Business information systems - experiences from Slovakia

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Abstract. *In this invited talk I present the study and research directions of Business information systems at the Technical university of Košice. Our research context as well as important changes in the Košice region where many IT companies came with their investments, created unique conditions for development of new study programs in Business information systems.*

Since their successful accreditation 8 years ago we acquired interesting experiences which will be shared with participants of the CECIIS conference in Varaždin, which is a bit symbolic. Faculty of the Organization and Informatics at Varaždin was namely one of our inspirations at the very beginning of this story.

Keywords. Business information systems, study program, research directions

1 Introduction

This paper presents a written version of an invited talk at the CECIIS conference in Varaždin. I decided to speak about this topic, because it is something to which I devoted very significant part of my professional efforts during the last 8 years. I hope that it will be interesting to at least part of the audience at the conference and possible readers of this proceedings from this very nice conference, which I had the pleasure to attend a couple of times since the year 2000.

I structured my invited talk as follows. In the following section 2 I will explain the necessary context and local conditions in Košice, which enabled us to start the Business information systems study programs. Section 3 presents the structure and some main ideas behind particular degrees of study programs. Important research projects as well as other projects which our small team has been working on during this period are sketched in section 4. Section 5 briefly lists main areas, which we would like to research in the near future and where we are open for any cooperation with you, if you are interested. Finally, short conclusions section sketches very briefly our near future plans.

2 The Context

Since my first attend in Varaždin I was fascinated not only with the friendly atmosphere which I could feel at the Facultuty of organization and informatics (FOI), but also with the way how this faculty is working and tightly cooperating with companies in the region. I found the combination od information systems, organization and management very perspective and useful for the close future. I hoped that may be we also will be able once offer such kind of study and inspire us with the best practices from FOI.

Suitable conditions for such kind of activity have started to form in Slovakia in 2002 from the legislative point of view. Our ministry of education approved at that time, on the proposal of accreditation committee, a new structure of fields of study for universities in Slovakia, including prescribed core knowledge and skills for all identified fields of study. There was an important change for us, because in the group of informatics' fields of study appeared not only Information systems, Cybernetics, Artificial intelligence among others, but also study field Business information systems. Since 2003 all universities obliged to accredit all their study programs in accordance with Bologna declaration in three cycle degree structure, mapping also the new structure of fields of study in Slovakia.

Our department at that time guaranteed two study programs, Cybernetics and Artificial Intelligence, having also some basic informatics and programming courses taught by neighboring Dept. of Computers and Informatics. But our Technical University in Košice has also the Economic Faculty, where very actively acts (as a dean at that time) our earlier colleague, prof. Tomáš Sabol. When we came with the idea to accredit completely new study program Business information systems, he was very much supporting this idea. We agreed to create a small team

with the aim to prepare accreditation of Business information systems as a university study program, where two faculties cooperated, our Faculty of Electrical Engineering and Informatics together with Economic Faculty, sharing their responsibilities for envisaged study programs.

A small team of enthusiastic people from both faculties prepared together proposal for bachelor and master study programs and succeeded with their first proposal for accreditation in 2004. In such a way we could open the bachelor study for first students in 2005.

Before we took this serious decision, we first analyzed the situation in the Košice region with respect to employment opportunities. At that time already more large IT companies decided to open their branches in Košice, e.g T-Systems, Ness, RWE-IT, Siemens, to name the most important once. Of course there are more interesting employment possibilities for graduates in business information systems in other regions, especially in Bratislava, not speaking about employment abroad.

Of course we look for experiences outside Slovakia as well. Except of FOI, mentioned above, there is a long tradition of "Wirtschaftsinformatik" in German speaking countries, which I could partially observe as a student at the Technical University in Vienna (1990-1991) and later on as a researcher in a couple of European research projects with German partners, from which I would like to mention prof. Guenther Pernul. I knew him already in Essen 1998, and later at the University of Regensburg, where he is acting as chair of Information science I. department at the Faculty of Business, Economics and Management Information Systems. I had a chance to spent some weeks on his department in 2005 and learn some more details about organization of the study in business information systems there.

Currently organizationally is responsible for the business information systems study programs and related research Dept. of Cybernetics and AI, where we have Division for Business Information Systems lead by me. We currently have in our team three full time assistant professors in Business information systems with PhD. (František Babič, Martin Sarnovský, Peter Butka and earlier Karol Furdík, who is currently cooperating with us externally) and two researchers with PhD. (Jozef Wagner and Gabriel Tutoky) financed from our research and development projects as well as 5 PhD. students.

3 Study programs

As mentioned in the previous section, Business information systems field of study is in our structure of university educational fields in the group of Informatics' fields of study. We need to follow the prescribed core knowledge for particular cycle of degrees in Business information systems defined by the Ministry of education, whereas majority of the topics are coming from informatics. Therefore we decided that majority courses needs to come from our faculty and above the third from Faculty of Economics.

During the years there were some modifications and adjustments to the structure and offer of courses within the bachelor and master study, trying to reflect also the current situation in the amount of students, as well as their capabilities and skills, in order to maximize the quality of our graduates.

Current structure of ***courses in the bachelor degree study program*** is as follows:

1. year: Introduction to Programming and Networks, Mathematics I and II, Microeconomics, Enterprise and entrepreneurship, Computers and algorithms, Programming, Introduction to Business Informatics, Macroeconomics

2. year: Databases, Mathematics III, Information Systems Analysis and Design, Simulation Systems in Business Informatics, English, and something from elective courses like Operating systems, Accounting I, Management, Scheduling and logistics, Company Finances, Applied programming for Windows, etc.

3. year: Bachelor thesis I and II plus electives, e.g.: Project management, Knowledge based systems, Computer nets I, Optimization in business processes, Business information systems, Marketing, Heuristic optimization processes, etc.

Current structure of ***courses in the master degree study program*** is as follows:

1. year: Information Systems of Business Processes, Knowledge Discovery, Foundations of Software Engineering, Semester project, IT management, Applied Statistics and electives, e.g.: Financial Markets, Semantic and Social Web, XML technologies, Engineering Econometrics, Public Finance, Machine Learning, Electronic business, Distributed control systems, Multi-criteria Decision Making.

2. year: Diploma Thesis I and II, Knowledge Management, Labor and Commercial Law, Human Sciences, plus electives, e.g.: Economic Analysis of the Firm, Management information systems, SAP Administration, Decision making and complexity, Integrated manufacturing systems.

Very interesting was growth of interest among applicants for our bachelor study in Business information systems (see Table 1).

We did not expect so fast growth of interest for this type of study. On one hand side it was a very positive signal that there is significant interest for such a study. On the other side we could observe a slightly different structure of applicants for this study program. Besides applicants from gymnasia we have got a significant portion of applicants from secondary vocational schools, very often from so called business academies (business oriented secondary schools). Students from such types of schools have solid economic background, but they

lack more theoretical skills, especially mathematics and have sometimes also problems with algorithmic thinking and programming.

Table 1. Number of students in bachelor and master study programs of Business information systems

No. of students	2005	2006	2007	2008	2009	2010	2011	2012
Applic.	*40*	*60*	*110*	*270*	*420*	*610*	*450*	*200*
Bc.{1)	23	40	84	191	230	90	90	*80*
Bc.{2)	-	21	39	75	148	196	75	*75*
Bc.{3)	-	-	19	42	73	143	170	*70*
MSc.(1)	-	-	-	19	62	65	106	*120*
MSc.(2)	-	-	-	-	18	60	65	*105*
Sum:	23	61	142	327	531	554	506	*450*

We tried to react on this situation with increased number of subjects oriented on informatics' disciplines and more practical work with students within these subjects. This helped a lot those students, who really care about their professional development and are not going to study just for getting a degree.

The situation became even more complicated since years 2008 and 2009, where our faculty decided to accept a large number of applicants, despite the fact that we declared our optimal capacity for max. 100 students in the first year of the bachelor study. This necessitated slightly modifying organization of study in some of the subjects, because of very large numbers of students and limited capacity of educators. But the situation improved in the last years significantly. Our faculty heard our appeals and limited the number of accepted applicants since 2010 to the number which is optimal for our department.

On the other side, decreased chances of applicants to be accepted on our study, probably also together with the increasing number of informatics and more practically oriented subjects have lead to a significant reduction of applicants in last two years. Currently we are satisfied with the quality and extent of our bachelor study and will carefully observe how the situation evolves in the next few years.

We still have too many students in the master study, but within the next two years the situation should stabilize also there.

Finally I would like to mention our PhD study program, which was successfully accredited in 2009 so that we could select and accept first two PhD students in 2010.

Currently we have altogether 9 PhD students, 2 of them in last year of their study. For the coming academic year, 2 new PhD students for daily and one for external study have been accepted.

4 Our projects

I think that for successful development of a study and research direction it is absolutely necessary to have a suitable portfolio of projects supporting research as well as educational infrastructure and activities.

Currently our portfolio of projects consists of two national research projects, one educational grant, one IBM Faculty award and three research and development projects from structural funds. In years 2006-2011 we have participated also in one FP6 integrated research project KP-Lab. Some basic information about these projects is provided below in the following two subsections.

4.1 Research projects

4.1.1 KP-Lab

KP-Lab[1] (Knowledge practices laboratory) was a European IST project which developed theories, tools, and practices that significantly enhance understanding of knowledge creation processes and working practices [1]. This was a successful integrated project running for 5 years from 2006 till 2011. This project was coordinated by University of Helsinki.

The project consortium consisting of 22 partners from whole Europe and Israel provided theoretical framework as a baseline for collaborative virtual system KPE with many integrated functionalities to support collaborative knowledge creation processes. Technical University Kosice represented by our team was one of the 4 major technological partners in this project.

Our team participated in the research, design and development of semantic middleware services [6], and in the second half of the project mainly on logging and analytical services. More detailed description of our major results in this area is provided e.g. in [2].

4.1.2 Analysis of collaborative processes

This year started our new project supported by the Scientific Grant Agency of the Ministry of Education, Science, Research and Sport of the Slovak Republic and Slovak Academy of Sciences (VEGA) with the title "Methods for analysis of collaborative processes mediated by information systems". VEGA is our main and traditional scientific grant agency in Slovakia supporting mainly basic research. The success rate of project proposals in this grant agency is about 35%.

[1] http://www.kp-lab.org/

Our project is scheduled for 4 years. It actually follows our research activities in the last phase of KP-Lab project and brings some new aspects into them. This project focuses on research of methods for analysis of collaborative processes, which are mediated by information systems [5]. In these processes collaboration of more people is necessary in order to achieve a common goal. This common goal is usually some kind of artifact (e.g. a product, service, method or new knowledge in explicit form). When researching methods for analysis of such types of processes we focus on the following aspects:

1. *Process aspect* – methods for analysis of sequences of events in these collaborative processes.
2. *Social aspect* – methods for analysis of various types of interactions between actors of collaborative processes, especially:
   - Analysis of collaborative networks derived from interactions between process' actors,
   - Sentiment analysis in such kind of processes, where (at least some) activities are available in textual form.
3. *Economical aspect* – methods suitable for evaluation of changes in collaborative processes caused by information systems' usage.

4.1.3 Projects from Slovak Research and Development Agency

Slovak Research and Development Agency was established in July 2005 and provides very interesting resources for research and development projects. It is highly competitive with success rates in open calls almost similar to that typical in EU funded FP projects.

Our team in cooperation with other partners from Slovakia (mainly Institute of Informatics, Slovak Academy of Sciences, Faculty of Informatics and Information Technologies, Slovak University of Technology in Bratislava and microStep MIS company) succeed in a couple of calls for projects. We successfully completed the following projects: Semantic composition of web and grid services[2] (2007-2009) – see e.g. [4] and [8], Data Mining Meteo (2009-2011) [7] and currently we are working together on project TRA-DICE – Conginitve travelling through digital world of web and libraries with support of personalised services and social networks (2011-2013).

We also independently successfully completed project Support for knowledge creation processes[3] (2007-2009) form the same agency. For some of the main results, see e.g. [3].

[2] http://web.tuke.sk/fei-cit/semco/index-a.html
[3] http://web.tuke.sk/fei-cit/poznat/index-a.html

4.2 Projects supporting education

We have currently four projects which are focusing mainly to support educational processes. One of them is research and development oriented project IT4KT; the other three are more educational, one of them being supported by a grant agency and the other two by business sector (IBM and Tatrabanka resp.).

4.2.1 Project IT4KT

IT4KT project (Information Technology for Knowledge Transfer) is supported by the Research & Development Operational Program funded by the ERDF (ITMS project code: 26220220123).

This project is being solved at our Faculty of Electrical Engineering and Informatics as cooperation of researchers and educators from three different departments. We analysed current learning processes and best practices on a set of 15 different courses from mathematics and computer science.

Based on the analysis, crutial processes have been identified, modelled and will be supported by various electronic services – exsitng ones, which will be enhanced and combined with new types of services. All these activities are based on a common background of semantic technologies, where the shared semantics is modelled by means of an ontology [9].

4.2.2 Virtual laboratory for Business Information Systems

This is a project supported by the Slovak Cultural and Educational Grant Agency of the Ministry of Education, Science, Research and Sport of the Slovak Republic (KEGA). KEGA supports educational projects in Slovakia on all levels of education. The success rate of project proposals in this grant agency is about 75%.

The aim of our project is to provide suitable on-line tools supporting education of selected subjects within the Business information systems study at our university. The necessary technical infrastructure has been already established with support of other projects, two of them from structural funds. Therefore this project focuses on software and organisational aspects only. We are developing an on-line platform which enables easy distribution and sharing of relevant knowledge, continual update of information based requirements identified within our core subjects, but also master and bachelor thesis or other relevant student projects.

For these purposes we are designing and implementing elektronic learning materials for particular subjects; suitable elektronic services for active participation and collaboration of students in virtual environment (including e.g. support for social network analyses) and methodology for „web based training“ in relevant educational areas. Created

electronic materials and services will be freely available on-line not only for our students, but also for interested public.

4.2.3 IBM Faculty award

The IBM Faculty Awards is a worldwide competitive program[4]. The aim of this program is to foster collaboration between researchers at leading universities worldwide and those in IBM research, development and services organizations.

The aim of our project is to design and implement effective methods and tools for education of business analytics within the university courses. We aim to build on our experiences in education of knowledge discovery and data mining since ten years, making use of up to date IBM software and existing laboratories.

Our experiences show that it is not enough to teach students about methodologies like CRISP-DM and used data mining algorithms. It is inevitable educate students to understand the business aspects of a problem to be solved. Therefore our ambition is in cooperation with experienced IBM specialists to design and develop a couple of cases where the students will be able to better grasp the nature of (real) business problems and how to approach them with suitable business analytics methods and tools.

4.2.4 Other projects

One of the structural funds projects where part of our team is participated, lead by František Babič, is project SPES (Support Patients through E-Services Solutions) [10].

The SPES project[5] offers numerous opportunities to analyze and evaluate actual situation and existing conditions for integrated healthcare and social services on the European level. This initiative is implemented under Central Europe Programme[6].

The main aim of the SPES project is to design and implement a health and entertainment platform in four cities: Ferrara, Vienna, Brno and Košice, focusing on selected diseases and problems of elderly people. The Košice pilot will be devoted to the improvement of social inclusion of selected Slovak elderly through tailored SPES platform providing features collected from user requirements and expectations [10].

One of my PhD students (Peter Koncz) succeded with his application for a grant in Tatrabanka, within their eTalent program. His project called mine::YourFuture aims to build a publicly available knowledge store for support of study in knowledge discovery and efficient work with knowledge discovery tools. This small project very well matches and complements projects described above in this section.

[4] http://www.ibm.com/developerworks/university/facultyawards/
[5] http://www.spes-project.eu/
[6] http://www.central2013.eu

5 Research directions

One can already notice based our projects presented above what are our main research areas that we are focusing on. Nevertheless I would like to put it into more general context, identifying two main branches of our research interests.

First and major one is oriented on ***data analysis*** in general. In particular it is data analysis of various types of processes, where we are using different sources of data, like data from logs [2][5], textual data [4] [12], or social networks data [11][13].

This major area is a kind of backbone for most of our projects, both research, as well as educational ones (see above). My current PhD students working in this area are: Peter Koncz (sentiment analysis [15]), Martin Repka (analysis of company networks [16]), Jozef Kováč (profitability of analytics applications in database marketing [17]) and Alexandra Lukáčová (data mining in manufacturing processes [18]).

Second area which we are approaching in just last few years is ***cloud computing***. This is area is motivated mainly by the market requirements in our region. Based on these requirements my colleagues Karol Furdík and Martin Sarnovský prepared in cooperation with ITSMF Slovakia a new subject (IT management) and lead various master theses in this area. My PhD-student Adela Tušanová is working on a cloud computing adoption framework [14].

6 Conclusions

In this invited talk I presented a (hopefully success) story about new study programs and related research in the area of Business information systems performed in our team at the Technical university in Košice for the last 8 years.

We hope that all these efforts of people in my team will have positive influence on the informatics education in our region, providing well prepared professionals in business informatics for numerous companies not only, but mainly in Eastern Slovakia.

A nice example of a successful graduate is Jozef Kováč, who did interesting master thesis in data mining at our department. He worked for more than 5 years as data mining and business intelligence consultant and now he is starting his own company providing data mining services and consultancy using also his original software solution. He is currently also my external PhD student.

We do also hope to be able to perform interesting research in cooperation with partners from universities as well as from business sector.

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References

[1] Moen, A.; Morch A. I.; Paavola, S. (Eds.) *Collaborative Knowledge Creation.* Sense Publishers, Rotterdam, The Netherlands, 2012.

[2] Paralič, J.; Richter, Ch.; Babič, F.; Wagner, J.; Raček, M. Mirroring of knowledge practices based on user-defined patterns. *The Journal of Universal Computer Science*, 17(10): 1474-1491, 2011.

[3] Babič, F.; Paralič, J.; Furdík, K.; Bednár, P.; Wagner J. Use of semantic principles in a collaborative system in order to support effective information retrieval. In *Computational Collective Intelligence, Semantic Web, Social Networks and Multiagent Systems* (ICCCI 2009). LNAI 5796/2009, pages 365-376, Springer, Berlin/Heidelberg, 2009.

[4] Sarnovsky, M.; Butka, P. Paralic, J. Grid-based Support for Different Text Mining Tasks. *Acta Polytechnica Hungarica*, Journal of Applied Sciences, 6(4): 5-27, 2009.

[5] Babič, F.; Wagner, J.; Paralič, J. Investigation of performed user activities in overall context with IT analytical framework. In *Lecture Notes in Business Information Processing: Business Information Systems*. Vol. 117, pages 284-295 Springer-Verlag, Heidelberg, 2012.

[6] Babič, F.; Wagner, J.; Bednár, P. Java framework for managing semantic repositories based on RDF standard. *Acta Electrotechnica et Informatica*. 11(1): 33-37, 2011.

[7] Babič, F.; Bednár, P.; Albert, F.; Paralič, J.; Bartók, J, Hluchý, L. Meteorological phenomena forecast using data mining prediction methods. In *Lecture Notes in Computer Science: Computational Collective Intelligence*, Vol. 6922, no. 1, pages 458-467, Springer, Heidelberg, Germany, 2011.

[8] Habala, O.; Paralič, M.; Rozinajová, V.; Bartaloš, P. Semantically-aided data-aware service workflow composition. In *Lecture Notes in Computer Science*. Vol. 5404, pages 317-328, Springer-Verlag, Heidelberg, Germany, 2009.

[9] Paralič, J.; Furdík, K.; Paralič, M.; Bednár, P.; Butka, P.; Wagner, J. Semantic support for educational IT services. Paper submitted to *Acta Electrotechnica et Informatica.*

[10] Babič, F.; Tutoky, G.; Wagner, J. How to improve the daily routine and social inclusion of elderly people within suitable IT solution. In *Proceedings from 6th Workshop on Intelligent and Knowledge oriented Technologies*, pages 109-114, Equilibria, Košice, Slovakia, 2011

[11] Tutoky, G.; Paralič, J. Time Based Modeling of Collaboration Social Networks. In *Computational Collective Intelligence: Technologies and Applications: Third International Conference*, (ICCC 2011). pages 407-418, Springer-Verlag, Berlin, Germany, 2011.

[12] Paralič, J.; Furdík, K.; Tutoky, G.; Bednár, P.; sarnovský, M.; Butka, P.; Babič, F. *Knowledge Discovery from texts* (in Slovak). Equilibria, Košice, 183 pages, 2010.

[13] Tutoky, G.: Discovery and Exploitation of Knowledge in Collaboration Social Networks. *Information Sciences and Technologies Bulletin of the ACM Slovakia*. 3(4): 28-36, 2011.

[14] Tušanová, A.; Paralič, J. Cloud computing adoption framework. In *Proc. from MISSI 2012 - 8th International Conference on Multimedia & Network Information Systems*. to appear.

[15] Koncz, P.; Paralič, J. An approach to feature selection for sentiment analysis. In *Proceedings from INES 2011 - 15th International Conference on Intelligent Engineering Systems*, pages 357-362, IEEE Xplore digital library.

[16] Repka, M.; Paralič, J. Local Structure Analysis of Company Network. In: *Proceedings from 10th IEEE Jubilee International Symposium on Applied Machine Intelligence and Informatics*. Budapest, IEEE, pages 113-117, 2011.

[17] Kováč, J. Profitability of analytics applications in database marketing (in Slovak). In *Proceedings from WIKT 2011: 6th Workshop on Intelligent and Knowledge oriented Technologies*, pages 189-193, Equilibria, Košice, Slovakia, 2011.

[18] Lukáčová, A. A review of data mining applications in manufacturing. In *Proceedings from 12th Scientific Conference of Young Researchers*, pages 64-67, TU Košice, 2012.