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USAGE OF INFORMATION TECHNOLOGY AND DATA WAREHOUSES IN LARGER SLOVENIAN AND CROATIAN COMPANIES: A COMPARISON

Mojca Indihar Štemberger, Jurij Jaklič

University of Ljubljana, Faculty of Economics, Ljubljana
E-mail: mojca.stemberger@uni-lj.si, jurij.jaklic@uni-lj.si

Katarina Ćurko

University of Zagreb, Faculty of Economics, Zagreb
E-mail: katapur@efzg.hr

The modern information technologies (IT) facilitate new ways of enabling better business decisions and thus improving management. Usage of IT and the development of decision support systems, based on a data warehouse, have an important role in achieving better effects within management and decision-making.

At Faculty of Economics in Ljubljana, Institute for Business Informatics, and at the Faculty of Economics in Zagreb, Department of Business Computing, they have investigated the state of an information system in organizations, the usage of information technology (IT) and a data warehouse concept. The present study was conducted using a questionnaire survey that was given to the IT managers. Questions about Internet technologies and business process reengineering were also included in the research, but that part is not the objective of this paper.

In this paper the results concerning information technology usage and the data warehouse concept in large Slovenian and Croatian companies are presented. The results of the research in Slovenia and Croatia are compared. The goal of this study is to identify the similarities and differences between two countries involved in transition processes.

Keywords: information system (IS), transactional system, data warehouse (DW), larger companies, questionnaire.

1. INTRODUCTION

Companies are becoming increasingly aware that information is an important strategic resource and provides a vehicle for achieving a more competitive position in the marketplace. Managers have always used information to perform their tasks, but the novel thing here is the ability to obtain accurate and real information easily.

In the beginning, the only job for a computer was data processing. Then the computer was recognized as a tool that could produce data and information for managers. This is known as the management information system (MIS). MIS is the development and use of effective information systems in organizations [6]. The management information system is a computer-based system that makes information available to users who have similar needs [7]. Usually, it is based on the on-line

transaction processing (OLTP), the legacy system (operational databases), and to produce data (and information) to support the day-to-day operations and control. The modern information system includes a contemporary information technology environment, which means: client/server architecture, network computing, a modern database system with development tools, a sophisticated approach to IS development, a high level of cooperation with the end users, etc.

However, such information system has proved to be insufficient for high quality analysis, strategic and tactical planning and decision-making. The legacy system stores detailed data about every business process, so they are large and can't be searched in real time. Furthermore, it covers only the current data during short-time periods. If we want to explore a longer time period, the problem of large databases becomes even more critical. In addition, a complex query on such a large database would last for several hours, and also any transaction processing would have been slowed down by an unacceptable amount. And finally, the visual form of the query result is not suited to the end user's needs. It is a two-dimensional report with dozens of pages, and it is in fact selected data reprints from a database. The solution is a concept known as a data warehouse - a new generation of computer based information systems used for even higher levels of decision making.

The data warehouse is a new generation of decision support system. The data warehouse provides access to corporate data, and this is not just data, but is also a set of tools to query, analyze and present information [5]. It isolates processes for generating information – informational processing (i.e., reports, screens, extractions, aggregations, analysis, etc.) from operational processing [4]. Informational processing and operational processing are naturally totally different. Requests for information are constantly changing, because of changes in the organization of the firm, the business conditions, management, their goals, etc. A data warehouse, by using techniques of knowledge discovery, assures a constant discovery of new information needed for the newly developed conditions, without an additional burden for the operational levels of the system. A separation of the transactional system from the decision support system by establishing a data warehouse prevents operational databases from being overloaded with complicated queries; this improves their operational efficiency. Huge amounts of data, which are mostly archives, are eliminated from the operational databases and are moved to the data warehouse. Although the information system is now composed of two parts – a legacy system and a data warehouse, it becomes more efficient.

Data warehousing is the process of collecting and managing data from different sources. Data is aggregated, detailed, extracted and improved in order to support the analysis and decision process. A data warehouse is completely different from a transactional system in its contents and technical requirements, although it is based on the transactional system (operational database). The data warehouse could be understood as being an interface that divides the operational processing from the applications in order to support the decision making process [9]. Internal and external sources may be used to fill the data warehouse with data. The share of external data is usually greater for the higher levels of decision-making.

This paper is structured as follows. Following an introductory discussion on the information technology and the data warehouse, in Chapter 2 the main highlights concerning the methodology for the research are presented. The information technology and computer based information systems in Slovenian and Croatian companies are analyzed and compared in Chapter 3. In Chapter 4 a comparison between the data warehouse in Slovenian and Croatian companies is presented. The main conclusions are pointed out in the Chapter 5.

2. THE METHODOLOGY USED FOR THE RESEARCH

Data for the research was collected using a survey based on a questionnaire. The questionnaire included questions about two key areas: the company information system and the data warehouse. The data warehouse, as a new information technology, can be developed only if a computer based information system exists in the firm because the data warehouse gathers the internal data from it.

The research carried out on the data warehouse concept included: the adoption of DW technology, the time and expenses related to the DW projects, how successful the data warehouse is, the data sources for a DW, the management level that use the data warehouse, and the key tools used in the data warehouse development. Because of the nature of the questionnaire, the majority of the respondents were information technology department managers.

In Croatia the research was conducted on a sample of 100 large companies in the period February 1 - March 15, 1999. How companies were selected was based on their revenues and the proportion of assets and capital they actually possess. The main source of data in the "the biggest" Croatian companies was the special issue of Privredni Vjesnik [8], and this includes every industry except banking. Only 35 companies refused to cooperate because the time of the research was inappropriate for them. In this case, other companies where selected from the list of the "400 biggest" companies in Croatia.

In Slovenia the research was conducted from May 1 to June 30, 1999. The sample was not limited to large companies only. Companies were selected from all over Slovenia, and the sample reflects the geographical structure of the companies. More than 150 completed questionnaires were received from companies of different sizes and from many different kinds of industries. For comparison purposes, some of the questionnaires from small and medium sized-companies (Slovenian law [10] was used here) and banks were removed from the sample. And because of this 81 companies were left in the sample and were under further examination.

Slovenian and Croatian methodologies were compared and analyzed [1] in accordance with 4 factors: the proportion of samples, the criteria for company selection (i.e. the number of employees and the amount of theirs revenue), the distribution of companies according to the industry type and the level of transition.

The number of companies that were examined in Slovenia seemed to be smaller than those in Croatian. But when you actually look at it relatively, they were larger, this in accordance with the population of Slovenia. It should be pointed out that Croatia had about 4.4 million inhabitants in 1999, while Slovenia had 2 million.

The size of the selected companies was analyzed according to the number of employees and based on Slovenian law [10]. Although the number of employees was not on the criteria for the selection of Croatian companies, about two thirds (74%) of the selected companies were large companies, according to this criteria (i.e. having more then 250 employees). 18% of those companies that were selected were medium-sized companies (with between 51 and 250 employees), while only 8% of them were small companies.

The large companies in Slovenia were selected according to the number of employees they had their revenues for 1998. About 60% (49) of the selected companies in Slovenia met both these criteria: they had more then 250 employees and their revenue was over 4 million USD. Other companies (40%) met only one of the two selected criteria: the number of employees or their revenue. All of the Croatian companies met the second Slovenian criterion because none of the companies had a revenue lower then 4 million USD. Even 74% of those Croatian companies that were examined met the first Slovenian criterion because they had more than 250 employees. The other Croatian companies (26%) met only the second criteria. The distribution of companies according to their revenues is shown in Figure 1.

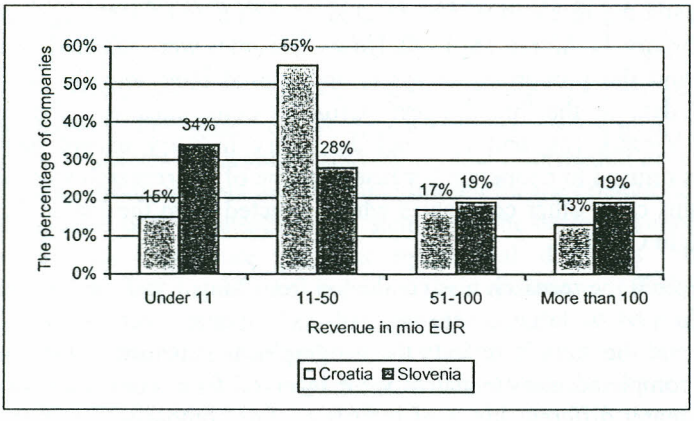

Figure 1. The distribution of companies according to their revenues

Croatian and Slovenian samples differ mostly when we look at the third criteria: the percentage of companies that operate in a certain industry. The percentage of companies is almost the same for some industry types (Table 1). Business entities have been classified into different industry types according to the Croatian National Classification of Economic Activities and that is based on the European Classification of Economic Activities NACE Rev. 1 and this is obligatory for all EU member-states [2].

Table 1. The companies that were exam med and the type of industries they were involved in

Industry type	Percentage	
	Croatia	Slovenia
A Agriculture, hunting and forestry	2%	0%
B Fishing	0%	0%
C Mining and quarrying	1%	0%
D Manufacturing	29%	34%
E Electricity, gas and water supply	5%	4%
F Construction	6%	3%
G Wholesale and retail trade	33%	17%
H Hotels and restaurants	4%	4%
I Transport, storage and communication	12%	4%
J Financial intermediation	1%	15%
K Real estate, renting and business activities	7%	5%
O Other community, social and personal service activities	0%	15%

The analysis of the companies according to the level of transition showed that there were no significant differences between the Croatian and Slovenian sample [1].

The results of the analysis showed that the Croatian and Slovenian companies that were examined could be compared because they were very similar according to other three criteria, and the type of industry could not have any major influence on further research results.

The questionnaires used in both countries were the same.

3. COMPARISON OF THE IT STATE

A modern computer based information system should be integral, and this means that all business functions should be computer supported and they should be integrated. According to the results of the questionnaire, 99% of the Croatian companies and all of examined Slovenian companies that were examined have a business information system. Almost 74% of the Croatian and 68% of the Slovenian companies have integral information system, which means that all the business functions are computer supported and integrated. The most frequent computer supported business functions are analyzed for the companies that do not have an integral information system. The majority of examinees pointed out the following functions: selling, purchasing, marketing, finance, inventory, production, accounting and personnel.

In the area of system architecture, the hardware configuration of the information system was analyzed and compared. As is evident from Figure 2, in both countries the most frequent hardware configurations are client/server architecture and host based information system.

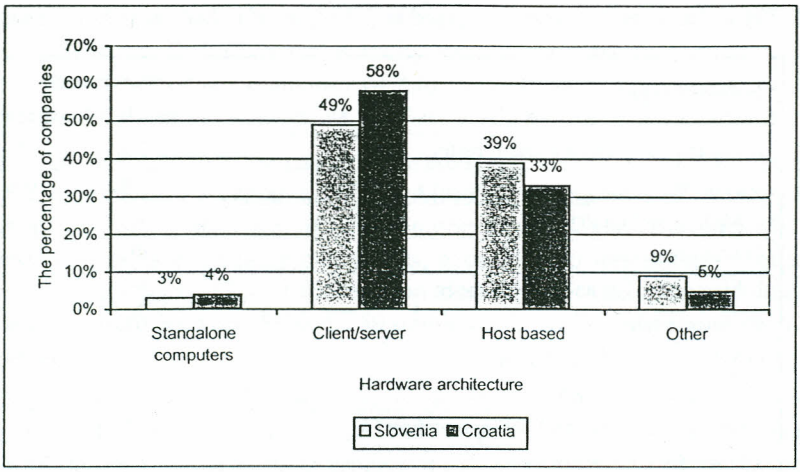

Figure 2. The hardware architecture of the IS

The software environment in the companies was also analyzed. The respondents were asked to answer to two questions:

1. Is your information system based on a database?
2. Which database management system is deployed in your information system?

Databases are used in 88% of Slovenian and in 85% of Croatian companies. The analysis of the data base product is presented in Figure 3. In both countries the Oracle, DB2, MS SQL server and the Informix database were used more than any others.

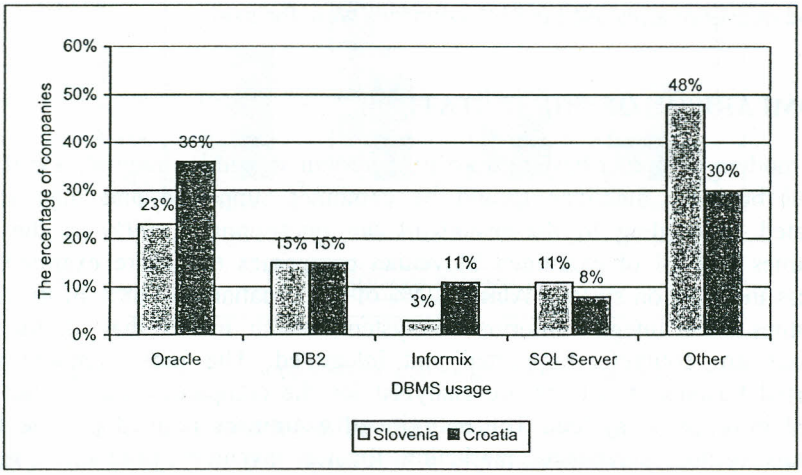

Figure 3. The percentage of companies who use database management systems

The respondents were asked about the information system development. The situation is similar in both countries. 36% of Slovenian and 35% of Croatian companies bought IS from a specialized software firm (a software package from the market) and 25% of Slovenian and 32% of Croatian companies used IS development

services (outsourcing). In Slovenia 38% of the companies had developed their own IS, while in Croatian the percentage of such companies is 32% (Figure 4).

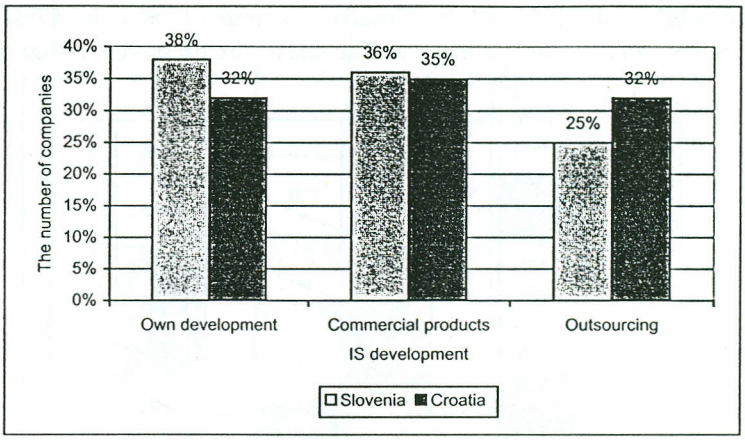

Figure 4. The IS development approach

An analysis of the cooperation between the IS users showed similar results for both countries – there is quite good cooperation between the IS users and the developers. However, the situation is much better in Croatia. 62% of Croatian companies (54% in Slovenia) have full cooperation with their users and only 2% (5% in Slovenia) have not.

The respondents were asked to estimate the quality of their companies' information system. The answers were more positive in Croatia than in Slovenia, which is evident from Figure 5.

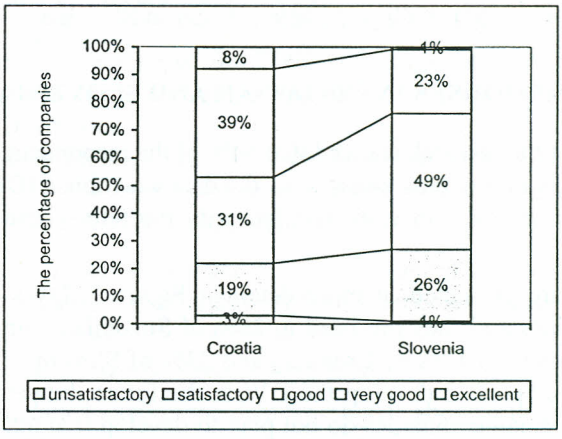

Figure 5. An estimation of the quality of the information systems used in these companies

The ISO-9000 certificate is not directly related to IS, but it is related to the quality of an organization and its management directly, and it influences the quality of IS indirectly. The need to satisfy ISO prerequisites requires improvements in business

processes and this indirectly leads to an upgrading of the IS. This is the reason for analyzing the state with an ISO-9000 certificate. We found out that the situation in Slovenian companies is much better. 38% of Slovenian companies have the ISO-9000 certificate while only 19% of the Croatian companies have it. 57% of Croatian companies have no plan to ever make it. The results are presented in Figure 6.

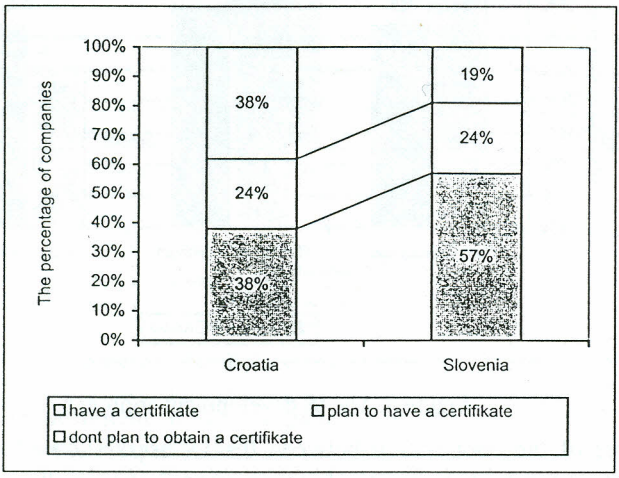

Figure 6. The state of the ISO-9000 certificate

From the results presented in this section we can see that there are no major differences between the IT states in the two countries but theire are two exceptions:

- IT managers are a little more satisfied with the quality of IS in Croatian companies and
- the state of the ISO-9000 certificate is better in Slovenia.

4. DATA WAREHOUSES IN CROATIAN AND SLOVENIAN COMPANIES

The results of the research showed that 60% of the respondents in Croatia and 91% of the respondents in Slovenia know what the data warehouse (DW) is (see Figure 7). Only those respondents who were familiar with the terms answered the rest of the questionnaire.

The results are presented in more detail in Figure 7. DWs are used in 12% of Croatian companies and they are used in 20% of Slovenian companies; and they are just being developed in 12% of Croatian, and 23% of Slovenian companies. The rest of the respondents plan to develop the DW in the future, however 16% of Croatian, and 10% of Slovenian companies do not plan to develop it at all. The reasons for this decision are similar in both countries: the lack of investment assets (financial resources) as well as the lack of information and knowledge about data warehouse efficiency in supporting an decision-making process. Some respondents in Slovenia who do not plan to develop the DW also stated that they did not need it.

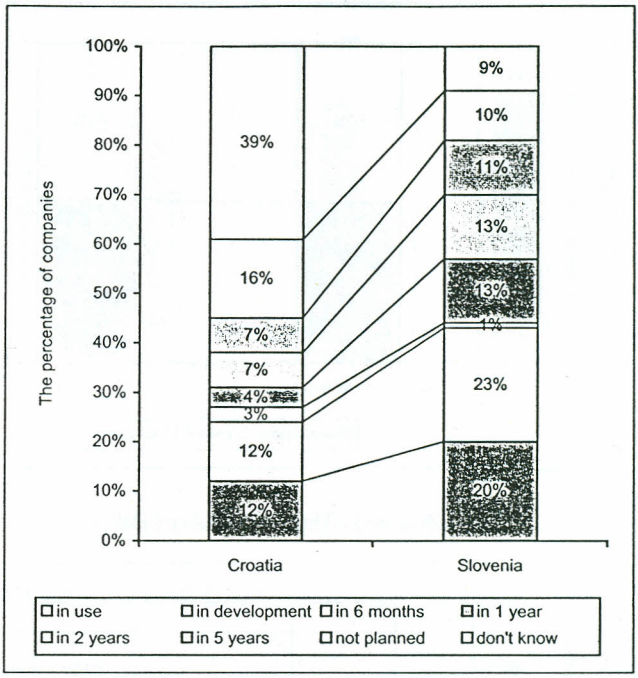

Figure 7. The state of the DWs

We will now point out some of the differences between the state of DWs in both of these countries:

- IS executives in Slovenia are much more familiar with the concept of DWs.
- According to [3] the DWs are used or are being developed in 70% of US companies. The percentage of the DWs which are being used or are being developed is much lower in both countries but the situation is still better in Slovenia than in Croatia.
- As is evident from Figure 7, quite a lot of Slovenian companies plan to develop the DWs soon (in six months or in one year), while two thirds of Croatian companies have not even planned to do it in the near future.

The respondents (companies who use or are developing a data warehouse) were asked about data warehouse usefulness. All of them estimated that their data warehouse is useful (24 answers from Croatia, and 35 from Slovenia). The results in both countries are very similar, as is evident from Figure 8.

An analysis of the data source in the data warehouse showed that only 16% of the Croatian companies' data warehouses included external data, but the figure was 59% for Slovenia (Figure 9).

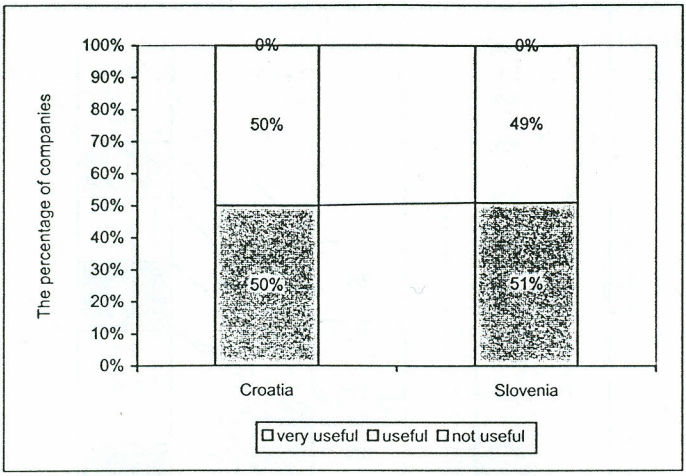

Figure 8. The usefulness of DW

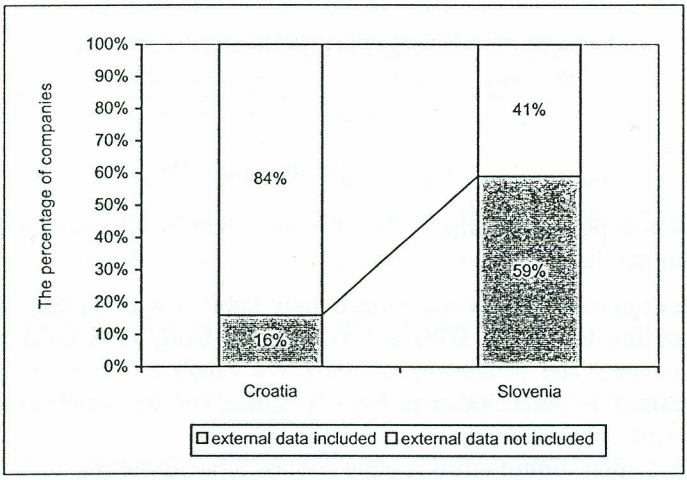

Figure 9. The inclusion of external data

The respondents were asked which management level (e.g. operational, tactical and/or strategic), uses the data provided by the data warehouse. The results are presented in Figure 10 and are similar for both countries. The only exception is at the strategic level.

An analysis of the data warehouse tools presents a large variety of tools that companies use (Table 2). Oracle tools and MS SQL server tools were used in most companies in Slovenia and Croatia. Many respondents in both countries did not use any specialized DW development tools. The lack of investment capital is probably the reason for this situation.

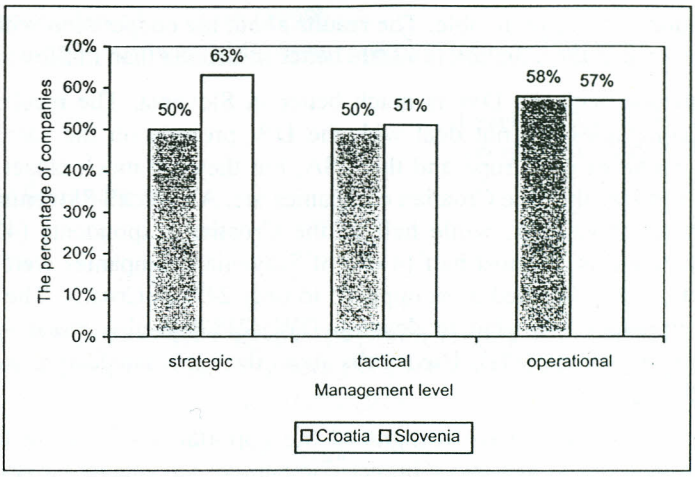

Figure 10. The usage of data warehouses at different management levels

Table 2. Data warehouse development tools

Development tools	Croatia		Slovenia	
	Number	Percentage	Number	Percentage
Oracle tools	5	21%	6	17%
MS SQL server tools	3	12%	4	11%
IBM DW and DB2 OLAP	0	0%	3	9%
Other	11	46%	20	57%
No response	5	21%	2	6%

5. CONCLUSIONS

Only an information system based on modern information technology can possibly provide the data (information) needed to manage the business processes. This means that a modern company's transactional system acts as a base for the day-to-day operations and control, and the data warehouse acts as a base for quality analysis, planning and decision-making.

A comparison of the research conducted in Slovenia and Croatia showed that there are a lot of similarities and a lot of differences between the state of information technology in large companies. In the area of computer supported information systems the results are very similar, but some differences do exist. In both countries nearly all companies have a information system, and it is mainly integral IS. According to the results about the hardware architecture and the software used, both countries adopt contemporary information technology standards and trends. The analysis of the IS development approach showed that Slovenian companies combine more varied approaches to the development of the IS, and with the development of their own IS,

and this option is more preferable. The results about the cooperation with users and IS quality showed that the situation is a little better in Croatia than in Slovenia.

The situation with the DW is much better in Slovenia. The results showed that Slovenian companies did not deal with the DW projects on the same scale as the developed countries of Europe and the USA, but they are much closer to using DW projects of this size then the Croatian companies are. Almost all Slovenian respondents were informed about DW, while half of the Croatian respondents (40%) were not aware of the concept. Almost half (43%) of Slovenian companies were engaged in a DW project or have finished it, as opposed to only 24% in Croatia. The percentage of Croatian companies that plan to develop DW (21%) is also much lower than the percentage in Slovenia (38%). The results about the users satisfaction were similar for Croatia and Slovenia.

Slovenian companies have recognized the importance of DW in term of global competition in order to achieve a bigger competitive advantage. Croatian companies have not yet realized the need to separate informational processing from operational processing and therefore to create DW. They tend to adopt their transaction system to the needs of decision-making and management, but they rarely develop additional data warehouse solutions.

We plan to repeat this research again this year and to compare the results. We would also like to include other Central European countries in our investigations.

REFERENCES

[1] Bosilj-Vukšić, V. Kovačič, A., Ćurko, K. (2000). Business Process Restructuring in Croatian and Slovenian Companies: A Comparison. *Journal of Contemporary Management Issues*, June, Vol. 5, No. 1, Faculty of Economics, Split, pg. 49-71.

[2] Central Bureau of Statistics (1997. Statistical yearbook, Zagreb.

[3] Cutter Information Corp. (1999). Data Warehousing Issues and Trends, [http://www.cutter.com/itgroup/reports/dwissues.html].

[4] Inmon., W. H. (1996). *Building the Data Warehouse*. John Wiley & Sons, Inc.

[5] Kimball, R. (1996). *The Data Warehouse Toolkit, Practical Techniques for Building Dimensional Data Warehouses*.John Wiley & Sons, Inc.

[6] Kroenke, D. & Hatch, R (1994). *Management Information Systems*, McGraw Hill.

[7] McLeod, R.(1995). *Management Information System: A Study of Computer-Based Information Systems*. Prentice Hall.

[8] Privredni Vjesnik (1998). Special issue on 400 Croatian biggest companies, June 29, Zagreb.

[9] Varga, M.(1996). Problematika i perspektive spremišta podataka, *Zbornik radova* s 8 konferencije Case alati/1996., Opatija, 93-103, Croatia.

[10] Zakon o gospodarskih družbah (1999), [http://ius-info.ius-software.si/Baze/regi/zakoni/B/Z93512DH.htm]

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Mojca Indihar Štemberger
Jurij Jaklič
Katarina Ćurko

KORIŠTENJE INFORMACIJSKE TEHNOLOGIJE I SKLADIŠTENJA PODATAKA U VEĆIM SLOVENSKIM I HRVATSKIM TVRTKAMA: USPOREDBA

Sažetak

Transakcijska baza podataka, kao osnova za tekuće obrade i kontrolu i skladište podataka kao baza za kvalitetne analize, planiranje i odlučivanje, mogu osigurati podatke (informacije) potrebne za upravljanje. Suvremeni transakcijski sustav podrazumijeva moderno okruženje informacijske tehnologije, što znači: klijent/poslužitelj arhitekturu, mrežno računarstvo, modernu bazu podataka i razvojne alate, sofisticirani pristup razvoju IS-a, visok stupanj suradnje s korisnicima, itd. Međutim, takav sustav nije dovoljan za kvalitetne analize, strateško planiranje i odlučivanje. Rješenje je u konceptu poznatom kao skladište podataka.

Skladište podataka osigurava pristup informacijama o cjelini poslovanja poduzeća. Skladište podataka je skup podataka i skup alata za postavljanje upita, analizu i prikaz informacija. Ono izdvaja informacijske procese (tj. generiranje izvještaja i ekrana, ekstrakcije, agregacije, analize, itd.) od transakcijskog sustava (procesa obrade).

Ekonomski fakultet u Ljubljani, Institut za poslovnu informatiku, i Ekonomski fakultet u Zagrebu, Katedra za informatiku, su ispitivali stanje informacijskih sustava poduzeća, korištenje informacijske tehnologije (IT) i koncepta skladišta podataka, uporabom ankete na koju su odgovarali IT menadžeri. Uspoređeni su rezultati istraživanja u Sloveniji i Hrvatskoj. Cilj istraživanja je bio prepoznati sličnosti i različitosti dviju zemalja uključenih u tranzicijske procese.

U obje države gotovo sve kompanije imaju računarski podržan informacijski sustav, većinom integralni IS. Prema rezultatima o korištenju hardverskih i softverskih rješenja, u obje zemlje su kompanije usvojile moderne standarde i trendove informacijske tehnologije. Analiza načina razvoja IS-a je pokazala da slovenske kompanije kombiniraju više različitih pristupa uz preferiranje vlastitog razvoja. Rezultati o suradnji s korisnicima i kvaliteti informacijskog sustava (prema procjeni korisnika) su pokazali da je stanje nešto bolje u Hrvatskoj nego u Sloveniji.

Situacija sa skladištem podataka je značajnije bolja u Sloveniji. Slovenske kompanije su prepoznale važnost skladišta podataka u postizanju veće konkurentske prednosti u uvjetima globalne konkurencije. Kompanije u Hrvatskoj još nisu uvidjele potrebu razvoja skladišta podatka odvajanjem informacijskih obrada od operativnih. One nastoje prilagoditi transakcijski sustav za potrebe odlučivanja i upravljanja, a rjeđe razvijaju skladište podatka. Razlog tome vjerojatno je u nedostatku financijskih sredstava.

Ključne riječi: informacijska tehnologija, transakcijski sustav, skladište podatka, istraživanje, anketa, velike kompanije.