9] Etzioni O, Weld DS. Intelligent agents on the Internet: facts, fiction and forecast. IEEE Expert 1995; 10(4), 44-49.
[10] Liautad B, Hammond M. e-Business intelligence: turning information into knowledge into profit. New York: McGraw-Hill, 2001.
[11] Maes, P. Agents that Reduce Work and Information Overload. Communications of the ACM 1994; 37 (7), 31-40.
[12] Nwana H, Ndumu D. An Introduction to Agent Technology. BT Technology Journal 1996; 14(4): 55-67.
[13] Wooldridge M. An Introduction to Multy-Agent Systems. London: Wiley & Sons, 2002.

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[*] Kn – Kuna is the official monetary unit in Croatia