1st CEE Symposium on Business Informatics
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EDITORIAL

Nowadays when Information and Communication Technologies (ICT) play an important strategic role for business success, enterprises are challenged to efficiently leverage their most valuable and underleveraged resource: the intellectual capital of their highly educated, skilled and experienced employees. This challenges academia to provide students with excellent education comprised of interdisciplinary Business Informatics competences and up-to-date research results.

The CEE-symposium at the WI 2009 aims to bring together researchers and practitioners to discuss innovative aspects of Business Informatics in the CEE region. According to the Call for Papers the content is organised in the following three parts:

- Education
- Cooperation between academia and industry on ‘research’ level
- Impact on industrial projects

The Bologna Study Architecture challenges universities and other higher-education institutions to change the structures of educational programmes, to provide new academic degrees, to establish, adapt and enhance new quality frameworks and criteria and to increase the level of international cooperation both in research and in academic programmes. The provision of new modular curricula in Business Informatics needs to tackle, especially at a Masters’ Degree level, the topics of knowledge communication and evaluation, methods and content delivery in the context of technology-based knowledge transfer, quality criteria and performance indicators for education.

A raising number of cooperations between academia and industry on a ‘research’ level provides both sides with beneficial, application-driven research results. The selection of appropriate research methods and tools is of utmost importance in this context especially in the view of industry-driven research initiatives as well as in empirical research. One aim of such concepts is to investigate approaches and offer for the storage and delivery of knowledge in enterprises that become essential pillars in the context of world wide competition.

Tightly linked to it is also the question of distribution and communication of research results as well as general legal conditions of intellectual property and interdependencies of law and technology.

Considering the impact on industrial projects, staffing requires fitting skill profiles and clear qualification requirements for enterprises. Therefore the business strategies in CEE countries and the alignment to the corresponding HR and IS strategies must be clearly defined. Nevertheless, cultural, social, economical and educational differences can be an additional hurdle for enterprises when they consider concepts like outsourcing and offshoring. From this point of view it is seen as especially interesting to also have Best Practices and Case Studies for ICT-applications in CEE countries.

The CEE-symposium “Business Informatics in Common Europe” would like to offer a communication forum and meeting ground for researchers and practitioners involved in educational and research topics for Business Informatics, with special focus on the CEE countries. Until now great interest has been shown by various guest speakers and practitioners to participate in the conference and to present their knowledge from an industry-related point of view.

Vienna, 2009  
Hans Robert Hansen, Dimitris Karagiannis and Hans-Georg Fill
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EDUCATION
PAID CONTENT A WAY TO ELECTRONIC KNOWLEDGE-BASED ECONOMY

Wojciech Cellary

Abstract
This paper deals with the dilemma followed from the double character of knowledge. On the one hand, knowledge is an individual and social good determining quality of life. On the other hand, knowledge is an economical good, a funding concept of the knowledge-based economy. The dilemma is: should knowledge be for free or paid? It is argued in the paper that achievement of knowledge (information) society without knowledge-based economy is impossible. A compromise approach to financing knowledge is proposed motivated by the need of sustainable development of economy as a condition of social welfare. This approach consists of public financing only precisely defined part of the knowledge sector: first, knowledge that does not develop any more, and knowledge necessary to bring new social groups of people to the knowledge-based economy.

1. Introduction

Nowadays, two of the most significant concepts determining the future of the world are: information society and knowledge-based economy. Information society may be defined as a community whose collective life is organized by the wide use of the information and communication technologies, and which economy is based on knowledge. An economy is based on knowledge if the market value of dominating products and services depends mostly on knowledge, instead of resources, energy, or physical work. It is worth to emphasise that the information society (previous term) and the knowledge society (newer term) are synonyms. It follows from the fact that in order to benefit from information people need to have appropriate knowledge necessary to interpret information and to use it for making right decisions. For people without appropriate knowledge, information is useless [2].

Knowledge has always played and still plays a crucial role in both individual and community life. A person with knowledge has an advantage over the one without knowledge, because he/she is able to better foresee the consequences of his/her decisions, to make less mistakes, and thus to achieve better quality of life. Similarly, societies with higher degree of knowledge dissemination, which is measured by its members education, live better, face better the challenges, and win with other societies at the global scale. That is why since the beginning of humanity the knowledge has been considered as a particularly precious good. People having knowledge have been respected. Governments have been allocating public funds to widely disseminate knowledge. From the economic point of view, in an industrial society era, knowledge creation and transmission – i.e., science and education – were financed first of all from the public funds.

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Such model of knowledge financing was perfectly justified when people earning a living in the science and education sector have been a small part of the society, while majority of people have been earning a living doing physical work or routine administrative work. Due to technical progress, more and more physical work can be done by machines, automates and robots equipped with computers. There is a need for people having advanced knowledge for developing, programming, maintaining, and servicing the machines, automates and robots instead of people doing simple physical work. Similarly, at the current level of development of computer and software engineering, more and more routine white-collar work may be done by computers, therefore the demand for low-skilled administrative workers decreases, while the demand for highly skilled workers able to program computers, and for decision-makers able to use computers to decision support significantly increases.

Computers revolutionize labor market followed by deep societal and economic changes also in another way, namely, by giving to societies a universal, common, cheap and multimedia information and communication tool – the Internet. Internet significantly changes an approach to acquiring, exploiting, and creating knowledge. These changes are not limited to a simple replacement of old forms by electronic forms. Indeed, Internet changes the essence of social communication, as well as the means of knowledge acquisition and participation in knowledge creation [1]. All together, these changes are so deep that we can talk about the knowledge society and the knowledge-based economy.

In a situation when knowledge remaining a social good becomes also an economical good, it is necessary to define an economic model being a cornerstone of the knowledge-based economy. This paper presents the dilemma to be faced while trying to define such model, because social arguments clash with the economic ones. Considering knowledge, on the one hand, there is a strong need of social justice followed from the conviction that all people are fundamentally equal even if they differ in many aspects. On the other hand, it is necessary to keep in mind the relation between society and economy – there is no healthy society without healthy economy. An economy is healthy when it remains in a state of sustainable development, because only then it may respond to changing social needs.

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In Section 2, emerging knowledge society is presented using Poland as an example, and the scope of knowledge-based economy is defined. In Section 3, a sense of economic activity with respect to knowledge is explained. In Section 4, principles and consequences of public aid in a free market economy are recalled. These consequences are illustrated in Section 5 using teaching materials available for free as an example. In completion, in Section 6 – as a warning – negative economic consequences of food aid given to the third world countries are presented. In Section 7, criteria are proposed that permit to distinguish the part of knowledge diffusion that may be granted public funding without negatively affecting the knowledge-based economy. In Section 8, threats following from knowledge privatization are presented. “Public or private” dilemma is illustrated in Section 9 recalling an example of pharmaceutical market, where the conflict of values is particularly visible. Finally, Section 10 concludes the paper.

## 2. Knowledge society and knowledge-based economy

In Poland, only 11% of people 45-60 years old have higher education, while 49% of people 19-24 years old are studying at universities and will acquire higher education [3, 5]. Therefore, in the next society almost half of its members will have higher education and, as a consequence, will like to work in knowledge-based service sector. This sector encompasses three functions: knowledge
acquisition (discovery), knowledge exploitation, and knowledge transmission. Knowledge discovery means scientific research in all possible fields, and – what is important – a search for relationships among them. Less and less research results have monothematic character, and more and more of them have the horizontal one, penetrating many different disciplines, also those that are far one from another, as technical and human sciences.

Knowledge exploitation means creation of new products, services and processes, and putting them into practice, i.e., innovation. Finally, knowledge transmission means education, consulting and advising. Increasing importance will be attached to education of adults. Due to fast knowledge growth and equally fast outdating of its part, the knowledge acquired in the youth, including studies at a university, will be not enough for the whole life. Whole society will need to constantly update its knowledge according to “life-long learning” principle.

In the three areas of knowledge-based economy mentioned above: knowledge discovery, exploitation, and transmission, the crucial role plays knowledge exploitation. The main economic goal is to innovate, i.e., to apply new solutions into practice, to gain competitive advantage on the market[4]. For enterprises, research is only a means to acquire an innovation. Therefore, for enterprises the best and the simplest way (which does not mean – a short one) to acquire an innovation is targeted research defined by enterprises. Consequently, each innovation is followed by the necessity of knowledge transmission, not only with respect to the employees of an enterprise deploying an innovation, but also to consumers of new products and services.

3. Economical activity with respect to knowledge

If after natural replacement of the old generation by the young one, the half of a society would like to earn a living providing knowledge-based services, then such activity must be a part of economy. As totally unrealistic should be evaluated an economic model in which non-educated part of the society works physically in the private sector and pays taxes to finance public sector, while the educated part of the society is paid from taxes to provide “free of charges” knowledge-based services. In addition, a characteristic feature of knowledge is a positive feedback: more knowledge acquired – more demand for new knowledge. Due to cognitive curiosity of highly-skilled people, their demand for new knowledge is bigger than this of non-educated people, even though objectively, a non-educated person should be interested in receiving more knowledge.

The more knowledge the society will be given for free – which means in reality financed from public funds – the more knowledge well-educated part of the society will demand. As a consequence, it will be necessary to increase the fiscal charges of non-educated part of the society. Such economic system – as every one based on the positive feedback, a phenomenon well known from the control theory – is unstable and must fail. That is why the knowledge-based economy needs a stable economic model in which knowledge will be first of all considered as an economic good – a commodity – an object of purchase and sale.

Economical activity with respect to knowledge – like in every healthy economic model – should generate profit for enterprises, and should be taxed to bring income to the state budget enabling realization of social goals. To conclude, the more knowledge workers will earn a living providing paid knowledge-based services as business activities, the more profits for the whole society.
4. Public aid in a free market economy

The necessity of knowledge-based economy development does not exclude public aid and realization of its part in the public sector. However, a question arises: what can be realized in the public sector to prevent knowledge-based economy from damages? To answer this question it is necessary to briefly recall the basic free market rules.

Production of any product or service needs to bear costs. These costs must be included in the final price of the product or service offered on free market. The price must also include a profit that is necessary for further development. Freedom of the market stimulate competition between enterprises offering similar products and services. Competition guarantees that big part of the profit will be invested in development – production costs reduction, functionality and quality improvement, and new products and services development. Sustainable development is the value for which the free market must be protected.

The mechanism of free market or its sector destruction is the following. A certain enterprise offers on the market a product or a service for a price below its production costs, financing it from funds coming from other sources than the profit from its sale. No enterprise making a profit from the sale of that product or service is able to face such unfair competition, so it bankrupts, at least with respect to this product or service. The monopolist remains the only one (or almost) on the market. It can – with impunity, because it is free from competitive pressure – first, to impose prices, and second, to abandon development. The second problem is particularly destructive for the society, therefore, a role of governments, European Commission, WTO, etc. is to prevent such cases.

Particularly controversial is governmental intervention in the free market by subsidizing some products or services. Occasionally, such interventions arise, most often justified by „employers interest”. In European Union, they have to be approved case by case by the European Commission. However, permanent subsidizing of selected products or services is always destructive for the economy. In case of free market rules applied, a commercial success of a product or a service means big profits which can be devoted to further development. In case of subventions, a success of product or service means a hole in the state budget, which cannot be easily filled, so, as a consequence, such “success” leads to frustration instead of development. Knowledge development in the knowledge-based economy is subject to the same mechanism. This is why financing knowledge from taxes will lead to the frustration instead of development.

5. An example: free of charge teaching materials

As an example of non-free market approach to knowledge, denying the idea of the knowledge-based economy, consider a problem of teaching materials for students, i.e., the content of lectures. According to the idea of “free access to knowledge for everybody” a government is encouraged to gather the best lecturers representing various fields, particularly the most modern ones like computer science, to pay them for preparing lectures for students and for transferring theirs copyrights to the government, and then to make the lectures available for everyone in the Internet. Following the old philosophy formulated before knowledge-based economy, the idea seems to be perfect. Consider computer engineering as an example.

In many countries the number of young people who want to study computer engineering is very high (for example in Poland there are 100.000 students of computer engineering), while the number of computer scientists who can serve as lecturers is very limited compared to needs. That is why computer science is taught by many representatives of other disciplines, like mathematics, physics,
and several engineering disciplines. Some of those representatives have been retrained to make research in computer science, which is appreciable, because they keep up with social needs. But some of them limit their activity to teaching selected lectures in computer science. For such lecturers the idea of free access to the ready-to-use lectures prepared by specialists is excellent. It allows them to give lectures without putting any effort into preparation of content, without good comprehension of the subject, and without their own creative scientific contribution. This is an easy way to achieve superficial effects – a student will hear a well prepared lecture, but he/she will not receive an answer to any non-standard question requiring deeper knowledge.

From the point of view of knowledge-based economy, the above idea should be classified as an unfair competition and illegal interference of the government in free market. If lectures that are ready-to use, free of charge, and prepared by the specialists are available for everyone in the Internet, no manager of an institution dealing on the scientific and educational market (rector, dean, provost, etc.), thinking rationally and respecting economic rules, will invest in preparation of original lectures. Moreover, if those free of charge lectures are accepted by some legal body evaluating the quality of higher education, for example by an accreditation committee, there will be the second important reason for not investing in original lectures – a risk. Why to risk possible remarks or bad evaluation of the original lectures made by the accreditation committee, if one can use formally approved lectures available for free in the Internet. As a result, development of new lectures is ceased. As a result, students in whole country (world?) will be taught the same content which will quickly become obsolete. Such consequences of free teaching materials are in total opposition to the need of originality and innovativeness which are cornerstones of the knowledge-based economy.

6. A lesson following from the food aid

A free food aid for the third world countries justified by humanitarian reasons and absolutely necessary in case of disasters, while continued becomes destructive for local agriculture. No producer can compete with a free gift, therefore he/she bankrupts. As time goes by, as a consequence, production competences are lost, so people in the helped country become unable to produce. The country falls in strong dependence on food aid which makes its development impossible. Such aid depends on goodwill of donators and not on real needs of the country. A single donation due to a disaster turns into permanent necessity to maintain the aid, which sooner or later, becomes unacceptable for donators. The former recipient of free aid, in face of oblivion and rejection, becomes unable to solve his/her problems on his/her own.

7. Knowledge supported from the public funds

Taking into consideration the arguments presented in Sections 5 and 6, a question arises: what can be financed from taxes in the knowledge-based economy to not destroy economic mechanism? The answer follows from two different motivations: social and economic ones.

For social reasons it is worth to finance from public funds the dissemination of knowledge indispensable for social coexistence, i.e., the knowledge that has rather social than economic impact. People are not ready to pay for acquiring such knowledge, but social interest requires its acquisition by as many people as possible. A first aid is an example of such knowledge. Statistically, dissemination of the knowledge about the first aid allows avoiding many individual drama. But statistically only minority of people are willing to pay for first aid training, maybe because most often first aid is offered to a stranger. Therefore, it is in common social interest to finance spread of this kind of knowledge from public funds.
For economic reasons, it is purposeful to finance every action aiming at extension of the knowledge sector market from public funds. The argument for such financing is that people without certain basic knowledge cannot play an active role on the knowledge market. From the economic point of view, it is also acceptable to finance the “knowledge without development”, i.e., a canon of knowledge (for example, knowledge of basic laws like Ohm’s law in electrical engineering). Such financing does not stop knowledge-based economy development, because this kind of knowledge does not develop anymore. Another applied practice is selective financing of research, development, and innovations in enterprises. Since this kind of subventions is addressed only to selected enterprises, it indeed disturbs the market. However, a justified motivation of this practice is to stimulate economic development, even at the cost of some inequality of enterprises and unfair market play.

8. Knowledge privatization

In accordance with this concept, particular pieces of knowledge have its owners. The rights to knowledge are protected by intellectual property rights upon principle of ownership, which means that private knowledge cannot be used without its owner’s permission. To have an access to private knowledge one has to purchase patents or licenses.

Privatization of knowledge can also stop development of the knowledge-based economy. First, for economic reasons: potential users of knowledge cannot afford buying it. Second, because of lack of permission of the knowledge owners to use the knowledge they own. The second reason seems to be irrational from the economic point of view. However, in many real circumstances, an enterprise decides to launch a new knowledge-based product or service not in the earliest possible moment, but in the most convenient for it, i.e., when economic conditions are considered the best. The period between development of a knowledge-based product or service and its launching in the marketplace may count many years. The reason for such attitude can be so strong position on the market of the current knowledge-based products or services that temporarily there is no need for placement of new ones. The owner of some piece of knowledge may do not want to use it to develop new products or services, because he/she does not want the new products or services to compete with its current ones, whose sale is still going well. Moreover, such owner of a piece of knowledge may prevent his/her competitors from exploiting that piece of knowledge, even if they have acquired the same piece of knowledge independently.

9. An example: A dilemma of the pharmaceutical market

A relationship between knowledge privatization and development, as well as related dilemma, can be well illustrated by an example of the pharmaceutical market. The economic approach to the pharmaceutical market is as follows. Effectiveness of a medicine is limited in time. The process of development of a new and effective medicine needs high expenditures for research. In accordance with the free market economy principles, financial resources to achieve this goal must be acquired from profits of current medicines sale. This is one of the reasons why prices of medicines are high. Too low prices would make research and development of new medicines impossible.

A social thinking about medicines is the following: countries are different with respect to wealth, but people suffer from the diseases everywhere, in poor countries even more often than in rich ones. Too expensive medicines make it impossible to cure people from poor countries.

There are three possible models that can be applied to the pharmaceutical market: economic, social, and hybrid. A consequence of recognizing knowledge as an economic good is a sustainable
development of pharmacology in the framework of an efficient pharmaceutical industry, which will enhance health care. However, the people who cannot afford paying for pharmaceutical knowledge embedded in medicines will suffer from illnesses and will die without treatment. First of all, it concerns people from poor countries.

A consequence of recognizing knowledge as a public good is the sale of medicines at a price close to the production costs. On the one hand, it makes medicines more available for poor people, but on the other hand it stops the development of pharmacology due to lack of funds. After some time it may cause ineffectiveness of medicines due to new strains of bacteria and viruses, and as a consequence, lower health care quality.

Finally, a hybrid model means that in rich countries medicines are sold to the patients at high prices, while in poor countries poor patients can buy (generic) medicines at low prices close to the production cost. Such model tries to reconcile to some extent economic development reasons with conviction about equality of all people in face of diseases, regardless their material status. However, it is necessary to note that generic medicines can be legally produced after 20-25 years from patenting. Such medicines may be already ineffective.

Of course, for humanitarian reasons rich countries or their rich citizens can offer modern medicines to poor countries, but such model is unstable. As mentioned in Section 6, rich donators can cease their aid in every moment. Such system may also – at least potentially – cause some kind of dependence of poor countries from the rich ones which may expect to get back their donation in other fields, economical or political.

10. Conclusions

As follows from considerations presented in this paper, the knowledge society and knowledge-based economy are a natural consecutive step of socio-economic development. Knowledge orientation follows from the impact of computer science on all the areas of science and technology. The knowledge, while preserving traditional value of an individual and social good, becomes a primary economic good in the knowledge-based economy. Therefore, it is so important to find an appropriate economic model based on a right trade-off between social and economic values. Free access to knowledge for everyone financed from public funds is not a right model, because it does not contribute to development. As follows from this paper, achievement of knowledge society without knowledge-based economy, i.e., trade of knowledge, is unrealistic.

On the other hand, full privatization of knowledge brings a peril that high-tech large private corporations from rich countries will protect everything new with patents and licenses. They will live as knowledge capital rentiers and will control development, which means de facto to slow it down. It is not in social interest of the world, because it reinforces diversification of countries which as a result may cause destructive clash of poor and rich. A compromise approach to knowledge proposed in this paper is motivated by the need of sustainable development of economy as a condition of social welfare. This approach consists of public financing only this part of knowledge sector that does not compete with economical activity or extends participation in knowledge-based economy to new social groups of people.
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TRAINING BUSINESS INFORMATICS IN BULGARIAN HIGHER EDUCATION INSTITUTIONS

Dimitar Christozov

Abstract
This paper draws the picture of training business oriented IT specialists in Bulgaria by distinguishing innovators and followers. It shares the experience obtained so far by one of the most innovative schools – the State University of Library Studies and Information Technology – in offering a new specialty oriented to train information brokers.

1. Introduction

Rapid development of computer and communication technologies changed all and every facet of human life. The last twenty years are characterized with digitalizing the world of business on macro level through globalization and on micro level via digitalizing all aspects of data collection, storage, dissemination, processing, analysis, decision making, planning, control, selling, purchasing, servicing, etc. This rapid development leads to rapid grow of the demand for business oriented IT expertise [7] and to significant change of expectation of what graduated students have to know and what they have be able to do from the very beginning of their carrier. Dynamics in the IT word caused dynamics in word of real business, which expects educational institution to follow similar dynamics in adjusting the curriculum and course content to respond to market needs.

From other side, educational institutions have to be more conservative in adopting the change. The IT word changed during the four years period of bachelor study, which means that the market demand for particular expertise also changed. Adoption of curriculum to address the momentum, may lead to too frequent changes.

The balance between early adoption and following is the problem faced by all educational institutions offered IT related training. The Bulgarian Higher Education does not differ from this tendency. For a school in a country like Bulgaria, the strategy of follower is more natural and majority of universities follow this pattern. To great extend, the real business in Bulgaria also adopts the strategy of follower, not early adopter, which also supports the conservative behavior in change of the curriculum.

This paper will try to draw the picture of Bulgarian Higher Education, oriented to train IT specialists for the real business, from point of view of dynamics in response to the market, by

1 American University in Bulgaria, Bulgaria
distinguishing early adopters from followers. The first section highlighted the basic trends in business informatics and shows how those trends are adopted in the standard curriculum in a bachelor level. In the second section the experience of State University of Library Studies and Information Technologies to behave as an innovator in offering relevant to the market need training is shared. The structure and content of a curriculum, oriented to train information brokers, is presented and discussed.

2. Trends in Business Informatics

2.1 Standard curriculum

The standard curriculum follows recommendation of ACM/IEEE [1] and the curriculum model proposed by IRMA [5]. Both documents are comprehensive and highly useful, but they address already established curriculum patterns, proved content. Building curriculum according to these sources is typical strategy for the followers.

There are three different patterns of adoption of those recommendations on bachelor level:

- As an element of the general business curriculum. All business students are offered IT oriented courses. The number of courses varies in different institution between one, in the American University in Bulgaria, and four – in Faculty of Economic and Business Administration of Sofia University.
- As specialization or concentration in business curriculum.
- As part of Computer Science or Information Technology curriculum, offered to students majoring primarily in informatics related fields.

On graduate level there is a great variety of borrowing from those recommendations in building programs emphasizing different aspects of this content.

2.2 Business intelligence

Training data analysts is one of the areas, recognized as the most rapidly evolving. In the USA Department of labor forecast (see [7]) this area of expertise is set to number one for opening new positions till 2016 – more than 50% grow of demand for specialists in this area, requiring bachelor degree

Business intelligence is a new academic field. Training specialist in the field of data warehouses and data mining requires solid background in several areas – information technologies; statistics; informatics, etc. And also, which is more important than academic background, experience in the real business. It is not surprising that business schools offer training in this field on graduate level. There are few exceptions. I will list here only two of them. Faculty of Mathematics and Informatics of Sofia University includes a course on Data Mining in its curriculum of the major of Statistics. In this case, the course emphasizes particular aspects of data mining – statistical techniques of learning from data. American University in Bulgaria offers such a course in its Information System minor, exploring the broad training of students typical for the liberal-art educational model.

2.3 Information mediators

The speed of development in IT field, the growing amount of data and variety of sources, the increase of markets’ complexity are only few reasons of growing demand for information brokers.
Training information brokers on bachelor level happened to be a challenging project. The broad variety of expertise (see [6]) is required to be successful. The next section shares the experience in building such a curriculum in the State University of Library studies and Information technologies. Usually, such training addresses students on post graduate level – mostly in the form of continue education; pre-qualification, etc. (see [4]).

2.4 Information Assurance and Security

Another area of training business informatics is the area of security. With evolving technology, spreading and increasing reliance of digitally available information resources, the problem of information assurance and security in all its forms reaches the real business in all sizes.

Training Information security now goes well beyond pure technical solutions as cryptography. It addresses all aspects of organizational, cultural, behavioral, and, of course, technical nature of a social organization.

3. Innovators: training Information Brokers

There is a school, on Bulgarian business informatics landscape, which behave highly as an innovator rather follower. This is the State University of Library Studies and Information Technology. Here, on the best of my knowledge, programs on bachelor level training Information Brokers and Information Security were launched emphasizing its broader nature. In this section the experience accumulated in launching and implementing a curriculum model for training of information brokers will be shared. The program was launched in academic year 2003/04 and the first class graduated in 2007.

Designing and launching an entirely new program, leading to bachelor degree, is a challenging job for every school, especially if this program is a new one not only for the school itself, but globally. Such project requires allocation of significant resources, first of all human and intellectual resources, but also financial, material and information. The puzzle of the new program is constructed by pieces of information collected from many sources. Also designing the curriculum for a new program has to balance between what is assumed to be needed with available training resources – relevant courses taught in other majors, instructors, training materials, laboratories, equipment, etc. available in the school, but designed for different purpose.

Information brokerage, as an educational subject, existed solely as qualifying professional training at that time. Special programs were designed for serving different categories of students, e.g. designed to qualified unemployed professionals to find a new carrier path (see[4]). Some universities offered graduate programs oriented to train the expertise we are defining as information brokering. But at the time of launching the major, mentioned above, there were no, on the best of our knowledge, programs designed for a bachelor level, which educated for information brokerage.

At that time, we had clear understanding about how important the earliest start of training in the field to accomplish the objectives of this program is, as well as quite clear understanding what has to be included in such a program. Also we were fully aware of the difficulties in building such a program, because lacking direct sources, we may learn from, and more important, because of the lack of social and professional experience students needed as a preliminary condition to advance in this subject. The third difficulty comes from huge and diverse corpus of knowledge we have to
accommodate and order. Lack of preliminary social experience requires ordering carefully the sequence of topics to allow smooth grow.

3.1. Needs of properly educated information mediators

The dilemma “sinking in information and being not enough informed”, characterizes the last twenty years. There are two major factors in supporting the need of establishing proper education in the field of informing clients, and therefore the need for professionally educated information mediators – information brokers.

The first one is the advancement of information technologies and its impact on all and every piece of human activities. In the last years all facets of human life have changed completely, making information technologies unavoidable attribute. The second major factor is globalization of the world economy, with two basic consequences:

- To do his or her every day business, to make proper and rational decisions, one needs information – complete, correct, reliable, etc. Both parties, sellers and clients, have similar access to information and to succeed in the business everyone has to be better informed.
- The amount of available information, which flooded our life, makes it impossible to dedicate the attention needed to comprehend the possible effects of one or another path of activities.

Effectiveness and efficiency in dealing with information becomes the most significant factor for success in any sphere of human activities and in the same time exploring information is becoming more complex requiring special knowledge and techniques.

Dedication of significant efforts for development own expertise in the field of information research often conflicts with the needs of other needs of particular profession. Big companies are able to establish their own bodies of professionals providing information services. The understanding of the need of proper use of information is growing and further extended to medium and even small size businesses. Often, they solved the above-mentioned conflict by using external consultants, whose role is to serve as mediators between “flood of information” and the client – information brokers. Thus the role and market demand for services of information brokers in its two qualities – as independent consultants, and as information service experts is growing and this process will continue.

3.2 The corpus of knowledge

We have recognized the following special areas of expertise, the information brokers need to posses to be a successful professional information broker. Of course, any additional qualification in a particular specific area of knowledge is a plus.

3.2.1 Information searching and delivery

The following factors affect effective and efficient search of information:

- The volume of accessible resources. Through Internet one can get free access to such a huge volume of information.
- Not free accessible sources. The most valuable information is delivered via sources, which do not provide free access. Also, the most precious information is available as ‘old fashion’ hard copy or it is possessed solely by human experts.
- Good understanding of the tools used by searching engines (e.g. organization of indexes) helps in writing queries, which improves the quality of the retrieve sample.
- The diversity of sources, which impacts the quality of information, requires expertise allowing assessing information from point of view of reliability and trustfulness and expertise about techniques to verify that.

3.2.2 Efficient use of IT

Skills of efficient use of Information technology are essential nowadays for everybody, but this is especially important for professionals dealing with information. The major objective in training such skills is to develop self-learning attitude – continuous learning and ability to learn by experimenting with new technologies. Usually, during a regular period of study of four years, information technologies pass at least two realizes and when students graduate, they will operate in completely different technological environment, compared to those they started their study with.

3.2.3 Analysis and structuring of information and creation of secondary information

Nowadays, skills in information retrieval, as it is understandable by classical field of Information Science, are not sufficient to serve clients. Retrieved information need to be analyzed, structured and presented to clients in the best form to serve their needs.

Statistical knowledge, as well as knowledge about data analysis drawn from other disciplines, such as machine learning, artificial intelligence, etc., is essential for discovering the pieces of valuable information from available data. Additionally, presentation of information requires knowledge of psychology, because the role of Information broker is to serve human clients.

Achieving expertise in this broad area is critical for successful information broker, but training it on bachelor level is quite challenging:

- The students are still inexperienced about the realities in business, and cannot understand clearly the complexity of the problems;
- The lack of sufficient mathematical background, demands comprehension of those methods and techniques and does not allow students to start building the necessary knowledge and skills on the earlier stages of their studies;
- The area is too broad, some of the topics and techniques are still on research level, but dynamics in the field requires their introduction to students.

3.2.4 Consulting and business

The essence of the job of an Information Broker is consulting. Students need to gain information and to develop skills in performing consulting activities in a professional manner, which includes writing offers, contracting, planning, reporting, etc. Also, skills of running business, as basic accounting and principles of management, are quite important. Additionally, the majority of problems information brokers will face in their professional career are business problems.
This places understanding about the business and economics among the necessary elements of training.

### 3.2.5. Information systems design

A special part the corpus of knowledge needed is the design of information systems. Their role is to bridge between clients and technical staff.

### 3.3 The structure of the curriculum model

In building the curriculum model of Information Brokerage major, we face the problem of how to order courses in a way to allow smooth introduction to so diverse fields. Also, we have to solve the problem of appropriately trained instructors. The curriculum model applied is a tradeoff between, what was recognized as necessary and what was available and possible.

We divided the courses offered in the following categories:

#### 3.3.1 Introduction to the profession

“Introduction to Information Brokerage” (see [3]) is the very first course in the curriculum. Its role is to draw the big picture. It defines the role of information brokers in the society, the major problems they have to solve: information retrieval from heterogeneous sources, structuring, generalization and presentation of secondary information. The course introduces fundamental concepts as information, communication, system, cybernetic system, information system, information technology, etc.

#### 3.3.2 Fundamental knowledge

The first two years of studies, curriculum stresses on building the required fundamental knowledge. The basic concepts needed in the different fields of study are presented in this group. The following disciplines contribute in building the corpus of fundamental knowledge:

- Mathematics (Algebra, Analysis)
- Informatics Fundamentals (Discrete Mathematics)
- Information Systems
- Information Science Fundamentals
- Information society and policy
- Data/documents processing
- Documental sources
- Knowledge organization and management, etc.

#### 3.3.3 Specific knowledge

This set of courses represents the back bond of the curriculum. Students are trained on specific qualification needed by information brokers.

- Information Management. This course covers the factors necessary for successful management of information systems. Both technical and behavioral aspects of project
management are applied within the context of an information systems development process.

- **Probability and Statistic.** It develops the skills and insights required to make effective use of statistical methods and techniques. The course covers rigorous training on fundamentals of probability theory and applications of basic statistical methods, such as regression analysis and forecasting. The course also trains the use of statistical software.

- **Systems analysis.** The course provides experience determining system requirements and developing a logical design. A variety of development approaches are exposed to the students.

- **Theory and Practice of Consulting** trains students on basic skills required by professional consultants: writing CV, developing offers for tenders, contracting, planning, reporting, etc. Also it trains some basic techniques as market study and reading financial statements.

- **Introduction to IB Law and Legal regulation.** Students are introduced to legal issues of professional practice and ethical behavior. Topics included are drawn from the fields of commerce and contractual law.

- **Mathematical Foundations of IB.** It represents an introduction to modern financial theory, mathematical techniques and formal mathematical reasoning; it emphasizes development of practical application skills as well. The students are introduced to securities market, “portfolio” theory, and to the modern banking system.

- **Information Brokerage.** This is a cap-stone project. It emphasizes the application of specific knowledge acquired so far to fulfill effective information service, consulting, information management and intermediation. It addresses also the ability of students to integrate the knowledge and skills to solve problems and to run business in the field of information service.

Students may choose also among the following elective courses: **E-commerce and E-Business,** **Artificial Intelligence and Expert Systems,** **Scientific research methods,** which also contribute to this area of expertise.

### 3.3.4 Technical skills

Training technical skills both in using information technologies and in applying specific analytical methods are essential for Information Brokers. This group of courses includes:

- Optimization,
- Applied Software,
- Internet,
- Database Design and Integration,
- Programming Fundamentals,
- Computing system architectures,
- Computing Networks and communications,
- Information security,
- Software Ergonomics,
- Projects Design and Management.

The students acquire experience to algorithm development, principles and application of computer hardware and software programming, data base, computing networks and communications etc. They will use them as tools for organization, communication, research, and problem solving.
The group of elective courses in this category is composed by: *Object-Oriented Programming, Logic Programming, Artificial Intelligence and Expert Systems*, etc.
The technical disciplines form abstract, technical, and algorithmic way of thinking, “computer literacy” and “information technology literacy”. They give the info-broker the necessary technical skills to collect, summarize, process and interpret data and information in design, development and implementation of contemporary information systems.

3.3.5 Social and business skills

The next area covered by the curriculum includes courses oriented to social and business skills of the future brokers.

Besides technical background, each info broker is expected to operate effectively and efficiently in society. This includes accepting and valuing the diverse opinions and perspectives of others, accepting responsibility for professional and personal behavior and keeping abreast of social and political developments as well. The disciplines *Philosophy, Political science and Business Psychology* are classified in this group.

Since the information brokers operate within organizations and with organizational systems, they must also understand organizations and the functions within organizations (finance, marketing, human resources and so on). In the curriculum they may choose two courses out of *Management of a Company, Business communications, International Finance, Competition*. They contribute in acquiring of useful business skills and substantive managerial abilities of students.

3.3.6 Language skills

This is the last, but not the least important group of skills. Currently about 90% of the content accessible on Internet is in English, which makes proficiency in English a necessary skill. English is studied during every year of the curriculum and includes four levels: *Elementary, Pre-Intermediate, Intermediate* and *Upper-Intermediate*. To guarantee working knowledge of English for graduates, an intensive English course is offered for seniors, which includes four classes twice a week.

The *Business Russian* is an optional language course in the IB curriculum. It requires some preliminary knowledge of Russian on intermediate level.

3.4 Discussion after six years of experience

Information Brokerage as a field of academic study is new not only for our school. There are several forms of post-graduate qualification training, especially addressing training of unemployed professionals (see [4]). This attempt of offering Information Brokering as a regular discipline on bachelor level meets curtain social demand. The growing interest in this new specialty is an indication for the recognized conscious need of such professionals. Evidence of this tendency is the increasing number of candidates for study Information Brokerage over the years (see Table 1). The word tendency of switching from more technical to more analytical areas affects the job market in Bulgaria as well. In the same time, the job market has no experience with such profession and the role of the first graduated classes is to create the market for this kind of professionals.
<table>
<thead>
<tr>
<th>Academic year</th>
<th>Number of candidates</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003/2004</td>
<td>539</td>
</tr>
<tr>
<td>2004/2005</td>
<td>764</td>
</tr>
<tr>
<td>2005/2006</td>
<td>1314</td>
</tr>
<tr>
<td>2006/2007</td>
<td>2593</td>
</tr>
</tbody>
</table>

Table 1: Count candidates for an academic year

The Information Brokerage curriculum as it is offered today is a product of 4 years of experimentations and refinements. The most serious difficulties in this process were lack of skilled teachers, training resources, textbooks and as last but not least lack of previous experience in other universities we may learn from.

4. Conclusions

The current market of Business oriented IT specialist is highly dynamic and fast growing. The real business expects students, graduating from the universities to possess knowledge and skills, which will allow them to contribute without or short training. They expect that such training addresses the nature of business and not the available technologies, methodologies, objectives, etc. The higher education institutions, which continue to follow the conservative role of followers, are exposed to train students who will not be able to meet the market expectations. Dynamics in the job market requires dynamics in education and the experience of innovative schools proves that.

To be an innovator is very challenging. It requires on-going refinement of curriculum, with extra work load for instructors and for the whole institution. The lack of trained instructors and dedicated training materials are among the most obvious obstacles in such projects. On the other side, the market demand supports the efforts of innovators. On a discussion, organized by the newly established “Club of IT managers in Bulgaria”, managers of IT departments of banks, telecoms, large industrial enterprises shared that the current graduates are not well prepared for the realities in the business world. They asked for shifting the curriculum toward training analytical skills; toward security of information systems in their complexity and toward training abilities to work with different aspects of information – large sets of data, explicit and tacit knowledge. Their major request was to train students in a balance between business and curriculum.

5. References


[5] IRMA recommendations


BIN-NET: A BUSINESS INFORMATICS NETWORK
BETWEEN AUSTRIA, THE CZECH REPUBLIC,
HUNGARY, IRELAND, PORTUGAL, ROMANIA AND
THE SLOVAK REPUBLIC

Elena-Teodora Miron

Abstract
BIN-Net – the Business Informatics Network started in 2004 as an Erasmus funded project aiming
to develop and implement a Joint Master Degree within 10 universities, mainly from Central and
Eastern Europe. Besides striving to establish a common curriculum in Business Informatics, the
network aimed to provide a basis for research and teaching collaborations. The paper at hand
presents the motivation for establishing the network, the project course, results achieved and
lessons learnt, as well as perspectives for future cooperation and research.

1. Establishing the Business Informatics Network

Amidst 2003 major changes among many factors influencing study programmes and cooperation
frameworks in universities were occurring. On the political scene the next enlargement of the
European Union towards Central and Eastern Europe was prepared; the European Union had
already started the Bologna Process aiming to reshape study structures and to create a European
Higher Education Area by 2010 and the development of Information and Communication
Technologies (ICT) was an omnipresent topic.

1.1. The changing environment

The biggest enlargement of the European Union was to occur on May 1st, 2004 by the addition of
ten new members to the community. A further enlargement, to include Romania and Bulgaria, was
considered and took place in January 2007. The inclusion of new countries in the European Union
was opening new cooperation possibilities among universities of ‘old’ and ‘new’ EU members in
community funding programmes.

The European Union started 1999 with the meeting of European Ministers in Bologna, as a part of
the “Lisbon Strategy for Growth and Jobs”, an initiative aiming to create a „European Higher
Education Area“ by 2010 with principal priorities on :

1 University of Vienna, Institute for Knowledge and Business Engineering, A-1010 Vienna, Brünner Str. 72.
• introduction of a three cycle system (Bachelor, Master, PhD)
• quality assurance
• recognition of qualifications and periods of study

Cooperation scenarios in developing new study programmes became increasingly attractive.

Especially the development of Joint Degree Programmes, which were aimed to lead from a recognition system of study periods abroad to an integration of those stays in one specific study programme, which seems interesting and promising for the future. The criteria for a Joint Degree Programme were defined as followed [2]:
• the study programmes are jointly developed and recognised by several institutions
• students at participating institutions spend part of their studies at another institution
• the periods of study and examinations, which were completed at other institutions, are automatically recognised in full at their home institutions
• the teaching staff of each participating institution works out the curriculum together, formulates regulations for admission and the examination conditions and also teaches at the other institutions
• upon completion of the study programme, students receive either national degrees from the individual institutions or a degree which is jointly conferred.

1.2. Development of ICT and its effects on study programmes

Additionally to the structural changes of study programmes and student exchange schemes occurring on international and national level, the ICT-market experienced major changes within the last two decades. The development of new technologies, applications and services as well as of the internet led to pressure on Europe for producing highly skilled “IT-Professionals” because:
• ICT-industry innovates very fast and skill profiles are changing accordingly
• ICT is applied among different specialist domains, requiring interdisciplinary educated professionals
• Business internationalisation requires professionals who are able to deal with different cultures and organisational structures
• Business internationalisation makes the definition of standards for “IT-Professionals” necessary.

Business Informatics is the application field emerging with the introduction of ICT in the business world. The massive implementation of information technology infrastructure will boost the demand for Business Informatics specialists in Europe during the next years. The markets are already aware of this need, as the following quotation indicates: “On the top of the list are graduates who studied Business Informatics. They have an economic science and computer science background and have additionally profound knowledge of the branch and/or the internet”.

30
As the forecast above shows, it is estimated that investments in IT services will grow in all member states of the European Union, making requirements for specialists in Business Informatics even more urging. The median growth of 6% among all countries and areas of IT services places the development of this branch far above the estimated median for economic growth at a national level and thus representing an interesting employment opportunity for graduates.

2. BIN-Net: The application

Pursuing to apply for an international cooperation project to realise a common curriculum in Business Informatics different financing possibilities were considered. Quickly European Union’s Socrates-Programme was singled out. Its programme line Erasmus, which was dealing with higher education, contained in its second tier, the tool of “curriculum development projects”, which fitted exactly the objectives proposed.

In creating the project consortium three main criteria were considered:

- organizational structure available
- the necessary qualification of project partners
- geographical balance of project partners.

Organizational structure

When deciding upon the universities to be invited to join the consortium an important criterion was for them to have either a Business Informatics faculty – which in most of the cases was not available – or to have at least a Business Administration and a Computer Science faculty. Having both faculties was concluded to be a risk diminishing factor for the implementation process of the curriculum. In the long term it is important for each university to be able to sustain the study programme on its own, from the provision of teachers and/or lecturers, attraction of students and...
financial means. Universities which already have the input structures for such a study programme established, are more likely to succeed as the ones who need to set up everything.

**Specialist qualifications**

The contact persons from each partner university were selected upon their qualifications and experience for a Business Informatics curriculum and project management experience. A balanced mix between computer scientists and social scientists (like specialists in business administration, sociologists, etc.) was aimed at. Within each specialisation field it was strive to diversify as far as possible the qualifications available in the project consortium in order to cover a knowledge base as broad as possible.

**Geographical balance**

As the university cooperation programmes, student and teachers exchange numbers were relatively low with Central and Eastern European countries in contrast to the western part of Europe, it was decided to focus within the partnership composition mainly on the first region. Nevertheless in order to keep the geographical balance and considering the specialist input required one partner from Ireland and one partner from Portugal were invited to join the consortium.

Considering whether to invite one or more partner universities from one country to participate to the project the population of the respective country was the decisive criterion. Small countries, like Austria, Hungary, the Czech Republic, the Slovak Republic, Portugal and Ireland ended this way having one representing university in the project, while large ones like Poland and Romania have each two universities representing them.

For the neighbouring countries it was tried to find suitable universities as far from each other as possible. Nevertheless for the Slovak Republic and for Hungary two universities which are geographically relatively close have been chosen, due to their qualifications and the faculties available.

**2.4. The project proposal**

The project application proposed to develop a Joint Master Programme in Business Informatics, while the project focused on realising an innovative approach for a study programme compliant to the Bologna Architecture. It was considered that:

- Interdisciplinary education especially in the field of Business Informatics will be gaining importance, because on one hand the deployment of IT in the business process will increase and on the other hand ICT will forego an ‘industrialization and standardisation’ process on its own.
- Mobility and internationalisation will occupy a more and more important in the higher education, due to the globalisation process and the raising work force mobility.
- A stronger cooperation between academia and industry is needed in the Bologna Architecture on a Master level in project on ‘research’ level and for Master Thesis. Although universities and industry may have different objectives regarding the skills to be delivered to students - universities focus on science and reflective research, industry focuses on application development and deployment.
3. BIN-Net: The project

The BIN-Net project application was approved by the European Commission for funding under the Grant Agreement number 28545-IC-1-2003-1-AT-ERASMUS-PROGUC-1 and the project title “BIN-Net: Business Informatics Network in Common Europe”. The eligibility period of the project started on October 1st, 2004 and was planned to last until September 30th, 2007. Due to problems caused by lacking legal and institutional regulations for the implementation of Joint Degree Programmes the project consortium applied for the extension by one year of the project duration, application which was granted resulting in a final date of the project of September 30th, 2008.

The BIN-Net project showed its innovative character on two different levels: 1) by supporting the establishment of the “European Higher Education Area” as well as by 2) the establishment of a highly specialised, future-oriented interdisciplinary study programme with long-term growth potential. Furthermore, synergy effects resulting from the close cooperation between business administration and computer science have raised the competitiveness and sharpened the profile of the respective university units, supporting the absorption of research activities in the proposed application field.

During its due course the BIN-Net project achieved to:

- Establish a modular curriculum which offers bachelor graduates from either business administration or computer science studies, the possibility to diversify and deepen their interdisciplinary knowledge through further education.
- Diversify the proposed study disciplines in post-graduate education in order to diversify or complete core competencies, as well as competitiveness of the participating institutions where the Joint Master Curriculum – or a derivation from it – was implemented.
- Create a modular curriculum, allowing the re-use of developed courses, e.g. not only within the scope of the Master of International Business Informatics but also in regular teaching activities.
- Offer professionals, who seek additional competences at a high quality level the possibility to gain or deepen their skills in the interdisciplinary field of Business Informatics, supporting this way the life long learning process.
- Convey intercultural dialogue by involving universities from across Europe.

Nevertheless the set-up for the project proposed to provide the implementation of an internationally recognized Joint Master Degree in International Business Informatics. While on specialist and content level an agreement upon structure, skill and qualification profile, as well as the course content was fairly easy to reach, the administrative component of the project proved to be rather difficult. Universities awarding a Joint Degree need to:

- respect the legal framework which constraints the design of a joint curriculum.
define the admission criteria and requirements (the nomination through a partner university will automatically mean that he student fulfils the admission criteria).

- define the amount of ECTS-credits the student has to obtain at the partner universities.
- define the modules the student can follow at the partner university.
- define the regulations for study fees and mobility grants.
- establish the possibility of authoring scientific papers or the master thesis supervised by professors from the partner universities.
- define an academic title recognized by the universities participating in the Joint Degree Programme.
- run the accreditation process if applicable.

Items depending on national regulation and/or institutional procedures were in many cases not manageable, either due to a lack of legislation and institutional procedures or because of reticence among the participating institutions to embark on such a difficult issue.

Nevertheless the project consortium managed to set up a network, which although not established to a formal act, is a living entity gaining new members, as well as dealing further one with the administrative hurdles met by the Joint Degree Programme in International Business Informatics.

4. **Curriculum of the “Master on International Business Informatics”**

In the Joint Degree curriculum information, is provided on: the definition of Business Informatics within the curriculum context, on admission and examination rules, skill and competence profiles graduates will have acquired and the modular structure – including the syllabus of each course.

4.1. **Basic terminology**

Within the terms of the Joint Degree curriculum it is understood that Business Informatics’ main task is to design and implement company information systems, to further develop and introduce organisational concepts, to support specialists at the development and implementation of application software for companies as well as to carry out theoretical and applied research for application of Information and Communication Technologies (ICT).

Business Informatics makes use of Business Administration models and descriptions as well as Computer Science techniques and methods. The methodology used by Business Informatics qualifies it as a high-tech discipline and demands students the ability of analytical thinking and recognition of interdependencies.

The study programme will cover the field of applied Business Informatics taking into account the theoretical background. It aims to educate students to entrepreneurial thinking and acting persons. They will collect and update knowledge in Business Administration and Computer Science and learn to apply this knowledge in practice. They will deepen skills previously acquired through study or professional activities.

Simultaneously to the professional specialisation the Master of International Business Informatics aims at strengthening the integrative view of the discipline, which emphasizes the interaction and mutual penetration of business administration, economical, technical, sociological, legal, ergonomic and communicational components, theories, models and methodologies.
4.2. Competences and skill profiles of graduates

Graduates of the Master of International Business Informatics will be equipped with the following competences:

- Professional competences
  The Master of International Business Informatics leads students to the ability and practical skills for adaptation and development of Business Informatics methodologies. Students will also gain the ability to work together with professionals from different application areas in interdisciplinary teams. They will have the capability to communicate with users on an adequate level about results of Business Informatics analysis and to support these during the implementation process.

- General competences
  Beside professional competences the students will be equipped with competences important for their future professional life: English specialist language, problem solving competencies, teamwork, presentation techniques, independent literature search, familiarity with new media and new information technologies, as well as learning and adaptation capabilities for lifelong learning.

- Ethical competences:
  Ethical questions like the objective and confidential handling of data are relevant during Business Informatics activities. Beyond the corresponding legal regulations the students will be equipped with understanding of responsible dealing with confidential data.

Students will also have further achieved:

- “Hard” Skills:
  - Design and implementation of company information systems
  - Development and introduction of organizational concepts
  - Specialist support at the development and implementation of application software
  - Knowledge of “specialised” English language
  - Project management skills

- “Soft” Skills:
  - Ability to adapt to different cultural and organizational structures
  - Ability for team-working
3.3. Modular structure

The final curriculum on the Joint Degree Programme “Master of International Business Informatics” was designed in a modular form.

The basic structure is composed of a group of four major topics:

- Introductory courses, which aim at two targets:
  - to help bring the knowledge level of the students to a homogenous level, meaning that students coming from Business Administration studies have the possibility to focus more on technical modules, while students coming from Computer Science studies can focus more on business oriented modules. The flexibility is provided within the first semester of study by a set of electives, with different foci, from which students can choose.
  - to help those students coming from other study disciplines to receive a basic insight as well in Business Administration as in Computer Science.

- A course string of “Business Informatics” modules, which can be regarded as the backbone of the programme. In every semester, except the fourth one when students realise their Master Thesis, one “Business Informatics” will take place, focusing on relevant topics.

- The specialisation will be realised within the “Advanced Topic” module groups. An “Advanced Topic” is a combination of four modules with a common professional focus. An “Advanced Topic” has to be composed of at least two or three modules, which belong to the field of Business Informatics. The other module(s) have to complete the Business Informatics modules in a meaningful manner. Each Advanced Topic focuses on one specific important topic of Business Informatics, providing within four modules in-depth knowledge with lectures, seminars and practical trainings.

- The Master Thesis together with the corresponding seminar represents the last block.

The structure created by the BIN-Net project consortium provides on one hand “a ready to use” curriculum for any university wanting to adopt such a programme, but also has a high degree of flexibility for adaptation at local constraints. Furthermore, it provides modules which can be used within other educational programmes.
5. **Conclusion**

The BIN-Net project finished about four months ago. All the content and specialist tasks have been achieved, while implementation steps in different partner institutions are still pending. In order to ensure the long-term sustainability of the Joint Degree Programme “International Master in Business Informatics” the following steps will be realised:

- Firstly, the cooperation for the implementation with the consortium partners will be continued where it is desired and applicable.
- Secondly, two universities have shown interest to joint the network in order to implement the Joint Degree Programme. The University of Applied Sciences of Nordwestschweiz, Solothurn (Swiss) has implemented a study programme of 90 ECTS which has been designed to complement the Joint Master Degree Programme and to be integrated, as a later step. Furthermore the University of Utrecht (Netherlands) has a one year study programme, which they would like to upgrade in order to join the BIN-Net Network. Discussions with the FH Nordwestschweiz are carried on the level of pre-contract negotiations for the collaboration, while discussions with the University of Utrecht are in the phase of content discussions.

6. **References**


BUSINESS INFORMATICS IN ROMANIA

Stefan Ioan Nitchi

Abstract
In this paper the author comments upon informatics and especially upon economic informatics (EI) in Romania from the point of view of a person that has been a researcher for 26 years and head of the Research Laboratory in Data Base and Transaction Systems Programming Environments of the Research Institute for Computing Technique (ITC - www.itc.ro) from Romania and who has been, for 17 years now, professor and head of the Economic Informatics Department within the Faculty of Economics and Business Administration (FSEGA – www.econ.ubbcluj.ro) of Babeș-Bolyai University of Cluj-Napoca (BBU – www.ubbcluj.ro). This note is rather an essay than a survey on the domain of discourse. The main issue of this paper will be the Romanian experience in informatics and EI in general, with focus on education in these fields, and our department as a case study.

1. Introduction
The EI is at a state-of-the-art level and education in this field can be considered a paradigm. Starting from our ideas, at a recent meeting\textsuperscript{2}, with a wide participation of the representatives of Romanian Universities, it has been decided to edit under the guidance of INFOREC\textsuperscript{3} a survey of the main faculties and departments in this field in Romania. This study will be published as a monograph at the International Conference in Economic Informatics in May 2009, organized by INFOREC at the Academy of Economic Studies (ASE – www.ase.ro) in Bucharest.

2. Informatics in Romania
The history is so long. The start was made by some visionary professors like Grigore Moisil from the University of Bucharest or Tiberiu Popoviciu from Babeș-Bolyai University of Cluj-Napoca. The researches in this field began their studies in the ’40s or in the ’50s. In this respect, the first Romanian computers were created very soon, that means CIFA-1 at the Nuclear Institute of the Romanian Academy (1953-1957), MECIPT-1 from the Politechnical University of Timișoara (UPT - www.upt.ro, 1961) and DACICC-1 at the Computing Institute of the Romanian Academy of Cluj-Napoca (1958-1959).

Unfortunately, in Romania, the development of informatics took place in waves. After a period of stagnation, when some Romanian second generation computers were developed, a small number of the 3\textsuperscript{rd} generation computers like IBM-360, ICL 1900, Siemens or Elliot 4100 were imported.

\textsuperscript{1} Babeș-Bolyai University of Cluj-Napoca, Romania, Faculty of Economics and Business Administration, Romania
\textsuperscript{2} The Economic Informatics Days of Cluj-Napoca, October 11-12, 2009
\textsuperscript{3} INFOREC is a professional organization that promotes Economic Informatics
Around 1965, some openness appeared. In this respect, in 1967, the ITC was founded in Bucharest with subsidiaries in Timișoara and Cluj-Napoca. This institute was responsible for the development of IT&C. In 1970, the ICI was set up\(^4\). The original purpose was to develop the field of Applied Informatics in Romania and, starting with 1973, to coordinate the Territorial Computing Centers that were in charge of Applied Informatics in the different regions of Romania. In 1968, CII\(^5\) licensed the computer IRIS50, renamed in Romania Felix C-256. This license was much commented by the specialists, but thanks to it, Romania became one of the most important main frame exporters in the ex-socialist countries, China being our most important client. Between 1975 and 1977, minicomputers were set up for the Independent and Coral families compatible with PDP-11 of the Digital Equipment Corporation. These computers were exported to Germany, the Czech Republic, Iran, Syria, Egypt, but mainly to China.

In the ‘80s, before 1989, the Romanian microcomputers from the Technical University of Bucharest (UTB acs.ubt.ro), ITC, and The Electronic Computer Factory Bucharest etc. were developed. The main problems in the development of the PCs were [1] “Ceaușescu did not agree with the electronics because this needed currency and, in addition, the notion of personal computer was not corresponding to the Communist Party ideology. In Romania, such terms as microcomputers or programmable automata for instruction were used”. After 1989, the PCs rapidly spread in Romania, but because of the gap between Romania and the other EU countries the recovery was very difficult. The Romanian Governments have had different programs to develop the PC market and usage.

The nets were developed between 1975 and 1976 by the modems, and the first projects at ITC, ICI, etc. The main problems were the quality of the lines and the very low speeds (110-4800 bauds). The first net based on package commuting was developed at ICI, but this project was stopped in 1985 \(^4\). In 1991, the first node from Romania was financed at EARN and in 1992 the first Romanian node (EARN.BITNET) was realized, connecting through the University of Vienna. In 1993, the first project, RoEduNet was created for the development of a net for research centres, universities, high schools and cultural institutions, and the first private commercial Internet operator SC UUNET SRL began its activity. Since 1998, RoEduNet has been a national institution coordinated by the National Agency for Scientific Research and by the Ministry of Education, Research and Youth. It is a member of TERENA (Trans-European Research and Education Networking Association) and CEENet (Central and East European Networking Association)\(^6\). In 1992, the Directory Program for Development of Romanian Informatics was elaborated, and in 1995 the principal elements of the National Strategy for Information Society were established in Romania in 1996 [6]. Another step was the Romanian Government’s Decision No. 1440 in December 2002, regarding the National strategy to promote the new economy and to implement the Information Society, the basis of the development of this field in Romania. 2003 represents the starting year for the Ministry of Communication and Information Technology (MCTI - www.mcti.ro) in charge of the implementation of that strategy.

The number of internet users (expressed in millions) per year in Romania is represented in Figure 1. According to the providers, in June 2008, Romania registered the biggest increase in the Internet connections in Europe. 2.29 million Internet connections were registered in 2008 at fixed points,

\(^4\) The original name was Central Institute for Informatics, but since 1990 the name is The Research Institute from Informatics
\(^5\) Compagnie Internationale pour L’Informatique
\(^6\) www.roedu.net/default.php
450,000 in addition to 2007, and 1.2 million of connections at mobile points, an increase by 80% compared to 2007. 99% of the connections are in broadband.\(^7\)

The evolution of E-Banking in Romania is shown in the following table and is represented in Figure 2.

<table>
<thead>
<tr>
<th>Year</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Users</td>
<td>18259</td>
<td>44538</td>
<td>100799</td>
<td>621275</td>
<td>1540622</td>
<td>2015317</td>
</tr>
</tbody>
</table>

An advertising study of IAB Romania and PricewaterhouseCoopers\(^8\), on June 24 2008, considered that the Romanian market would grow from 10 million Euros in 2007 to 15-20 million Euros in 2008. The growth in advertising on the Internet, as it is considered by “Media forecasting 2008” Deloitte study, will be by more than 50% per year. Other authors are more optimistic\(^9\).

Unfortunately, the crisis will be felt in Romanian IT companies as well. In this respect, in the last period of time, the values of the IT companies have diminished by 15-20%, as estimated by Business Standard, while Eugen Shwab Chesaru, CEO of Pierre Audoin Consultant (PAC), considers that in 2009 these will lose 30% of their worth, and in 2010 it is possible for the IT companies to be 50% cheaper [8].

\(^7\) COMPUTERWORLD, Romania has the biggest growth in Europe concerning the Internet connections, December 03, 2008.

\(^8\) economie.hotnews.ro/stiri-media_publicitate-3691121-piata-publicitate-online-evaluata-independent-iab-romania-pwc.htm

The software development in Romania was very similar to the software development in the world. It means we could more or less divide the history in exactly five waves.

<table>
<thead>
<tr>
<th>Years</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1953-1965</td>
<td>The first generation was oriented to numerical analysis problems and to solving operation research issues. The programming was developed under machine code or assembling languages. The first FORTRAN compilers were developed.</td>
</tr>
<tr>
<td>1965-1968</td>
<td>The development of EI programs, inventory or salary and the first integrated information systems were tested etc. The first COBOL compilers were developed.</td>
</tr>
<tr>
<td>1968-1975</td>
<td>The CODASYL Data Bases and integrated applications at the company level etc. were developed. There were also created many methodologies in the development and the use of batch processing and computer centres. The main problem was to achieve efficiency at company level and return on investment.</td>
</tr>
<tr>
<td>1975-1989</td>
<td>The Romanian informatics was developed mainly on minicomputers. There appeared the first huge integrated systems to solve the enterprise problems. Different programming environments were developed for Fortran, Ada, Pascal, C, Basic Plus, Modula, different kinds of DBMS, like DBMS-11 of DEC, or implemented dBASEIII-Plus etc. The first distributed applications were started. It can be considered that a mature industrial and economic informatics was underway.</td>
</tr>
<tr>
<td>1989 - Now</td>
<td>1989 was the beginning of the modern software development [1]. The old state monopoly disappeared. Unfortunately, only ICI remained as a research institute in informatics. The research is nowadays carried out in universities, in the Romanian Academy and also in some small groups or enterprises. Romania does not manufacture hardware, but the software industry is well developed.</td>
</tr>
</tbody>
</table>

### 3. The education in informatics and in EI in Romania

#### 3.1. General presentation

Education in the field of informatics in Romania has a pyramidal structure, with specialized informatics and general education high schools at the base, BA and MA studies at the middle level, and PhD studies at the top.

Historically, the first ones were the BA studies within the Departments of Computer Machinery at the University of Bucharest and BBU, at the Faculty of Mathematics in 1959. The computer science studies started in 1964 at the Faculty of Automation and Computers within the UPT and in 1967 at the PUB. Today, many state and private universities have Informatics and/or Computer Science Faculties.

Representatives of the openness in 1965, Grigore Moisil and some other intellectuals explained to Ceauşescu that the economy could not work without informatics. In this respect, in 1967 CEPECA (the Centre for the improvement of the staff) was founded, financed by the UN that had the mission to prepare top managers in Romania. The lectures were held by UN experts. These delivered lectures to the top managers to make them sensitive to computers, information systems and EI.

Some presentations were delivered concerning informatics and its usages between 1965 and 1969 at the Cybernetic Committee of the Romanian Academy, led by Grigore Moisil. The participants analysed the curricula of the new Informatics Departments. The conclusion was that the curricula contained much more unusable mathematical theories and lacked in economic disciplines. For this
reason was set up the Cybernetics, Statistics and Economic Informatics Faculty (CSEI) at ASE in 1967.

In 1990, the EI Chairs were set up at BBU and at the University of Craiova and, one year later, the first EI departments with BA studies were initiated. A map of the actual geographic distribution of EI higher education in Romania is presented in Figure 3. Next, we will present shortly the main actors in education in Economic Informatics.

Figure 3. The map of the distribution of higher education institutions of EI

3.2. The Main actors in higher EI education

In Bucharest the first university is ASE; it is a state university. It contains two faculties. The first is the FSCEI, as it was mentioned. At BA level they have EI studies. At graduate level, there are 7 programs (EI, Data Bases, E-Business, Project Management using Informatics, Information Systems for the Management (ERP), Information Security and Forecasting and Decisions in Finances and Insurance. The faculty also includes a PhD School with 13 advisors. The second is the Faculty of Accounting and Administration Informatics, which was founded in 1993. At BA level they have studies in Accounting and Administration Informatics, while at graduate level they have Accounting, Auditing and Administration Informatics. They also run PhD programs, with 6 PhD doctoral advisors in charge.

The second university in Bucharest is the Romanian-American University, a private university. They have a Faculty of Management Informatics (www.rau.ro), which was opened in 1998. Their studies are at BA level in Management Informatics and at MA level in EI.

The second city as importance is Cluj-Napoca, where we have 3 EI departments. Our EI department is within FSEGA of BBU. As we have already mentioned, the BA EI studies were introduced in 1991. At the MA we have 3 programs: EI and Information Society, Decision Support Systems in Economy, and e-Business. We run PhD programs under the supervision of 3 professors.

The second actor is “Bogdan Voda” University (www.ubv.cluj), a private university that has BA studies in EI at the Faculty of Economics since 1991.

The third actor is the Technical University of Cluj-Napoca (www.utcn.ro), a state university that introduced BA and graduate studies in Economic Computer Sciences at the Faculty of Automation and Computers since 2007.
Another important actor is the Faculty of Economics and Business Administration (FEAA) of “Alexandru Ioan Cuza” University (www.uaic.ro), a state university in Iaşi. They developed an EI BA program and 3 graduate studies in Administration Informatics, Information Systems for Business, and Accounting Information Systems. They also have a PhD school with three EI doctoral supervisors.

FEAA of West University of Timișoara (www.uvt.ro), a state university, has introduced an EI BA program and 4 graduate programs: Accounting and Integrated Information Systems in Corporations, Information Systems in Business, Information Systems in Finances, and Formation-Research-Innovation in Knowledge Society.

Remarks.

1. The faculties of ASE and BBU, Iaşi and Timişoara are considered to be the best and they form together a Consortium in EI education.
2. Because many faculties implemented the Bologna Program, 3 years at BA level, 2 years at MA level and 3 years for PhD studies in 2003 or 2004, now we have 3 and 4-year undergraduate programs and, therefore, 1- or 2-year graduate programs.
3. Some universities have postgraduate or post-PhD programs, not mentioned in this paper.
4. Only 3 universities have PhD programs in EI or related to it.
5. The EI chairs deliver the core or optional EI courses for the other departments of their faculties.
6. In some universities, such as Braşov or Sibiu, 1 or 2 years ago, the EI BA program was transferred from the Faculty of Mathematics and Informatics to FEAA.
7. Only 3 universities have PhD programs in EI. These are organized into three 3 phases. The first phase, the PhD School, lasts one year during which the doctoral candidates study 5-10 subjects and are given the corresponding exams. At the end of this year, the students need to elaborate and defend a research report. The second stage lasts 1 or 2 years and consists in 3-4 papers. The thesis has to be finished in 3 years, or 4 at the most, since the beginning of the stage.

3.3. Some other aspects concerning the activities in the EI education

In 1993, the INFOREC was set up as the ASE initiative. Among the activities of INFOREC is the organization, every two years since 1993, of an International Conference in Economic Informatics at ASE. The journal “Economic Informatics” has been edited since 1977, with 4 issues per year. It has subsidiaries in Cluj-Napoca, Iaşi and Timişoara. Then, each year since 2000, the Grigore Moisil award has been granted to a personality in the EI, student contests are organized and books are edited. Concerning the conferences, each year there are some national or international EI conferences and workshops, in Cluj-Napoca, Iaşi, Timişoara, Suceava, Oradea, Craiova etc. Some of these are indexed in International Data Bases and some are ISI Proceedings or IEEE (Oradea, Timişoara, Suceava etc.). There are also other journals published in EI and the related fields, besides EI. In this respect, we can mention the Economic Computation and Economic Cybernetics Studies and Research (Bucharest) and IJCC (International Journal of Computers, Communications and Controls - Oradea), which are in the ISI mainstream, and the journals of different faculties in Cluj-Napoca, Iaşi, Craiova, Timişoara etc., which publish papers that are indexed in the main International Data Bases.

Generally, the cooperation with the economic environment is very good. Unfortunately, the Romanian business environment is not very well developed to have the necessary force to sustain
the research. For this reason, research activity in Romania is based mainly on grants supported by the state.

4. Economic Informatics at Babeș-Bolyai University

BBU is the biggest university in Romania, having around 56,000 students enrolled in 21 faculties with 111 departments. It is a multicultural university, running programs in Romanian (99), Hungarian (59), German (16), English (8) French (1), Ukrainian (2) [2] and soon some programs in Chinese, Korean, and Polish will start. FSEGA is the biggest faculty in Transylvania. It has 14,000-15,000 students in 11 departments with instruction in Romanian, Hungarian, German, English and French.

4.1. Students

A statistical situation of the students OF EI can be represented as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>Bachelor (Day Course)</th>
<th>Bachelor (Distance Learning)</th>
<th>Graduate</th>
<th>No. years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Romanian</td>
<td>Hungarian</td>
<td>Romanian</td>
<td>Hungarian</td>
</tr>
<tr>
<td>Start</td>
<td>1991</td>
<td>42</td>
<td>-</td>
<td>12</td>
</tr>
<tr>
<td>Graduate</td>
<td>1996</td>
<td>41</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Rate (%)</td>
<td>97.61</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Start</td>
<td>1992</td>
<td>84</td>
<td>-</td>
<td>14</td>
</tr>
<tr>
<td>Graduate</td>
<td>1997</td>
<td>75</td>
<td>-</td>
<td>7</td>
</tr>
<tr>
<td>Rate (%)</td>
<td>89.92</td>
<td>-</td>
<td>58.33</td>
<td>-</td>
</tr>
<tr>
<td>Start</td>
<td>1993</td>
<td>67</td>
<td>-</td>
<td>15</td>
</tr>
<tr>
<td>Graduate</td>
<td>1998</td>
<td>62</td>
<td>-</td>
<td>9</td>
</tr>
<tr>
<td>Rate (%)</td>
<td>92.53</td>
<td>-</td>
<td>64.28</td>
<td>-</td>
</tr>
<tr>
<td>Start</td>
<td>1994</td>
<td>77</td>
<td>-</td>
<td>31</td>
</tr>
<tr>
<td>Graduate</td>
<td>1999</td>
<td>68</td>
<td>-</td>
<td>10</td>
</tr>
<tr>
<td>Rate (%)</td>
<td>88.31</td>
<td>-</td>
<td>32.26</td>
<td>-</td>
</tr>
<tr>
<td>Start</td>
<td>1995</td>
<td>59</td>
<td>-</td>
<td>37</td>
</tr>
<tr>
<td>Graduate</td>
<td>2000</td>
<td>54</td>
<td>-</td>
<td>23</td>
</tr>
<tr>
<td>Rate (%)</td>
<td>91.52</td>
<td>-</td>
<td>62.16</td>
<td>-</td>
</tr>
<tr>
<td>Start</td>
<td>1996</td>
<td>62</td>
<td>-</td>
<td>27</td>
</tr>
<tr>
<td>Graduate</td>
<td>2001</td>
<td>60</td>
<td>-</td>
<td>15</td>
</tr>
<tr>
<td>Rate (%)</td>
<td>96.77</td>
<td>-</td>
<td>55.56</td>
<td>-</td>
</tr>
<tr>
<td>Start</td>
<td>1997</td>
<td>60</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Graduate</td>
<td>2002</td>
<td>52</td>
<td>-</td>
<td>16</td>
</tr>
<tr>
<td>Rate (%)</td>
<td>86.67</td>
<td>-</td>
<td>59.25</td>
<td>-</td>
</tr>
<tr>
<td>Start</td>
<td>1998</td>
<td>76</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Graduate</td>
<td>2003</td>
<td>65</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Rate (%)</td>
<td>85.52</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Start</td>
<td>1999</td>
<td>101</td>
<td>-</td>
<td>99</td>
</tr>
<tr>
<td>Graduate</td>
<td>2004</td>
<td>88</td>
<td>-</td>
<td>10</td>
</tr>
<tr>
<td>Rate (%)</td>
<td>87.14</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Start</td>
<td>2000</td>
<td>92</td>
<td>-</td>
<td>28</td>
</tr>
<tr>
<td>Graduate</td>
<td>2005</td>
<td>88</td>
<td>18</td>
<td>8</td>
</tr>
<tr>
<td>Rate (%)</td>
<td>95.65</td>
<td>64.28</td>
<td>80</td>
<td>66.67</td>
</tr>
<tr>
<td>Start</td>
<td>2001</td>
<td>77</td>
<td>-</td>
<td>39</td>
</tr>
<tr>
<td>Graduate</td>
<td>2006</td>
<td>47</td>
<td>19</td>
<td>22</td>
</tr>
<tr>
<td>Rate (%)</td>
<td>61.03</td>
<td>48.71</td>
<td>451.40</td>
<td>50.00</td>
</tr>
</tbody>
</table>
### Table 2

<table>
<thead>
<tr>
<th>Start</th>
<th>2002</th>
<th>82</th>
<th>40</th>
<th>4</th>
<th>2</th>
<th>15</th>
<th>4</th>
<th>5.5 &amp; 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graduate</td>
<td>2007</td>
<td>70</td>
<td>15</td>
<td>17</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rate (%)</td>
<td></td>
<td>40.67</td>
<td>17.42</td>
<td>23.52</td>
<td>40.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Start</td>
<td>2003</td>
<td>90</td>
<td>42</td>
<td>13</td>
<td>7</td>
<td></td>
<td>11</td>
<td>3/4 &amp; 3/4</td>
</tr>
<tr>
<td>Graduate</td>
<td>2007</td>
<td>70</td>
<td>15</td>
<td>17</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rate (%)</td>
<td></td>
<td>52.32</td>
<td>19.20</td>
<td>76.47</td>
<td>70</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Start</td>
<td>2004</td>
<td>84</td>
<td>42</td>
<td>10</td>
<td>7</td>
<td>23</td>
<td>3/4 &amp; 3/4</td>
<td></td>
</tr>
<tr>
<td>Start</td>
<td>2005</td>
<td>88</td>
<td>24</td>
<td>14</td>
<td>7</td>
<td>32</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Start</td>
<td>2006</td>
<td>84</td>
<td>24</td>
<td>12</td>
<td>5</td>
<td>23</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Start</td>
<td>2007</td>
<td>92</td>
<td>22</td>
<td>7</td>
<td>5</td>
<td>35</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Start</td>
<td>2008</td>
<td>112</td>
<td>11</td>
<td>7</td>
<td></td>
<td>63</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

**Remarks.** By analysing table 2, we may conclude that:

1. The success rate was better when an admission exam was used (until 2000).
2. The studies in Hungarian started in 1999, which means later than those in Romanian.
3. The success rate is approximate because there are students who have not graduated with their generation.
4. The number of graduate students grew after the implementation of the Bologna Program.
5. The number of graduate students is bigger since 2008, as we had a 3-year and a 4-year bachelor studies generation and as the graduates have enrolled in 3 master programs.

#### 4.2. Curricula

To illustrate the difference between informatics and EI we explain this to our students: “An e-shop can be made by students from computer science, informatics, you or even pupils from high school. You have to assure the knowledge about management, marketing, finance, accounting, simulation and forecasting, business plan etc. You need to be able to make an e-business by this.”

The curriculum is conceived by respecting some basic principles as the following:

1. The preparation needs to be interdisciplinary, it covers 4 areas: economic sciences and business, computer science, intermediary disciplines, and complementary disciplines. 30-40 percent of our graduates are working in informatics, 20-30 percent are working as employees in different economic fields, and the rest have their own business in different fields.
2. The preparation needs to be differentiated for each level of study.
3. The preparation needs to assure a balance between theory and practice.

The BA prepares operational personnel and first-level managers. In Romania, the economic and business software companies are well developed and need specialized testers, programmers, technical assistants, data base and data warehouse administrators. Some of them have their own SMEs.

The MA prepares people for EI analysts, middle or top managers in the same or different economic and business fields. One of the alumni, who is an economic top manager of a German-Romanian company said: “I have to admit that since my graduation I have never written a program line, but EI has taught me to analyse differently the problems, data and knowledge in the company.”

The PhD level usually prepares top managers, personnel for higher education, top analysts and EI developers, as ERPs, core banking systems, e-Business systems, economic and informatics advisor etc.

Some of our alumni are working abroad, from Australia to Canada. There are 30-40 of our alumni working only in Paris alone.
Referring to the curriculum, we can mention that:

- The BA has 220 ETCS, 20 for the Diploma. 3 semesters assure the general preparation and the other 3, the specialisation. The first 3 semesters represent 30% of the courses mainly in economic and business subjects (economics, management, marketing, accounting, and finances, international and European business etc.). Other 40% include informatics (algorithms and data structures, programming languages and environments, design of IS, 2 Data Bases courses, introduction to Artificial Intelligence, ERP/EAS, web design and Internet programming), intermediates 20% (e-Business, testing of the programs and systems, 2 practical stages), 10% complementary (modern languages: main language English and secondary languages that can be German, French, Spanish, or Italian, business ethics, philosophy and sociology, history of economy etc.). 80% of the courses are core, 20% being optional. The BA exam consists in a Diploma Paper.

- At the graduate level there are two kinds of curricula.
  - The one-year graduate Economic Informatics and Information Society has 70 ETCS, 10 for dissertation. This program is 50% informatics (C Sharp, CORBA and Java, Programming on components, Special chapters in Data Bases), 50% intermediates (special problems of e-Business, Decision Support Systems, Banking and finance information systems and EI systems engineering and reengineering).
  - A two-year master program totals 130 ECTSes, of which 10s are for the dissertation. The curricula contains: the first semester – economic core 20% (collaborative management, strategic marketing, finance administration), 10% – informatics; the second semester – 30% core informatics and intermediates (Knowledge Management, Advanced programming environment, EI project management and design, Advanced Data Bases, Programming engineering and Artificial intelligence). The third semester is dedicated to the specialization and represents 30% of the curricula. The e-Business program includes e-Business design and development, m-Business, Grids and distributed systems, Virtual enterprises and business; the Decision Systems Program includes DSS design and development, Special issues in ERP/EAI, Simulation, Component programming and development. The last semester represents 20% and contains the Praxis and two specific optional courses. The graduate level is concluded by a dissertation. An interesting study was made in [2]. The author made a survey modelling the EI students profile based on questionnaires and data-mining.

- The PhD School contains 5 courses. Two of them are from the EI: DSS and collaborative systems and Techniques to design and security of the EI systems; the other two contain economic or business subjects chosen by the students and their advisors. A general subject that is included in all the doctoral programs is Research Methodologies. A short statistic of the number of doctoral graduates per years is given hereinafter:

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Table 3

The staff and research

The staff is made up of 23 members – 9 professors, 2 associated professors, 8 lecturers and 4 assistants. In December, there will be hired 5 lecturers and 4 assistants. We have also 8 PhD students enrolled in day courses.
The research activity of our department has resulted in some hundreds of papers published in different journals and proceedings of different national and international conferences in Romania or abroad. Since 1995, we have benefited from some international grants, such as a Senior Fulbright grant, post doctoral grants, but also many World Bank Grants, National grants supported by CNCSIS (National Council of Academic Research), ANRC National Agency of Research or BBU. Only in 2008, from the 9 PhD students, 5 have been awarded PhD Grants at National Level; the department has been awarded 4 grants, of which two 2 partnership grants are concluded, 2 regular research grants and 6 research ideas grants. For an idea our faculty has won 11 grants (6 of which by our department) and the EI department has been awarded 14 grants. Since 1999, we have organized an annual international conference, generally in October. Apart from this, in May 2004 we organized the Central and East European Conference in Business Information Systems, with participants from 12 countries: the U.S.A., Chile, Spain, Austria, Moldavia, Romania, The Netherlands, France, Germany, Sweden and Sri Lanka, who contributed with 130 papers. Mention should be made that the students’ research papers are published every year in special proceedings. In 2007, at the last National Student Contests in Cybernetics, Statistics and EI, our student team obtained the Great National Award.

4.3. The infrastructure

As it has been noticed and testified by visitors, the infrastructure of FSEGA and of our department is one of the best in Europe. FSEGA has 31 EI labs, 4 servers (Econobcluj.ro, Proxyubbcluj.ro, Studubbcluj.ro, Economica.ubbcluj.ro) [3] more than 6000 desktops as stations, wireless, a platform for e-learning etc. Today, most of our students come to courses with their own laptops.

4.4. The relationships with the companies

Our department cooperates with different companies mainly specialized in EI systems and ERPs. These companies sponsor the department with their products, for example, sBS (a German company), Ciel (a French Company) or TRANSART, WinMentor (Romanian companies). Not only do they install their products, but they also deliver servers or LANS to demonstrate their performance. Some of these companies, such as sBS, ICDL or EMERSON, offer our students grants and internships.

5. Conclusions

We consider that EI is very necessary in the future because of the globalization, the Internet and the Information and Knowledge Society, respectively, where the EI systems need well interdisciplinarily prepared specialists. EI education is important for Romania because, in our opinion, the large number of students specializing in finance, banking and other economic departments will decrease due to the current economic crisis. We estimate that the informatics activity will also be diminished because of the increase in salaries in IT in Romania. Finally, this specialization offers our EI students diverse opportunities in the areas of informatics, economics and business.
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IMPLEMENTING BOLOGNA ARCHITECTURE – THE CASE OF BUSINESS INFORMATICS CURRICULA IN POLAND

Przemyslaw Polak

Abstract
The article contains a critical assessment of the new educational standards in the field of Business Informatics developed by the Polish Ministry of Science and Higher Education, following the adoption of the Bologna declaration. They were compared with the standards widely recognized in the world and with the curricula of the unique major Quantitative Methods and Information Systems developed in the Warsaw School of Economics. The analysis of ministerial standards clearly shows that they do not reflect the ideas of the Bologna declaration and impede education in the field of Business Informatics.

1. The field on Business Informatics in Polish education

In a Polish tertiary education system, study majors are a subject of standardization by the Ministry of Science and Higher Education. Universities have limited freedom of creating their own fields of study and their proposals have to be acknowledged by the Ministry. The field of Business Informatics was never granted an independent formal recognition in the Polish tertiary education. It was always combined with another field of studies. Until nineteen nineties, the field of study concerning the topics related to Business Informatics was called Data Processing and Accounting. After the fall of communism and political and economic changes, also the educational system was also reorganized. New majors were developed including Informatics and Econometrics. This major is offered by faculties of economy or management in general universities, four specialized universities of economics, and various other higher education institutions.

The major Informatics and Econometrics covers wide range of topics related to the fields of Econometrics, Statistics and Informatics, from Mathematical Economics to E-Business and Computer Programming. Various efforts were undertaken in order to establish Business Informatics as an independent major field of study. So far they are unsuccessful. Linking up these fields of study is often blamed for an unsatisfactory number of students enrolling in this major. Some students’ comments suggest that they are concerned about difficult courses in the wide range of topics. Particularly, students interested in a career in software development or IT consulting question the necessity to take courses on advanced mathematical methods. On the other hand, it is questionable that a future financial analyst has to study Software Engineering.

1 The Warsaw School of Economics, Department of Business Informatics, Poland
2. The implementation of Bologna architecture in Polish tertiary education

The form of unified first and second degree studies lasting 5-6 years was dominant in Polish tertiary education. Separate undergraduate and postgraduate studies were popular only in private education sector and in the form of extramural studies in state owned universities. However, these kind of studies were never considered prestigious in comparison with unified first and second degree studies.

In 2007, in Polish tertiary education, the system of unified first and second degree studies was abandoned following the adoption of the Bologna declaration. New teaching standards for separate undergraduate and postgraduate studies were published by the Ministry of Science and Higher Education, and tertiary education institutions were obliged to adjust their curricula to the ministerial standards.

The implementation of the new standards led to the disintegration of well established curricula for unified studies. This process is widely discussed in Poland. Some academics claim that it will lead to the deterioration of quality of the studies particularly in the field of hard science. In this case, gaps in knowledge and skills from earlier stages of education will be very difficult to catch up. The consequence of this may be a reduction in the quality of education, especially at the master degree studies, due to the enrolment of students previously awarded a bachelor degree in another, unrelated field of study. However, the purpose of this article is not the criticism of the two level studies, but the discussion of its implications for teaching Business Informatics.

Additional problems were caused by the very late publication of the Decree of the Minister of Science and Higher Education including teaching standards for respective studies [2]. It was published in July 2007, whereas it was put into force already on October 2007, forcing the universities to develop their curricula without full knowledge of ministerial standards.

3. The Ministry of Science and Higher Education standards

The Decree of the Minister of Science and Higher Education from July 12th 2007 [2] defines new learning standards for the first and second degree studies in 118 majors, including Informatics and Econometrics. The document does not include the detailed curricula but so called “learning content”. However in many fields, including Informatics and Econometrics, the elements of learning content are directly reflecting the names of courses listed in the previous ministerial curricula for unified master degree studies [1]. The learning content specific for the area of Informatics and Econometrics in the undergraduate studies includes ten elements [2]:

- Mathematical Analysis,
- Linear Algebra,
- Descriptive and Economic Statistics,
- Probability Theory and Mathematical Statistics,
- Econometrics,
- Financial and Insurance Mathematics,
- Operational Research,
- Computer Programming,
- Systems Design,
- Databases.

Only three of ten topics are directly in the field of Business Informatics. Similar situation occurs in the case of postgraduate studies, only three of nine learning contents are within field of Business Informatics:
Multicriteria Analysis,
Representative Sampling,
Dynamic and Financial Econometrics,
Mathematical Economics,
Actuarial Methods,
Statistical Analysis in Market Research,
Computer Networks,
Software Engineering,
Management Information Systems.

A characteristic of this standard is little repetition of the learning content on both levels of education. As a result, students' knowledge can be considerably different depending on which level of studies they carried out. Moreover, it is hard to find explanation why, for example, Computer Networks are taught at the second degree, whereas Computer Programming at the first degree. Such way of developing the program of study indicates incomplete understanding of the concept of separate undergraduate and postgraduate studies, allowing students to get both degrees in different fields. In fact, paragraph 12 of the very same document states as follows: “The completion of the first degree studies enables to continue education on the second degree studies in the same or different field” [2]. It can be assumed that the core courses from the curriculum of the unified first and second degree studies were split into learning contents of separate levels, without thorough consideration. The reason for this can be lack of understanding the idea of Bologna architecture, scepticism about the quality of two level studies or, simply, attachment to the traditional curriculum and unwillingness to change.

4. ACM curricula recommendations

Information Systems is a popular field of study in the United States. It is an equivalent of Business Informatics – a term more popular in Europe. The federal government of the United States does not develop curricula and teaching standards. In the case of Information Systems, this role is played by professional associations: Association for Computing Machinery (ACM), Association for Information Systems (AIS) and Association of Information Technology Professionals (AITP). They developed two model curriculum recommendations:

- IS 2002 (Information Systems) – undergraduate level [3],
- MSIS 2000 (Master of Science in Information Systems) – postgraduate level [4].

They were created as a consensus of many circles and organizations dealing with information systems and, therefore, are widely acclaimed around the world. They are a source and a reference point for many curricula in academic institutions in the United States and other countries.

The first degree studies curriculum Information Systems 2002 includes, among others, the following core courses [3]:

- Programming, Data, File and Object Structures,
- Analysis and Logical Design,
- Physical Design and Implementation with a DBMS,
- Networks and Telecommunication.
These are the equivalents of four, out of six, learning contents in the field of study Informatics and Econometrics in Polish ministerial curriculum. The IS 2002 recommendations include also six other core courses within the field of Information Systems [3]:

- Electronic Business Strategy, Architecture and Design,
- Information Technology Hardware and Software,
- Information Systems Theory and Practice,
- Physical Design and Implementation in Emerging Environments,
- Project Management and Practice.

The second degree standard MSIS 2000 recommends that students changing their major should take three courses from IS 2002 curriculum including Programming, Data, File and Object Structures. The MSIS 2000 curriculum contains, among others, the following core courses [4]:

- Data Management,
- Analysis, Modelling and Design,
- Data Communications and Networking.

These courses are equivalents and extension of core courses from the IS 2002 curriculum. They also cover topics included in five learning contents in the Polish ministerial curriculum: Computer Programming, Systems Design, Databases, Software Engineering and Computer Networks. The program of Management Information Systems is covered in the MSIS 2000 curriculum by three of, so called, suggested courses: ERP Systems, Business Processes and Systems Integration.

On the other hand, the MSIS 2000 curriculum contains another three core courses which do not have their equivalents in the Polish ministerial curriculum [4]:

- Project and Change Management,
- IS Policy and Strategy,
- Integration (Integrating the Enterprise, IS Function and IS Technologies).

5. Quantitative Methods and Information Systems curricula in the Warsaw School of Economics

The Warsaw School of Economics (WSE) is a leading economic and business administration university in Poland. However the WSE does not offer Informatics and Econometrics major like other universities of economics in Poland. Instead, the WSE developed its own unique and highly acclaimed major in Quantitative Methods and Information Systems (QMIS). It was created as a result of the criticism of the ministerial learning standards of Informatics and Econometrics.

The first degree curriculum in Quantitative Methods and Information Systems contains 12 core courses, but only three of them within the field of Business Informatics:

- Algebra I,
- Mathematical Analysis I,
- Deterministic Models of Operational Research,
- Business Informatics I,
- Econometrics Models,
- Statistics Methods,
- Introduction to Systems Theory,
- Probabilistic Models of Operational Research,
- Designing Socio-Economic Research,
- Systems Design,
- Probability Theory I.

However, the QMIS curriculum defines also specialization core courses in five fields of study: Demography, Econometrics, Mathematical Economy, Business Informatics, Statistics. The curriculum in the field of Business Informatics includes specialization courses:

- Computer Programming,
- Computer Networks,
- Database Systems I,
- Operating Systems.

Similar situation takes place in the case of the second degree studies in Quantitative Methods and Information Systems. The curriculum contains 14 core courses, but again only three in the field of Business Informatics:

- Algebra II,
- Mathematical Analysis II,
- Demography,
- Macroeconometrics,
- Business Informatics II,
- Management Information Systems,
- Mathematics of Financial Instruments,
- Microeconometrics,
- Multicriteria Optimization,
- Probability Theory II.
- Mathematical Statistics,
- Artificial Intelligence,
- Game Theory,
- Introduction to Stochastic Processes.

However, the second degree curriculum in the field of Business Informatics includes more specialization courses:

- E-Business,
- Software Engineering,
- Multimedia Information Technology,
- Business Applications Development (in fact equivalent of Systems Analysis and Design),
- IT Projects Management,
- Database Systems II,
- Database Management,
• Information Systems Strategy,
• Integrated Information Systems,
• Knowledge Management.

The curricula of Quantitative Methods and Information Systems in the field of Business Informatics includes all learning contents listed in ministerial curriculum. Moreover, two crucial topics Systems Design and Database Systems are included in both levels of study. In both cases – the ministerial Informatics and Econometrics and Quantitative Methods and Information Systems, the curricula is dominated by mathematics and statistics leaving little space for courses in the field of Business Informatics. Although, QMIS curriculum gives some flexibility in choosing specialization core courses, it is also not satisfactory solution for building knowledge and skills necessary to start career path for IT specialists in business information systems development and management.

6. Conclusions

Implementing the Bologna architecture in the field of Business Informatics in Poland faces many obstacles. The biggest problem is caused by the lack of independent major in Business Informatics. It makes difficult to develop and improve curricula in this field. Serious problems are caused by the inconsistent study program required by the Ministry of Science and Higher Education. Although, universities are given freedom to fulfil the curricula besides general knowledge foundation and field-specific core courses it is a hard competition of specific field courses, various management courses, foreign language learning, etc. Students choices of elective courses may not be optimal and leave gaps in important, for the specific field of study, knowledge.

The efforts of academics should be aimed on separating the curricula of Business Informatics from Econometrics and Statistics. Participation in international projects leading to joint Business Informatics studies may be a turning point in a struggle for the recognition of independent Business Informatics major by Polish Ministry of Science and Higher Education.

7. References


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JOINT MASTER PROGRAM “BUSINESS INTELLIGENCE AND STATISTICS” OF KHARKIV NATIONAL UNIVERSITY OF ECONOMICS (UKRAINE) AND UNIVERSITY LYON-2 (FRANCE)

Iryna Zolotaryova¹, Jean-Hugues Chauchat²

Abstract
After presenting the legal and political context of joint high education programs and diplomas, according to Bologna process, we describe a French-Ukrainian joint Master; it is a two-years program and the fourth group started their studies in September 2008. We encounter some difficulties and describe some solutions, the main principles being to recognize the differences between the two university systems and to construct mutual confidence among the team in charge of the program. This takes time.

1. Main characteristics of joint programs and diplomas in European Union member-states

The Bologna declaration proclaims the importance of cooperation on European scope: in particular, joint academic curriculum, academic mobility schemes, integrated educational programs are tools for increasing the international competitiveness of the European system of higher education. This task was concretized in final documents of the meeting of European Ministers of Education in Prague, 2001 as the appeal to development of cooperation between universities leading to granting joint degrees [1] [2] [3] [4] [5] [6] [7] [8] [9].

Mostly the joint programs are represented at master and doctorate degrees and less at bachelor degrees. The majority of the programs arise from bilateral cooperation of universities, though there are some examples of multilateral programs.

Starting up joint programs in European countries was fastened by the assistance of the international educational society. But their development is followed by a lot of problems that are usually consequences of the difference in demands in European educational systems. The most important problems among these are:

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² Université Lyon2, ERIC, France
- financing education;
- recognition of joint degrees;
- management effectiveness;
- synchronization of students’ movement in universities of different countries.

Awarding of joint degrees in European countries is mostly regulated by agreements between universities, but not by the legislation at the higher level. It is caused by the lack of national legislation that recognizes double and, in certain cases, joint diplomas.

The main problem of the expansion of joint and double diplomas is the necessity of the financial support enlargement. Because of the mobility input in such programs, they require more expenses. It is worth mentioning, that there is a widespread practice when such high expenses are covered either by the network’s participants, or by students. The last situation can lead to discrimination of students who cannot afford such programs. This problem can be solved by different ways:

- increasing the number of partnerships and financial resources, including European and national level;
- using business financial supports;
- granting financial support for joint and double diploma programs, that contain planned mobility (in distinction from the mobility support in general).

By joining the Bologna Declaration, Ukraine took serious obligations of integration to the European high education system. However, there are still some serious differences in educational programs concerning terms, educational methods and result-oriented programs. The pattern for calculation of credits based on students’ efforts inputs corresponding to result oriented educational programs, still remains not designed.

It is known that Ukraine joined Lisbon Convention on the Recognition of Qualifications concerning Higher Education in the European Region, 1997 that was signed by around 40 countries of Europe. Every country that signed the Convention must recognize all the educational documents of other countries (if there is no essential difference in educational programs). All EU member-states recognize each other’s programs but the post Soviet Union countries are not among them.

Nowadays a couple of Ukrainian universities use the practice of double diplomas. This means that they sign agreements with Western European universities and coordinate the educational programs and the terms of studying abroad. Therefore, the graduates are awarded with diplomas of two universities.

All basic Bologna process documents define the main vector of the development of higher educational programs, including the programs of double and joint diplomas, as the harmonization of their architecture (Bologna and Sorbonne Declaration) by means of adopting by the countries 3 cycles of higher education (bachelors – masters - doctors).

The main requirements to the qualification of these 3 cycles are stated on the so called Dublin Descriptors and in the European Framework of Qualifications.

Knowledge gained during the first cycle can be characterized by originality and innovativeness, and include critical understanding of theories and principles, mastery in solving difficult and unexpected problems in the concrete field of study.
The second cycle assumes the existence of highly specialized knowledge that includes the newest knowledge in the field of study; critical understanding of knowledge in this and allied fields; ability to solve problems in the research field; creation of new knowledge and integration of knowledge from different fields. As practice shows the variety of profiles of programs increases at this cycle increases at the second cycle if to compare with the first cycle because the second cycle presupposes specialization of skills and knowledge.

The third cycle assumes the newest knowledge in the field of study and close fields; newest skills and methods including synthesis and evaluation that are crucial in solving principle problems in the field of study and creation of innovations and also the ability of rethinking current knowledge and practice in professional area show the authority, innovativeness, autonomy, scientific and professional integrity and ability to develop new ideas and processes.

While developing educational programs of all these cycles, these common requirements should be considered. Moreover, the main requirement in the development of programs of all these cycles is defining the results of the education that are judged not by lecturers but also by employers. Only in such cases, the aims of the program will be reasonable and the program will correspond to the demands raised for such programs.

The results of the education are drafted in cooperation with the professional society, and not only inside the academic society. Thus, professions profiles include 2 components: academic and professional. That gives an opportunity to define and form more adequate the content of educational programs.

The next phase is the calculation of credits according to the demands of European Credit Transfer and Accumulation System (ECTS). ECTS is used to provide the comparability of programs and to increase academic and labor mobility of citizens, and is also a mechanism of judging the labor intensity of programs.

There are two types of results of education: main and subject competences. Main competences include personal, methodological and social skills that are required for successful professional and personal self-fulfillment. Subject competence includes theoretical, practical and experimental skills and knowledge that provide the development of subject skills.

It should be emphasized that the results of education and competences are not synonyms. The expected results of education are defined by professors and the competences are developed themselves by students. But these terms are used as synonyms in description of educational programs.

Joint educational programs are implemented in a framework of agreements between universities on the basis of educational plans that are developed and implemented in the cooperation of universities. A set of modules/courses is offered to students by universities. At the same time, students have to take several modules in the partner universities and are mutually accepted due to ECTS.
There are 3 types of diplomas awarded to students when they graduate from joint educational programs:

1. a joint diploma of two universities that is accepted in both countries;
2. a diploma of foreign university in addition to the national diploma;
3. a national diploma where extra courses are mentioned (as an extra certificate that is not valid legally).

As usually, 3 types of joint programs can be defined:

1. similar structure and content of educational programs in each partner university (parallel courses/modules, common educational methods and examination procedures);
2. comparable main modules/courses of educational programs in partner universities, but different specializations provided by different partners;
3. modules/courses of different universities complete each other in the framework of sole coherent educational program (this means that the program is divided into several parts, each of which is conducted by a different partner).

The sense and attractiveness of joint diplomas programs is that each participant could contribute to the program with own resources and know-how that are absent at the partner university.

Joint programs based on synergy of unique experience of both parties help to develop programs, aiming at forming the different types of competence of students in different universities. However, a very narrow specialization is also ineffective because it prevents cooperation between professors.

While developing the joint programs it is essential to coordinate the modules/courses to complete each other. The next step is to negotiate upon the educational methods and possibility of modernization of educational programs that is especially important for non EU member states.

It is also very important that the program would not only provide students with possibility of getting the academic experience, but also the cultural experience and would reflect the variety of educational systems and traditions that are represented by the partner universities.

2. The French – Ukrainian Master of “Business Intelligence and Statistics”

This Master Program prepares professionals with the high level of knowledge in Informatics (Information System Principles, Programming, Web) and Statistics (Testing, Questioning, Projection) and related disciplines (Data mining, Data warehouse). It gives students the vision that they have to realize the needs of enterprises, to provide it with ideas how problems can be solved and then to implement the ideas. This diploma involves students in conducting projects at enterprises supervised by their professors.

This project also contains economic goals: creation of partnerships between French and Ukrainian enterprises. While students are conducting their projects at such enterprises partner relations will be created between the enterprises of 2 countries.

The French version of this Master Program was launched in Lyon more than 20 years ago. Students have different responsibilities: they are responsible for projects (Informatics, Statistics, Projection, Decision Making and etc), for research (Economic, Marketing, Bio-statistic and etc) at enterprises (banks, insurance companies, industry, service enterprises and etc) and organizations.
(governmental, non-governmental, regional, and recreational) and researches as academic people after getting a Doctorate degree.

The program is divided into four semesters: three for lectures in Kharkiv, and one in France, for six weeks lectures and 5 months with internship in enterprises.

The lectures are held in Ukrainian, English and French, half by Kharkiv and half by Lyon professors.

The lectures are accompanied by applied tasks that are held in groups and supervised by professors. Plots of tasks usually refer to practice and concrete situations that were studied by professors during their researches or consulting the enterprises. One example of work held by Master Students of university Lyon-2 for France-3 TV Channel can be found at http://eric.univ-lyon2.fr/regionales2004/.

There are 2 types of participants of the Program: graduated students and under-graduated. Most of the graduated have professional jobs during the day, so the lectures are held during evenings and on Saturdays.

There are 4 types of disciplines: Informatics, Statistics, Applied subjects (Economics, Management, Marketing, and Law) and Languages (English and French). New Information Technologies in the decision making process are emphasized (Data mining, Data warehouse, Knowledge Management, Artificial Intellect). Active pedagogical methods are used that include a big range of situational tasks.

All the students have five months internships from March till September at French or Ukrainian enterprises that have international relations. The practice is supervised by the head at the enterprise and by the professor from the university. Tasks, with which our students are provided are various: consultations on the informatics of the decision-making process, marketing for an enterprise or organization, definition of risks and rates in insurance business, preventive identification of unsustainable clients, accounting, human resources management. Such internships can be the first experience in founding enterprises in Ukraine, or French – Ukrainian partnership.

This Program is supported by the Ministry of Foreign Affairs of France and Rhône-Alpes Region Council, the French-Ukrainian Association of Innovation and Transfer of Technologies, and the organization IT-Ukraine that gathers a lot of Ukrainian enterprises that deal with Information Technologies and conduct international activity.

Twelve professionals in 2007 and twenty two in 2008 were awarded by the joint diploma in “Business Intelligence and Statistics” of Kharkiv National Economics University and the University Lyon-2. Now, 20 to 25 new students are involved each year.
3. Difficulties and solutions

3.1 Legal Problems

It is not so easy to create and manage such a joint program. Each national state has its own academic rules and traditions. Both Ukraine and France have centralized university systems; syllabus must be controlled and approved by the Ministry in Kiev or in Paris. A recent legislation simplifies international cooperation in France: if a new joint diploma project has the same syllabus as an existing French diploma, the French university does not have to ask the Ministry to approve it. [10].

French universities used to include long (5 to 6 months) internship in the workplace in their Master programs syllabus; this is new in Ukraine.

It is difficult to deliver an academic diploma is the privilege of each university. in order to share this power. The success key point is the mutual confidence between the two universities professor teams and the support from the two Rectors.

3.2 Language Problems

The two team members have to share a communication language. The Rector and the professor in charge of the program in Kharkiv speak French and the chair-persons of the two Departments, in Kharkiv and in Lyon speak English.

But, when working together, the two teams discover that, for historical reasons, some words have not the same meaning in the two countries: for instance the frontiers between “economics” and “management” are not the same: a large part of what French academics call “management” is included in “economics” by Ukrainians. The same for “accounting” and “statistics”: stock record and demography seems to be included in “statistics” in Ukraine and not in France; in Ukraine and former Soviet Union “descriptive statistics” is a larger part than in France and western countries in which “inference statistics” (confidence interval, hypothesis testing, sampling design…) is the main part of statistics. Note that, even between western countries, the borders of academic specialties are sometimes different; as an example, what French Universities call “sciences économiques” includes a large part of what American ones call “political sciences”, etc.

3.3 Solutions

The main lesson of our experience is the need of working together, sharing actual experience, going forward step by step and speaking freely about news difficulties. A main opportunity to understand each other is to organize visits of professors and deans in the partner university; during the visit, they must be able to attend lectures and exams. The process of building mutual understanding and putting trust in the other part takes time and effort.

A good point is that one young assistant professor, who received the joint Master is now preparing a PhD under co direction of two professors, one from Lyon and one from Kharkiv. We hope to get two kinds of improvement for our cooperation: 1) the PhD student will share the two academic cultures; 2) the two supervisor professors will have a better understanding of the way of working in research in the other country.
4. Conclusion

Joint/double diplomas that are awarded by universities on the basis of educational programs can be characterized by the following:

- courses/modules of education are developed and accepted by partner-universities;
- students from one university study a part of the program in the other university;
- study duration periods are quite long in both universities;
- study duration periods are mutually accepted;
- professors from one university give lectures in the other partner-university, and cooperate in the development of the content of educational programs and participate in exam panels on recruiting students and grade the exams;

Joint/double diplomas can be awarded as:

- double diploma in addition to national diploma;
- double diploma awarded by the universities without awarding national diploma;
- one or several national diplomas that are specially awarded as an official acceptance of the qualification.

Graduates of joint programs gain unique possibilities to apply knowledge and skills acquired during professional and research traineeship. While studying a year abroad, students:

- gain cross-cultural communication experience;
- adapt in foreign language environment;
- adopt foreign labor ethics elements;
- speak fluently several foreign languages;
- learn the most recent computer technologies.

All these offer them extra-benefits while searching for a job.

Joint master programs contribute to train highly-qualified international level professionals, that have a good chance to make a career both in Ukraine and other countries of European Union.

In order to build a joint Master program, two universities need to work together, to share actual experience, to go forward step by step and to speak freely about news difficulties. A main opportunity to understand each other is to organize visits of professors and deans in the partner university; during the visit, they must be able to attend lectures and exams. The process of building mutual understanding and putting trust in the other part takes time and effort.
5. References


[6] International Seminar on Bachelor-Level Degrees, Helsinki, Finland, 16-17th February 2001: Conclusions and Recommendations of the Seminar to the Prague Higher Education Summit


ORGANIZATION OF COOPERATION OF BUSINESS AND EDUCATION –
THE EXAMPLE OF KHARKIV NATIONAL UNIVERSITY OF ECONOMICS (UKRAINE) INITIATIVES

Iryna Zolotaryova, Oleksandr Dorokhov

Abstract
The conditions of the IT-industry, opportunities and problems of preparation of IT-specialists in Ukraine has been described. The ways of improvement of cooperation between IT-companies and universities for increases of IT-education quality and its level have been offered. Experience of Kharkiv National University of Economics in the organization of interaction with IT-business, the international cooperation for preparation of masters in the IT-technologies field has been given.

1. The conditions and perspectives of the IT-industry in Ukraine

At the moment Ukraine is facing the tasks of increasing the competitiveness of its economy, changing the structure of its gross domestic product (GDP) in favor of high-technology and science intensive sectors. It is impossible to solve these tasks without onrush of Information Technology (IT) sector due to the fact that it is basic for any economic sector. In the new economy the most valuable characteristics of workers are:

- informational competence: search and processing of information;
- creative and analytic way of thinking;
- ability to work with cycles and projects;
- ability to solve problems, personal responsibility;
- effective communication, team work;
- high efficiency.

IT specialists influence the economy a lot and, thus, the requirements for their competence arise. Nowadays Ukrainian IT sector can be characterized by these indicators (table 1) [3, 5].
There are 3 000 IT companies and groups, 260 Internet Service Providers, the number of Internet users is about 7.5 million people, and 17.5 million people are using cellular communication in Ukraine.

2. The IT-education in Ukraine: positions, difficulties, opportunities, possibilities

The 1/8 of the budget of Ukraine goes to science and education. One can get higher educational degree in 348 Universities, where 620 000 students study, this number also includes 30 000 students per year who graduate technical sciences.

Every year in Computer Sciences 1 000 people get a PhD or Associate Professor degree, 9 000 – Master of Science, 4 000 – Bachelor of Science. Main centers of IT education in Ukraine are Kyiv (25 000 students, 87 universities), Kharkiv (20 000 students, 61 universities), L’viv (15 000 students, 42 universities) [4].

Every sphere has the problem of training highly qualified professionals, but the IT sphere has the most significant problem [2].

This problem comprises of several factors: novelty and onrush of the sphere, variety of qualification requirements for professionals, high financial expenses on workshops equipment, difficulty in organizing professional practice for students, and many others.

The IT evolution is faster then educational system can get used to the changes. New approaches and technologies arise every 10 month, fundamentally new concepts – every 3 years, change of operational systems and hardware platform – every 5 years.

Universities do not have enough time to follow the development of IT sphere and, though, the professionals who graduate from the universities can not go to work without extra skills. Nevertheless, there is a lack of such professionals.

The companies are obliged to train their workers which requires high financial expenses. There is a high demand on financial, human resources and time which are spent on training professionals during their work. Not only IT companies suffer from the lack of qualified professionals, but also the consumers – all spheres of economy, state and population.

One of the biggest problems is also the situation with the professors’ qualification degree. These problems can be solved by means of organization of mutually beneficial cooperation between universities and IT companies, as well as the development of research and educational resources.

It is essential for universities to cooperate with IT companies during the process of preparing professionals in order to define requirements that face graduates, to have an advice during drafting
teaching plans, that correspond to the needs of modern IT industry, organization of students’ practices and etc.

IT companies should also consider the fact that without their influence to the educational process in universities, without providing the universities with adequate help, they will not be able to solve their human resources problems effectively and will not be able to involve in their work high-skilled professionals [1, 6].

There can be several ways of cooperation between universities and IT companies that will keep the balance between theoretical knowledge and practical skills in different types of technologies.

First of all, this is work with professional and certified organizations for promotion of innovations in educational sphere, creation of the permanent system of seminars and round tables.

During them, lecturers will be able to gain practical skills experience and also get methodological help. Even information events can be held that will help lecturers and researchers to share their knowledge and practical experience in the field of innovation, enterprise and research.

A special role in this case play Vendor Programs.

3. The cooperation between IT-department of Kharkiv National University of Economics and IT-companies for increases of IT-education’s level and quality

Microsoft Ukraine became such a Vendor for the IT department of Kharkiv National University of Economics. The department prepares specialists with the degree “Computer Science”.

At the first stages of cooperation the lecturers took part in seminars and trainings held by Microsoft Ukraine. The next step was subscription to MSDN Academic Alliance.

Afterwards the lecturers were participating in different kinds of educational programs that were aiming at getting certificates. At the moment 5 lecturers have the status of Microsoft Certificate Specialist, and 2 more – Professional and Trainer.

This fact gave the possibility to the department to open the IT-Academy. The IT-Academy provides students with additional trainings that help students to prepare for taking the exam on certificate. The students after their graduation go job-hunting with a certificate that is recognized worldwide. Also one can get extra IT education in the IT-Academy.

The relevance of such cooperation becomes evident if considering the fact that IT industry lacks high-skilled professionals. Thus, the main types of high professional IT education are:

- preparation of Bachelors, Specialists, Masters of Computer Science;
- additional qualification in IT sphere.

Among the lecturers are also professionals in computer architecture, architecture of operation systems, Windows 2003 Server administration, network security (Brainbench), Java-technologies, 1C and Parus products (information systems of class MRP represented at the Ukrainian market).

An important stage of cooperation of the IT department with IT companies was joining as the academic member the association IT-Ukraine.

This gave the possibility to proceed to the iteration model of preparing professionals that provides a possibility to compare the competence of the graduate with the modern needs. We have the vision of the model of the future graduate from the first years of his/hers education and constantly adapt it to the needs of companies during next years of studying.
The leading professionals of the companies participate in drafting and changing the educational plans, expertise of final papers. Since a couple of years, we practice students’ presentations of their final paper in companies, getting their feedbacks just after the presentation.

In 2008/2009 we started in cooperation with “NIXSolutions” the project of distance education for Bachelors in 4 fields: Development, QA, Business Analysis, and team-project. Students are divided into groups that have their own lecturer and a company lecturer, given tasks, put deadlines for intermediate presentations. Students and lecturers were provided with access to documentation and materials given by companies.

An essential part of such an education is the creation of real CASE base that gives the possibility to approximate the educational process to practical conditions.

Successful graduation of such a distance education program can give a chance for students to have their practice in the company and further to be hired there without losing their resources for additional education and adaptation. The practice in company is the important part of preparing the needed professional. Before recent time this task could not be solved due to low level of students’ preparation and the more formal procedure of the practice.

The quality and the relevance of the education are maintained by:

- permanent cooperation with IT companies;
- creation of educational and methodological basis for preparing IT professionals according to the demand of companies;
- provision of correspondence of basic education (Bachelor degree) with international standards of the extent of knowledge for basic IT education (for example, defined in “Computing Curricula 2001”);
- following the traditions of Ukrainian education in profound Math knowledge that is the basics of quality of professional IT education;
- provision of permanent education of lecturers.

4. Kharkiv National University of Economics international educational cooperation for preparation of masters in the IT-technologies field

One of the criteria of achievement of the quality’s education in the IT sphere became the integration to the international educational system and entering the international market of educational services, for example in the sphere of Masters education.

The IT department in cooperation with the university Lyon-2 (France) holds Master program “Computer Science and Statistics”. The duration of the program is 2 years, and 6 month from which students spend practicing at French enterprises.

During the last 2 years 11 and 21 students graduated the Program and the practice and got 2 diplomas of Lyon-2 University and Kharkiv National University of Economics. Among the enterprises in which students were practicing were bank Crédit Agricole Centre-Est, France Télécom, AUCHAN, France-Telecom Orange, Veolia Environnement (Veolia Eau), IPSOS, and also IT companies: TEAMLOG, GAMELOFT, Atilog (www.atilog.com) INCOTEC. Recognition of the quality of preparation of IT professionals was opening of affiliated companies of TEAMLOG and GAMELOFT in Ukraine (Kyiv, Kharkiv).

The most important results of cooperation between business and education are:

- preparation of today’s students and lecturers for information economy;
- provision with access to technologies;
- generalization and distribution of latest technological and educational ideas.
5. References


[5] Ministry of Transportation and Communications, Association IT-Ukraine

COOPERATION BETWEEN ACADEMIA AND INDUSTRY ON ‘RESEARCH’ LEVEL
METHODS OF COMPARATIVE ANALYSIS OF ELECTRONIC BANKINGS' WEBSITES CASE OF POLAND

Witold Chmielarz

Abstract
The main goal of the article is the evaluation of method problems of websites presentation. As an example e-banking websites for individual customers is taken. After introduction about aspects of valuation by traditional and known methods, new procedure of measure is shown. In the final part are comparing sets of results of investigation and conclusions are drawn.

1. Introduction

The main objective of this article is presenting the analysis of methodology used to evaluate the development of Information Technology. In this case the author concentrated on individual e-banking sector in selected banks operating in Poland. It constitutes a continuation and, simultaneously, a development of previous studies dealing with the comparison and evaluation of IT systems implemented in organizations which form the basis of electronic economy. The considerations presented below are a consequence of a second series of analyses and concerning the evaluation of e-banking, where the author tried to eliminate previously occurring methodological inconvenience and problems connected with obtaining rational expert evaluation [2]. The second series of experiments connected with electronic business systems started with presenting applications of traditional methods – a scoring method, with its different variations (with experts’ preference scale), and concluded with constructing the author’s own method (conversion) which combines the advantages of scoring and relative evaluation methods [1]. The applied methods allowed for indicating – the best at a time – banking services for an individual client. The third series, which includes also this paper, was initiated by the studies which are meant to facilitate the methodologies of websites’ evaluation. Therefore, initially, they were applied to a limited number of banks offering services for an individual client, as only internet banks have been considered. The present stage of this series consists in widening the selection to a larger number of banks.

It is difficult to estimate the number of the Internet users using internet banking. Clients having access through internet channel are counted several times for ever increasing number of products e.g. savings accounts and credit cards – possibly a few within one bank. It is worth mentioning that also banks are interested in the most favourable image which reflects their market share in internet banking. It is the reason why the statistics of some banks should be treated more as a potential possibility of all clients using an offered range of services within products available via the Internet. Nevertheless, on the basis of data obtained from Związek Banków Polskich (Polish Banks

1 University of Warsaw, Poland
Association), making a simple forecast with the consideration of the latest preference trends, we can estimate that in Poland the number of personal accounts operated via the Internet will reach over 12m in the end of 2008, and in 2009 it will exceed 13m.

Electronic banking, which is a modern, ‘non-contact’ form of providing banking services without the necessity to visit a bank branch, is becoming a very important division of institutional and individual customer service. Theoretically, with regard to its organization form it can be divided into: virtual branch – access to electronic account – a client who wants to use an internet access account opens a new account, even if the customer already has a traditional account in this bank; electronic account – a client does not have to open a new account, but obtains additional internet access to her or his traditional account together with a number of other services on offer; virtual bank – offering only accounts with network access, not having its own branches – the client has access to his or her account only through electronic access channels, and one can contact the bank by means of a telephone, e-mail or mail.

In the further part of this article the author will present and analyse services related to e-banking services offered on the Polish market for all the above forms with regard to individual clients. The basis for the undertaken research was a preparatory stage consisting in gathering and establishing an evaluating expert panel. This time they were specialists in the electronic banking field from reputable universities in Poland, already experienced in this kind of research. Next, the selected team identified the evaluation criteria for e-banking services. Usually, in similar studies functional, technical, economic, organisational and psychological criteria were applied. Previous studies point to the fact that at present psychological criteria and, to a large extent, organisational criteria for electronic services aimed at individual clients are shaped in a very similar way. It seems that we are dealing with an analogous situation in the case of visualisation and navigation of bank websites chosen for this research. Therefore, mainly economic and functional criteria have been taken into consideration, adding, following the example websites’ analyses, basic technological criteria, apart from websites’ characteristic features. In the study the author differentiated the following criteria: economic – annual nominal interest rate, maintaining an account month/PLN, surcharge for access to electronic channels, a fee for transfer to a parent bank, fee for a transfer to another bank, interest rate on deposits –10,000 PLN, fee for issuing a card, monthly fee for a card - month/PLN; functional – with regard to large similarity of basic services we only selected non-standard additional services such as: insurance, investment funds, cross-border transfer or foreign currency account; technological (the number of surcharge-free ATMs, account access channels (branches, the Internet, Call Center, mobile phone), security (ID and password, token, SSL protocol, a list of single-use passwords, a list of single-use codes)).

2. **Using scoring method to analyse e-banking services for individual clients**

In the first step the author applied a traditional scoring method together with its mutations and the assumed preference scale. In the scoring method the author collected information on selected criteria; they were assigned values according to the assumed scoring scale and the results were analysed in a combined table. The following scoring scale has been used: 1.00 – very good (complete criterion fulfilment, the lowest costs); 0.75 – good (almost complete fulfilment of criterion, slightly higher costs); 0.50 – medium (partial criterion fulfilment, medium costs); 0.25 – sufficient (satisfactory criterion fulfilment, high costs); 0.00 – insufficient (no feature, the highest costs). A scoring method was used in two variations: simple – where criteria were treated equivalently; and one with a preference scale – where sets of criteria were assigned indicator values differentiating their treatment by clients (the total of coefficients = 1).
In a simple scoring method you measure the distance from the maximum value to be obtained (according to the assumed scoring scale). It concerns the value of criterion measure and in the sense of a distance it is the same when we measure the distance from one criterion to another as the other way round. However, we do not define the relations between particular criteria. Assigning a preference scale to particular criteria (or sets of criteria) can be regarded as such a measure. A linear preference scale in a normalized form defines in turn the participation of particular criteria in the final score. It establishes a one-time relation between criteria in relation to the final score, it is also a specific „averaged” measure of criteria in particular cases, without the individualization of the evaluation for any of them. However, it does not specify to what degree one criterion is better/worse than the other. It is merely a derivative of the normalized distance.

Unfortunately, this commonly used methodology – in different variations - has certain disadvantages such as: subjectivity of experts’ evaluations, inadequacy of applied criteria for the evaluation of the situation, also there occur problems with comparability adjustments of various criteria evaluations. Also, this method causes problems connected with doubts as to the need for collective comparisons of various categories of banking services (e.g. cards, internet services, front-line services etc.) in various forms of e-banking (electronic access to a traditional account, electronic branch, virtual bank); or the scoring scale and its calculation from price value into agreed scoring or percentage.

Evaluation subjectivity can be limited by engaging a team of experts and calculating the average/establishing a model value from their assessments. Averaging does not eliminate subjectivity, but at least it can be reduced. Experts panel can also establish a set of evaluation criteria, eliminating, or at least limiting, their lack of conformity to the situation, and they can also determine an algorithm to be used for turning the valued indicators into quantitative ones.

The basic advantage of this group of methods is a possibility to present a combined score by means of one indicator for each bank, which is comparable to the score depicting of other banks and enables such a comparison. This way we are provided with an unequivocal answer to the question which of the selected banks is the best for a specified category of a client, not going into speculations concerning ranking of particular kinds of banking services. Also, it does not enforce – for the sake of comparison – creating an average banking services package, characterised by valued assessment, which clients perceive as illusory and approach with certain reservations.

To evaluate cost, functional, technological and other criteria the author used a preliminary table presenting bank offers related to internet banking services and fees connected with using bank accounts operated via the Internet. This table has been generated on the basis of data obtained from websites of selected banks. On its basis the author created a simplified and averaged combined table of criteria evaluations generated by experts. The data have been obtained from analyses performed from February to March 2008 which involved websites of selected, the most popular among clients, sixteen banks with electronic access accounts (including four internet banks), using information provided by helpline or other internet sources, if necessary. This time eight experts from academic spheres participated in the research.

Simple adding up scores obtained from the table presents a specified ranking of e-banking services for particular banks. The first place in this ranking was taken by mBank (73.96% of the maximum level services, compared to 68.42% in 2007), next Lucas Bank (76.04% owing to its very well-organized customer service), and in subsequent positions two internet banks: Toyota Bank (73.96% of the maximum score with relation to 77.63% last year – the unquestionable leader of last year)
and Volkswagen Bank with e-direct service (72.92%). Inteligo PKO BP ranked next, and its low position is the consequence of the owner’s inflexible policy (especially in terms of pricing).

Rating difference in the scores of the best three banks is limited to nearly 9 percentage points (compared to 2.25 points in the previous year), which demonstrates little price differentiation – this time the banks were being examined in the moment of changing mutual relations towards individual customers. Nevertheless, despite 24 points of the rating difference between the best and the worst score, we can notice that banks observe each other carefully and draw conclusions from failures and successes of their competition. In the majority of cases there are no obligatory minimum monthly payments, or they are deliberately minimised (which is not fully visible in the scoring scale), transfers to the bank are usually free of charge, and the level of security can be regarded as satisfactory for clients (2-4 kinds of security). Other elements are subject to competitive bidding on the market, striking a precarious, changing balance between the wish to gain a competitive advantage and the profit of the bank (in Poland still the latter is a dominating factor).

In particular it starts to concern the visualization (its tradition and new fashions and trends) and functional additional services (insurance, investment funds, cross-border transfers, foreign currency account, virtual card, etc.). ING – direct account 57.29%, Millenium – personal account – 58.33% and Nordea Bank – Nordea Spectrum account – 59.38% ranked the lowest. Apart from Millenium, whose low position is surprising (clients emphasise the poor navigation of the website), they are usually new partners in the market and they try to make up for their lack of experience in providing individual electronic services by adopting a good competitive strategy in terms of economic criteria (e.g. interest rates on deposits). The results of the ranking are presented in Fig.1.

![Figure 1: Ranking of the usefulness of electronic access to individual accounts of selected banks in Poland in 2008](image_url)

From our computations we can conclude that two services: a fee for issuing a card and a fee for transfer to a parent bank reached a level which, at present, satisfies clients’ needs in more than 90%. Undoubtedly, the worst indicator is an annual nominal interest rate (evaluated by the
majority of users as too low – 31.8% of the maximum scores). Indicators for fees for a transfer to another bank and additional services exceed slightly 50% of maximum values. From the factors not listed within the criteria clients paid attention to the lack of possibility to make a cross-border transfer or no possibility of fully automatic obtaining a credit – via the Internet.

As stated previously, the first method limiting a specific subjectivity in the expert panel’s evaluations is applying unitary preferences with regard to particular criteria or sets of criteria. Four experiments assigning preferences to variants have been carried out:

- economic (60%), others – each 20%;
- technological (60%), others – each 20%;
- functional (60%), others – each 20%;
- non-economic – each – 45%, economic 10%.

In each case mBank has a secure, first position. With decreasing influence of economic factors good positions of Inteligo and Toyota Bank move to individual accounts of BZ WBK and iKonto PKO BP. Lukas Bank is characterized by well-balanced evaluation factors in two out of four cases, and it moves to the second position in the ranking. The order of the last positions does not change significantly – apart from previously mentioned: Millenium and ING, there is also Getin Bank, with the dominance of economic factors changing places with Dominet Bank.

The presented results, obtained by means of a traditional scoring method and a scoring method with a different preference scale, do not exhaust the possibilities of websites’ evaluation. Detailed studies conducted for the last year show that methods eliminating subjective indicators show slightly different results than the ones presented in this study. Because the chief aim of this research is obtaining a rational method of the evaluation of websites’ usefulness for a client, therefore, the next stage will be testing various preference scales, AHP method and the author’s method of minimizing the distance from the maximum possible scores.

3. Using AHP method to analyse e-banking services for individual clients

In AHP method we apply a completely different procedure method. Namely, a comparison for the examined group of banks is performed separately for each criterion. In order to evaluate the degree to which a given criterion has been realised in one bank in relation to every other bank we use a simplified Likert’s scale: 1 – criteria are realised in an equivalent way; 3 – minor advantage of realisation of a subsequent criterion in a particular website over the realisation of the same criterion in another analysed website (respectively 1/3 with inverse relation); 5 – major advantage of realisation of a subsequent criterion in a particular website over the realisation of the same criterion in the case of another analysed website (respectively 1/5); 7 – significant advantage of realisation of a subsequent criterion in a particular website over the realisation of the same criterion in the case of another analysed website (respectively 1/7); 9 – absolute advantage of realisation of a subsequent criterion in a particular website over the realisation of the same criterion in the case of another analysed website (respectively 1/9).

Analysing the above compilation we can conclude that the value of the realisation of a criterion in every bank is not evaluated in an absolute way, it is only a relation of the realisation of a particular criterion in one bank to the realisation of the same criterion in other banks. If treated in terms of a distance (relative advantage) we would observe that e.g. the distance of realisation of the first criterion in one bank to the realisation of the same criterion in another bank is different than the reverse relation. It allows evading the answer concerning the value of a criterion feature and, simultaneously, defines its relation to others. Nevertheless, if we group total scores for all criteria,
we arrive at a combined table of evaluations for each bank. The preference scale for the criteria in this method is obtained in an analogical way. Criteria are compared in pairs according to the same scale, and their total (actually the sum of their squares) after normalization can constitute a specific preference scale and it can show which of them are the most significant for an expert and which can be disregarded.

Roughly, Saaty’s AHP method [3] is a relative, multi-criteria expert evaluation consisting in pairwise comparison of experts’ evaluations. Not going into methodological details, the stages of the comparison procedure were the following:

- on the high level (pairwise comparison of evaluation criteria) the author applied a method of averaging experts evaluations, which was turned into a combined matrix,
- according to AHP method the square matrix has been calculated, and subsequently – on the basis of the sum of rows – weight vector, and normalised preference vector with regard to criteria (through referring particular elements to the sum of the preference vector elements),
- for each criterion a low level average preference matrix has been constructed for each pair of compared banks (on the basis of experts’ evaluations),
- by collecting scores for each criterion a low level preliminary matrix has been constructed and a preference vector has been calculated with regard to banks; data matrix has been multiplied by preference vector with regard to criteria, and subsequently a preference vector with regard to particular banks (repeating operations analogically as before),
- obtained findings were analysed.

AHP methodology has caused considerable difficulty for the gathered experts’ team. First problems concerned the pairwise comparison of criteria. While within particular sets of criteria it seemed possible and reasonable, in the case of comparing e.g. functional and economic criteria the importance and advantage of ones over the others did not seem that obvious.

The final form of the table was a result of a compromise reached by experts. There was a common view (which did not appear during the scoring method), that there are too many considered criteria and it is sometimes too difficult to decide which of them differ and to what extent. It would be definitely easier to evaluate the degree to which the criterion has been fulfilled and its relation to the criteria fulfilment in the case of other banks. Also, the fact that there were as many as twelve tables was an additional problem. Moreover, by way of experiment, we notice that experts – especially inexperienced – pay more attention to these criteria in a pair which appeared in the side-heading of a table than those which are in the heading, assigning better scores to the first ones. Their evaluation – as it was later discovered – is also influenced (though it should not take place) by the order in which criteria are considered. It appears that this method is not objective as well – each expert evaluated both the relations between criteria and their fulfilment in particular banks in a slightly different way. Similarly to a scoring method, during calculations averaged experts evaluations have been applied. Nevertheless, also in this case we can conclude which of the used variants of Internet banking services is optimal.

The obtained results differed considerably from the previous findings. Unexpectedly, Dominet Bank ranked first, though in previous studies it was taking one of the last places. mBank, the best and the only virtual bank near the lead, ranked second and the third one was – again surprisingly – electronic access to Inteligo PKO BP account (currently named iPKO in contrast to Inteligo), which so far has been ranked low. The main decisive factors in this case were relatively high scores for the first and the last crucial criteria, such as a transfer to another bank – which were ranked as the worst in the case of other banks, as well as an extended – in relation to the previous one – scoring
scale. The worst positions in this ranking were taken by PolBank and City Bank, which was just behind Polbank. The third in reverse order was VWBank for many periods leading in traditional methods of expert evaluations.

AHP method can also be used in an indirect way. Namely, the preference vector calculated in the first steps of this method can be used in expanding the simple method instead of preference vectors imposed or agreed collectively by experts. The findings of such operations are shown in Fig. 3. The obtained results are closer to traditional methods (without a consideration of relativity in the evaluation of particular criteria fulfilment by subsequent banks). The first and second positions are taken by mBank and Toyota Bank, and the third was PolBank (valuated as the worst in Saaty’s method), and just behind them— with equally low scores - VWBank. The last places were taken by ING, Millenium and Dominet Bank. The results of both methods are given in Fig. 2.

An AHP disadvantage which was the most difficult to eliminate – from the experts’ point of view – was the work consumption of the method and relativity of criteria comparison. The second – no possibility of direct evaluation of the degree of realizing a given criterion in particular banks. Therefore, experts suggested creating a method combining the characteristics of both methods. The major problem in constructing it was a conversion of a linear evaluation scale of the scoring method into relative references in Likert’s scale. First experiences with regard to constructing such a method did not produce the results which could be regarded as fully satisfactory [1]. Experts convinced of the possibilities created by the new method, asked – for the sake of comparison – to examine the phenomenon by means of AHP method, treated the latter evaluations in a rather random way.

![Figure: 2. Ranking of the evaluation of electronic access to individual accounts of selected banks in Poland in 2008 according to AHP and a scoring method multiplied by AHP method preference vector.](image_url)
4. Using a conversion method to analyse e-banking services for individual clients

The assumptions of a conversion method were as follows: after experts construct a table of evaluations of particular criteria for each bank – conversion should be started with establishing a preference vector for superior level criteria. The following transformation of a combined scoring table into a preference vector (first converter) is recommended:

- constructing a matrix of distances from the maximum value for each criterion in each website,
- calculating the average distance from the maximum value for each criterion,
- constructing a matrix of differences in the distance from the maximum value and the average distance according to criteria,
- for each bank website: constructing conversion matrices (4) - modules of relative distances of particular criteria to remaining criteria (the distance from the same criterion is 0), the obtained distances below the diagonal are the converse of the values over the diagonal,
- averaging criteria conversion matrices – creating one matrix of average modules of values for all criteria,
- transforming the matrix of average value modules into a superior preference matrix (calculating squared matrix, adding up rows, standardization of the obtained preference vector; repeated squaring, adding up rows, standardization of preference vector – repeating this iteration until there are minimum differences in subsequent preference vectors).

Subsequently, the author performed a transformation of the scores presented by experts on the level of a matrix specifying expert websites’ evaluations for particular criteria (second converter). The results have been obtained in an analogical way:

- constructing a matrix of distances from the maximum value for each criterion and each website,
- calculating the average distance from the maximum value for each website,
- constructing a matrix of differences of deviations from maximum value and the average distance of the features from the maximum value,
- for each criterion: constructing a matrix (12) of transformations (conversions) of the differences of the average distance from the maximum value between the websites, analogically as presented above (the distance for a particular feature in the same website from the same website is 0), values below the diagonal are the converse of the values over the diagonal,
- constructing a module matrix of transformations of the differences of average distance from maximum value between the websites, for each criterion,
- for each module transformation matrix of differences of the average distance from the maximum value between the websites, squaring it, adding up rows, standardization of the obtained ranking vector and repeating this operation until the obtained differences between two ranking vectors for each criterion will be minimal,
- using the obtained vectors to construct a combined ranking matrix – returning to the matrix where in its side-heading there are criteria, in the heading names of bank websites by appropriate transfer of the obtained preference vectors for each criterion,
- multiplying the matrix obtained in such a way by the previously calculated preference vector,
- analysing final results and drawing conclusions (Note: the lowest distances in this case are the most favourable, comparability adjustments to other methods can be obtained by subtracting these values from 1 and their repeated standardization).
Conversion method – based on averaged distances from the mean ones – flattened the obtained results. Nonetheless, there occurs greater conformity with the results obtained by means of a scoring method than in AHP method.

In the first three positions – mBank (1) and Toyota Bank (3), confirm the results of the scoring method. A similar relationship occurs in the service of individual accounts in the case of the worst banks. A definite differentiation of scores in comparison to a scoring scale took place after multiplying the results of the scoring method by a preference vector from the conversion method. Here, Toyota Bank and Lukas Bank took first positions, and MultiBank and CityBank ranked the lowest. A similar dependence appeared in a scoring scale with non-economic preferences. The scores for conversion method and the scoring method multiplied by the preference vector from the conversion method are presented in Fig. 3.

5. Conclusions

In the findings presented above three methods of IT ventures evaluation have been applied: the scoring method (also called multi-criteria scoring method), AHP method (Analytic Hierarchy Process – T.L. Saaty) as well as the author’s own conversion method, based on measuring average distances obtained from the scoring method. The conversion method was created as a compromise between AHP method and the scoring method, and it seems to take into account all answers to claims made with reference to improving the scoring method (above all, it limits the subjectivity of experts evaluations).

Simultaneously, in this paper the author presents preliminary methods of preventing evaluation subjectivity: gathering an expert team, whose average scores were taken into consideration when assessing the measurement, team’s establishing various (technical, functional, economic and non-economic) user preference scales and the analysis of results of applying such assumptions, applying preference scales of other methods (here: AHP method and conversion method).
Although the evaluation of the same websites according to various methods in the same period of
time was carried out by the same team of experts, the obtained rankings – despite keeping within
the main trend (leading in one ranking usually meant taking first positions in another), differed
slightly. Considering the number of applied criteria it is sometimes difficult to point to the actual
reasons for these differences.
Generally:

- scoring method, though regarded as subjective, despite applying a large number of criteria
  and a traditional linear scoring scale, was evaluated by experts in a positive way, as a rational
  evaluation method which is easy to acquire. After taking into consideration the preference
  scale, experts claimed that – in their view – the impression of subjectivity and equivalence of
  radically different criteria is not as significant as the evaluations of academics suggest.

- in the experts’ view, AHP method turned out to be more troublesome in the case of the
  necessity to compare many websites, by means of a larger number of criteria. Declarative
  objectivity of this method was losing out with an expert’s fatigue; therefore, frequently the
  websites which were examined first were evaluated higher than subsequent websites (the
  change of the order of websites’ evaluation produced entirely different results). The presented
  score was often regarded by experts as ambiguous, owing to its relativity and the extended
  scale. Work consumption of this method was increasing, in comparison to the scoring
  method, exponentially in relation to the number of used evaluation criteria and the number of
  bank websites which were examined.

- conversion method combining advantages of a scoring method (unequivocal, easy criterion
  evaluation) and Saaty’s method (specifying the relation of one criterion to other criteria),
  consisting in defining the relation of one criterion with reference to other criteria based on
  averaged distances from a potential maximum value on the basis of the earlier scoring
  method, is regarded as a reasonable compromise between these methods.

The final results of the application of these methods for Internet services of e-banking websites for
individual clients are presented on Fig.4.
Figure 4: Ranking of electronic access evaluation of individual accounts in selected banks in Poland in 2008 acc. to scoring method, AHP and conversion method

Furthermore, both in the case of bank websites and earlier in the analysis of other e-business websites, experts pointed to a specific substitutability of particular features of evaluated websites. It was represented by attracting clients with economic features or – on the other hand, with technological advantages, with identical (comparable) functional features. Therefore, the best clients’ scores were assigned to the websites which on the one hand, were crudely constructed, but offered a wide range of goods or services at reasonable prices, or on the other – those technically sophisticated (search engines, high score for graphics, etc.) but with a limited range of more expensive goods and/or with more sophisticated services offered at higher prices. This phenomenon, which so far has not been analysed in the literature from the point of view of information technologies’ evaluation – will be examined in further studies.

6. References


Abstract
Nowadays when dealing with a great pace of changes, it is important more than ever, to have stable public institutions. In order for citizens to regain their trust to public institutions, they need to be effective and efficient. Just implementing the new information and communication technology (ICT) to support existing processes in public sector institutions will not do much of improvement. The mission of each public organization should be reconsidered as well as the business processes that are supposed to insure the fulfillment of mission. Only redesigning the business processes in order to effectively use contemporary ICT will improve the work and make public organizations more effective and efficient. There is no unique schema for business process redesign (BPR). It is more like exploring the very nature of each organization and trying to identify problems in functioning. These problems are usually interdisciplinary in nature and different scientific approaches and methods are needed to deal with them. This paper is about three different approaches used to solve problems in different public organizations. The first one is applied in Croatian Pension Insurance Institute and was about dealing with the huge number of paper documents archived for a long period of time. The second one is about formal description of defense organizations needed in analysis phase of defense information systems development. The third one is on implementing the balanced scorecard methodology in public sector organization and occurred as a result of international e-government project funded by Lithuanian Science Foundation.

1. Document Life Cycle

1.1. Introduction

Nowadays in the information age, for the first time information was recognized as something immaterial having its own value [7]. The pace of changes in the organization's environment increases every day and generates a huge amount of information. Therefore, management needs updated and secured information in order to make quality business decisions. This information can be insured through the properly designed information system within the organization. According to the contemporary researches in the area of organization and information systems science, business process redesign (BPR) supported by IT became the key factor of organization existence and success [4], [11]. Business processes and information flow between them form the basics of

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administrative business technology of the organization. By information flow we mean different media and its information/data content. These could be paper documents, verbal messages, video records etc. The role and importance of documents within the organization can be easy explained using the process model. Through the modeling activity we get a clear picture of organizational processes and information flow (documents) that connects them. There are different business process modeling methodologies representing processes and documents on different way. IDEF0/SADT methodology [22], [28] connects processes directly by input and output documents. In classic and widely known DFDs (Data Flow Diagrams) [24], [6], processes are connected by documents indirectly through the concept of data store.

While in process modeling the stress is put upon the concept of process itself, and can be analyzed well, documents are of less importance. The way of creating, using and storing documents can be, up to the a certain level, described by the process model. However, if the number of different types of organizational documents is huge, if different processes use the same types of documents on different ways, and if the archive procedures are different based upon legislation or some organizational rules, then using just process modeling activity is not enough for proper description of business document system. List of all documents used within one organization, together with their basic attributes (ID, name, short description, archive period) represents the basics of organizational catalog of documents. Generally, these catalogs are static structures usually designed and implemented as one relational schema (table) within the organizational database management system (DBMS). If the business document system is as complex as mentioned above, then the static structure of catalogue of documents needs an extension. In other words, a completely new document management system (DMS) needs to be designed.

DMS must, besides the static data structure of document type, contain a document type dynamics, too. In order to design and model a document dynamics, available process modeling and data modeling methodologies are not sufficient. A new methodological approach should be used in designing DMS supported by IT. The starting point of this approach is the document life cycle. The importance of DMS and document management in general is well elaborated in [19], while some basics of document based information systems are explained in [1].

The problem with dealing with the past, current, and future documents increases if they need to be stored for some time. It could cause the enormous accumulation of paper documents, especially in public sector organizations, where this accumulation is measured in (kilo)meters (length of paper documentation). Namely, for the public sector institutions to fulfill their mission, i.e. to insure the quality service to citizens, they must keep in archives majority of documents produced for citizens. Some of these documents are kept in archives even for citizens that already passed away, causing some documents in archive to be older than hundred years. We can ease this situation using the microfilm or digital techniques. Problems with the accumulation of documents, places for their storage, as well as the benefits of proper use of IT in dealing with these problems, are explained in [3]. Even private sector organizations are not immune to this problem, especially banks. However, modern information technologies will not solve by itself the problem of accumulating the new documentation, unless we change the processes that generate the documentation. In order to change these processes, we have to consider the life cycle of each document / document type and model it. Thus we develop the catalog of documents (CD), that is not just the list of all types of documents within the organization, but contains the document dynamics, too. Document dynamics relates to all standard operating procedures (SOP) performed on each instance of some document type. CD developed on this way is a foundation for the technological development of digital archives and DMS as a whole.
1.2. Dynamics of the Document Life Cycle

Each document used in organization business technology has its own life cycle. Document life cycle comprises several states (phases) through which it passes from its beginning to its end. Every document must pass through at least two phases, or in other words, be in at least two states during its life cycle: beginning state and end state. In each and every moment document can be in at least one state and at most one state.

Organization business technology can use several document types. In the public sector organizations, the number of document types can vary from few dozen to over a thousand. Documents can start their life cycles in one of two ways. First, document can come to the organization form the environment (sent by citizen, business partner, etc.). When this document appears in the organization, we say it is in a state of appearance. Second, the organization can produce the document itself (verdict, decision, birth certificate, etc.), as a response to some request from the environment. Public organizations usually produce the document based upon some data about citizen. These data are stored in the database or contained in other documents that serve as a proof for some facts. Either way, this data represents the elements of the document that is going to be produced. Thus, organization produces the document in the state of data usage. The states of appearance and usage are the beginning states in the document life cycle. When all the elements for the document to be produced are ready and checked, the document goes to the state of creation. Document can disappear from the organization in two ways. First, by ordering to destroy it when it is no more needed. At that moment document comes to a destruction state. Second, document can be sent to the environment, as result of solving the some instance's request. If that happens, document is in state of leaving the organization. The states of destruction and leaving are the end states in the document life cycle. In general, beginning and end states are necessary, but not the only states on the documents life cycle. Between these outermost states, exist states in which the documents are used by the organization in different manners.

These states are:

- **usage** (document is used for activating and performing some processes, which is, besides being the beginning state, another role of this state),
- updating the database – *DB update* (data from the document is used for updating the organization database or adding new transaction records),
- *temporary keeping* the electronic equivalent of the document (electronic equivalents of the documents, ready to be digitalized permanently, or electronic equivalent of the documents already stored in digital archive and temporary used by some employee), and
- *permanent digital archiving* (digital equivalents of the documents are permanently digitally archived).

These eight states are the only states in which each and every document can be in. In other words, any document's life cycle comprises some of these eight states, starting with one of the beginning states, and ending with one of the ending states.

All of eight document life cycle states, mentioned in former section, as well as relationships among them, can be described, precisely enough, with the state transition diagram of certain finite automaton (*figure 1*). This diagram, along with the above description of document states, relate to the target business technology of CD and DMS.
In this wished business technology the only paper documents are those that the organization produces and sends to the environment. All other documents (internal or those that come from the environment), are permanently kept as digital equivalents in digital archive. The document states are represented with circles (S1 to S8) on figure 1. Double circles (S6 leaving, S7 destruction), represent end states. In the terms of finite automaton, these are finite states. They are the end of the document life cycle. Life cycle of each paper document must have one of these states as an ending state. In the state S8 digital equivalent of the document is permanently kept. Therefore this state is a final state for digitalized documents and so shown as double circle. States S1 (appearance) and S2 (usage) are beginning states and one of them must be the first state in every document's life cycle.

![Figure 1: State transition diagram of the document](image)

Transition of document from one state to the other is caused by certain event. There are fourteen possible events (e1 to e14) shown as arrows on the diagram on figure 1. Event e1 caused the transition of document from the state S1 (appearance) to the state S2 (usage). The name of this event is "receive document" (table 5.1). The influence of this event on document and the change of its state has the following meaning: "if the document is in state S1 (appearance), and event e1 occurs (document is officially received), then the document will transit to state S2 (usage)". The influence of other events on documents can be understood following the same pattern.

The list of all possible events that can influence every document is shown in table 1. The event description consists of two parts. The first part, written in italic, depicts the activity, which uses data structure defined in the second part, written in regular. These two parts represent the syntax of the event [9]. Activity, as the first part of the event syntax, belongs to the business technology of the organization, and when executed, causes the document to change the current state in a way determined by the state transition diagram (figure 1).
Events e6, e7, and e8 occur over the data structure of the document that organization itself produces. Because of that, the second part of the syntax of these events (table 1) is titled as "organization document".

<table>
<thead>
<tr>
<th>EVENT ID</th>
<th>EVENT DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>e1</td>
<td>receive document</td>
</tr>
<tr>
<td>e2</td>
<td>read document by OCR</td>
</tr>
<tr>
<td>e3</td>
<td>enter data into DB</td>
</tr>
<tr>
<td>e4</td>
<td>digitalize document</td>
</tr>
<tr>
<td>e5</td>
<td>search for document</td>
</tr>
<tr>
<td>e6</td>
<td>produce organization document</td>
</tr>
<tr>
<td>e7</td>
<td>use organization document</td>
</tr>
<tr>
<td>e8</td>
<td>deliver organization document</td>
</tr>
<tr>
<td>e9</td>
<td>order document destruction</td>
</tr>
<tr>
<td>e10</td>
<td>show document</td>
</tr>
<tr>
<td>e11</td>
<td>show data</td>
</tr>
<tr>
<td>e12</td>
<td>return document</td>
</tr>
<tr>
<td>e13</td>
<td>permanently archive document</td>
</tr>
<tr>
<td>e14</td>
<td>temporary store document</td>
</tr>
</tbody>
</table>

Table 1: Events and their description

The importance of the state transition diagram (figure 1) and table 1, should be considered from several perspectives related to business technology and documents within the organization. These perspectives are:

- Each document type within the organization business technology has its own life cycle comprised of the states in which document can be found.
- Each document on its life cycle passes through at least two states: beginning state and end state. Thus document life cycle starts whether in state S1 (appearance) or in S2 (usage), and ends whether in state S7 (destruction) or in S6 (leaving). Some documents end their life cycle as digital equivalents in digital archive, i.e. state S8 (permanent digital archiving).
- The same document type can have more than one life cycle. For example, birth certificate can be received, digitalized and returned. On the other side, if it is already digitalized, it can be received and returned. In these two cases the document called birth certificate passes through different states, and thus has different life cycles.
- Different documents have different life cycles because organization processes use them in a different way. Whatever the document life cycle, it must consist of some of the states shown in figure 1. Life cycles are different in three ways: (1) they can consist of different states, (2) they can consist of different number of states, and (3) different events can change the same state.
- Among all processes/activities that are performed in the business technology of an organization, and can be found on process model, there exist processes/activities that are part of certain events. These events change the states of the documents (table 1).
2. Formal Description of Defense Organizations

2.1. Introduction

There are different approaches in business area analysis [12]. Structured analysis and object oriented analysis are widely known. Regardless of the approach we use, final results are process model and data (object) model, which represent the organizational business technology, as it was at the moment of analyzing. While modeling organizations, we can not take the future organizational changes into account, because they are mostly unpredictable. However, there are certain types of organizations, like some military organizations, which can change their business technology in the manner that is known in the moment of analyzing. In other words, process and data models are not constant in time. They change due to specific events that may occur. In the moment of analyzing we don’t know when the event will occur, but we know what will happen if it occurs. Such organizations have more than one state of functioning, each of which can be described by its own process and data model. We can name this type of organizations as “organizations with time changeable functions” [10]. Not just military organizations are of that type. Similar characteristics have some police organizations, organizations for preventing the consequences of natural disasters, organizations for organizing and monitoring social events with large number of participants, etc.

Development of information systems that will support organizations with time changeable functions must take into account the changeability of their functions. Available structured and object oriented methods can be used for analyzing and modeling each state of functioning, but they are not optimal to model this type of organization as a whole. Optimal approach in development of information systems for this type of organizations can come from the formal description of these organizations.

Hereby we therefore propose a possible formal description of organizations with time changeable functions, and represent some results gained from the ongoing research project “Strategic Planning and Development of Defense Information Systems”. This project is led by the Faculty of Organization and Informatics, Varazdin, University of Zagreb, and sponsored by the Institute for Defense Studies, Research and Development, Ministry of Defense, Republic of Croatia.

2.2. Ontological Perspective of Defense Organizations

For the organizations with time changeable functions is crucial to describe the way an organization changes its state, i.e. transits from one state to another. For this description finite automata theory is appropriate [20,21].

**Definition.** A finite automaton $M$ is an ordered 5-tuple $(A,S,T,q_0,f)$, such that:
- $A$ is a finite set of input symbols (events),
- $S$ is a finite set of internal states,
- $T$ is a set of final states ($T \subseteq S$),
- $q_0$ is an initial state ($q_0 \in S$),
- $f$ is a next-state function from $S \times A$ into $S$.

When implementing the above definition to the organization with changeable functions, five elements of definition can be considered as follows. Set $A$ has two characteristics – it’s finite and its elements are events. Event is a concept that has no duration, and when occurs, organization changes its state of functioning. Set $S$ is finite too, and its elements are possible states of organization. Set $T$ is a subset of $S$ and its elements are named final states. Final states are those in which organization
will transit for sure after some time. The time organization spends in non final states are negligible if compared with the time organization spends in final states. State $q_0$ is an initial condition and from that state organization starts to function. When considering organizations, we can assume that the initial state is one of final states.

Function $f$ represents the “rules of behavior” for the organization. It describes the organization from the dynamic perspective. Let $(q_i,d)$ be an ordered pair where $q_i$ depicts the current state of organization and $d$ depicts the event that causes the transition from the state $q_i$ to the state $q_{i+1}$. Function $f$ maps $(q_i,d)$ to $q_{i+1}$, i.e. $f(q_i,d)=q_{i+1}$.

For the purpose of formal description of organizational behavior, we’ll introduce some definitions through the next example.

Let $M$ be the finite automaton with the following elements:

- $A = \{a,b\}$, set of events,
- $S = \{q_0, q_1, q_2\}$, set of states,
- $T = \{q_0, q_1\}$, set of final states,
- $q_0$, initial state
- $f: S \times A \to S$, next state function defined by the table 1:

<table>
<thead>
<tr>
<th>$f$</th>
<th>a</th>
<th>b</th>
</tr>
</thead>
<tbody>
<tr>
<td>$q_0$</td>
<td>$q_0$</td>
<td>$q_1$</td>
</tr>
<tr>
<td>$q_1$</td>
<td>$q_0$</td>
<td>$q_2$</td>
</tr>
<tr>
<td>$q_2$</td>
<td>$q_2$</td>
<td>$q_2$</td>
</tr>
</tbody>
</table>

*Table 2: The next state function for the example*

$M$ is completely determined by the above elements. There is a concise graphical representation of finite automaton $M$. It is called a state diagram (figure 2).

State diagram of $M$ is a labeled directed graph whose vertices, depicted as circles, are the states of $S$. Final states are depicted as double circles. If $f(q_i,d)=q_j$, there is an arc (arrow) from $q_i$ to $q_j$ labeled with $d$. The initial state $q_0$ is denoted by having an arrow entering the vertex (circle) $q_0$.

Let $W$ be a sequence $a_1a_2a_3 \ldots a_n$ of events (input symbols) for the automaton $M$. We obtain the sequence of states $s_0s_1s_2 \ldots s_n$, where $s_0$ is an initial state and $s_i = f(s_{i-1}, a_i)$, for $i > 1$. We say that $M$ accepts sequence $W$, if $s_n$ is a final state, i.e. $s_n \in T$. Each individual sequence $W$, we call scenario. Scenario is good, if $M$ accepts it. Set of all good scenarios we denote $L(M)$ and call dynamic structure of the organization $O$, which is represented by $M$. Dynamic structure is, in fact, a description of behavior of organization $O$. For the example on Fig. 2, “aababab” is a good scenario, while scenario “ababba” is not good.
Let $O$ be the military organization for the air defense. It can be the whole air defense system or some air defense unit. Let $O$ has three states of functioning (three functions or business technologies) defined as follows:

- regular state ($q_0$),
- I. level of readiness ($q_1$),
- II. level of readiness ($q_2$).

Suppose we want to develop the information system for $O$. Appropriate variables whose values describe the states of $O$ are process model ($pm$) and data model ($dm$). Let $MP_i \ (1 \leq i \leq 3)$ and $MD_j \ (1 \leq j \leq 3)$ be process models and data models for each of three states. Let $MP$ and $MD$ be the sets of process models and data models, respectively. As number of possible states is greater than one, air defense system belong to the class of organizations with changeable functions. Individual states of $O$ can be represented by following formulas:

- $q_0 \ldots (pm = PM_1) \land (dm = DM_1)$
- $q_1 \ldots (pm = PM_2) \land (dm = DM_2)$
- $q_2 \ldots (pm = PM_3) \land (dm = DM_3)$.

Let $z_0, z_1, z_2$ be the events defined as follows:

- $z_0 \ldots$ giving the order for the air defense system $O$ to transit to state $q_0$,
- $z_1 \ldots$ giving the order for the air defense system $O$ to transit to state $q_1$,
- $z_2 \ldots$ giving the order for the air defense system $O$ to transit to state $q_2$.

We consider the regular state $q_0$ to be the initial state and the final state of $O$. It is logical because experience shows that time $O$ spends in the states $q_1$ and $q_2$ can be neglected if compared with time $O$ spends in the regular state $q_0$. Now we define the finite automaton $M$ for the air defense system $O$:

- $A = \{z_0, z_1, z_2\}$, set of events,
- $S = \{q_0, q_1, q_2\}$, set of states,
- $T = \{q_0\}$, set of final states,
- $q_0$, initial state
- $f:S \times A \rightarrow S$, next state function defined by the table 3.

<table>
<thead>
<tr>
<th>$f$</th>
<th>$z_0$</th>
<th>$z_1$</th>
<th>$z_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$q_0$</td>
<td>$q_0$</td>
<td>$q_1$</td>
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<td>$q_2$</td>
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<td>$q_1$</td>
<td>$q_2$</td>
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</tbody>
</table>

Table 3: The next state function for the example 3

Now we can draw the state diagram for $M$ (Figure 3). Dynamic structure $L(M)$ is a set of all good scenarios that can happen within the $O$. These good scenarios are possible sequences of events within the air defense system. Let’s look at the set $L(M)$:

$L(M) = \{z_0^*z_1z_0, z_1z_0, z_1z_2z_1z_0, z_1z_1^*z_2z_3^*z_1z_0, \ldots \}$,

where $z_i^*$ stands for none, one or more successive $z_i$’s.
Consider the scenario $z_1 z_2 z_3 z_0$. While being in regular state $q_0$, air defense system is ordered ($z_1$) to increase the level of readiness and transit to the state $q_1$. After some time the situation becomes more complicated and new order ($z_2$) is given, so $O$ transits to the state $q_2$. After some negotiation has been done, threat is decreased and new order ($z_1$) causes the $O$ to transit to the state $q_1$. When situation is resolved, there is no need for increased level of readiness and $O$ returns to the regular state $q_0$ as ordered ($z_0$).

![Figure 3: State diagram of the automaton $M$ described with the next state function from the table 3](image)

We have defined so far the way in which defense organizations change their states. Dynamic structure $L(M)$ is introduced as a set of all good scenarios that can happen in the organization described by the finite automaton $M$. The scenario is a sequence of events that can occur in the organization. The key concept here is an event itself. Although event is a momentary concept and has no time duration, it has a powerful meaning expressed through its syntax and semantics [10]. Consider the event $z_1$ from the above example (Figure 4).

![Figure 4: Elements of the event’s syntax](image)

We define the syntax and semantics of the event as follows.

**Definition.** Let $d$ be an event. Syntax of the event $d$, $\text{Syn}(d)$, is an ordered 3-tuple $(n,p,o)$, where $n$, $p$, and $o$ are defined as follows:

- $n$ … event title (short name of an event) that must be unique within the set $A$ of all events of the automaton $M$,
- $p$ … action (mostly in the shape of verb or verbal noun that depicts the activity contained in the event),
- $o$ … object that action $p$ deals with (must be defined in the organization (usually as document) and have the data structure).

**Definition.** Let $d$ be an event and $\text{Syn}(d)$ syntax of $d$. Then semantics of $d$, $\text{Sem}(d)$, is a set $\{e_1, e_2, e_3, \ldots, e_n\}$ of data that make the data structure of the object $o$ from $\text{Syn}(d)$.
Every event from the set $A$ of the finite automaton $M$ must have syntax and semantics defined, in order for the organization $O$ to function normally. For an example of the event from the figure 4, syntax and semantics are defined as follows.

$\text{Syn}(z_1) = \{z_1, \text{ giving, order for the air defense system } O \text{ to transit to state } q_1\}$,

$\text{Sem}(z_1) = \{\text{transition time, unit that will transit, communication system during transition, higher air defense headquarters, } \ldots\}.$

Let $O$ be the organization with changeable functions ($n$ possible states, $n > 1$). Dynamic structure $L(M)$ of $O$ is determined by the finite automaton $M$. Let each event $d$ from the set of events $A$ of the $M$ has syntax $\text{Syn}(d)$ and semantics $\text{Sem}(d)$ defined. Let $Q_i$ ($1 \leq i \leq n$) be the proposition “$O$ is in state $q_i$” and $P(Q_i)$ be the probability of $Q_i$. Let $Q_i \cup Q_j$ be the proposition “$O$ is in state $q_i$ or in state $q_j$”. Assume that following two formulas are true:

1. $P(Q_1 \cup Q_2 \cup \ldots \cup Q_n) = P(Q_1) + P(Q_2) + \ldots + P(Q_n)$ (1)
2. $\forall (t)(t \in T) \exists (i)(1 \leq i \leq n) ((P(Q_i) = 1) \land (P(Q_j) = 0) \land (i \neq j))$ (2)

If formula (1) is true then the propositions $Q_1, Q_2, \ldots, Q_n$, are mutually excluded and it is for certain that $O$ is at least in one of its states. Formula (2) is more restrictive and if true, $O$ is in exactly one of its $n$ states in every moment $t$ within the considered time interval $T$.

Let $d_{ij}$ be an event from the set $A$ of automaton $M$, which causes the $O$ to transit from the state $q_i$ to the state $q_j$. Let $D_{ij}$ be the event “$d_{ij}$ happened” and $T_{ij}$ be the event “$O$ changed the state from $q_i$ to $q_j$”. Then the probability of an event “$T_{ij}$ will happen if $D_{ij}$ happens” is called the conditional probability of $T_{ij}$ for given $D_{ij}$ and is denoted as $P(T_{ij} \mid D_{ij})$. Conditional probability can be evaluated with the formula:

$$P(T_{ij} \mid D_{ij}) = P(T_{ij} \cap D_{ij}) \cdot P(D_{ij})^{-1}$$ (3)

where $P(T_{ij} \cap D_{ij})$ is the probability that $T_{ij}$ and $D_{ij}$ occur simultaneously. In other words, $T_{ij} \cap D_{ij}$ is a complex event that describes the situation when event that causes the transition ($d_{ij}$) occurs and $O$ really changes its state. From (3) we get:

$$P(T_{ij} \cap D_{ij}) = P(T_{ij} \mid D_{ij}) \cdot P(D_{ij})$$ (4)

If $O$ has standardized business technology, than when $d_{ij}$ occurs, $O$ will for certain transit from $q_i$ to $q_j$. This means that for standardized organizations conditional probability $P(T_{ij} \mid D_{ij})$ equals 1. Now we have:

$$P(T_{ij} \cap D_{ij}) = P(D_{ij}).$$ (5)

Expression (5) means that the probability of occurrence of an event $d_{ij}$ and the transition form $q_i$ to $q_j$ depends solely on the probability of occurrence of $d_{ij}$. We can explain this using the example of the air defense system. The probability of occurrence of the event $z_1$ and the transition from the regular state to the state $q_1$ depends solely on the probability of occurrence of $z_1$. The difficult part here is to determine the probability of occurrence of $z_1$. As air defense system is well standardized, transition from the regular state $q_0$ to the state $q_1$ will be almost automatically done.
Definition. Let $O$ be the organization with changeable functions. If equations (1), (2), and (5) are true for $O$, then we say that $O$ is an organization with time changeable functions.

This type of formal approach in describing the defense organizations has a great impact on understanding the business technology of such organizations and can help in designing the information system and implementing the IT.

3. Management by Measurement in Public Sector

3.1. Introduction

Effective e-government presupposes proper application of the information and communications technology (ICT) as well as an effective management system in order to improve the economics of the public sector. The budget that public sector organizations start the new strategic planning cycle with should be partially used for enabling the organizational efficiency. This is done through implementation of the new ICT and employees’ education. Having improved business processes supported by ICT and educated employees will cause the citizens to be satisfied with the level of service of that public organization. This will, as a consequence, justify the budget allocated for the public organization and its mission will be thus fulfilled. Such a cause and effect chain, that can significantly improve the public sector economics, is in the very nature of Balanced Scorecard (BSC) methodology, when used for managing the organization. A clear definition of goals and natural strategy definition and implementation using BSC will lead the organization towards its goals by executing right activities with the optimal resources usage.

Performance measurement in organizations is not a novel concept. Research shows that all the preconditions for performance measurement had been fulfilled by the late 19th and early 20th century [29]. The first concrete performance measurement was conducted within The Center for Urban Research in New York. Performance measurement has been developing as a professional and scientific field of expertise ever since. However, whereas in the beginning performance measurement was closely connected to budgeting, and was therefore used for estimating an organization's financial performance, nowadays it is used for managing organizations. Although performance was initially measured in public sector organizations [20], nowadays it is quite common in both public and private sector organizations. In addition, organizational performance used to be initially measured at the easily quantifiable operational level, whereas nowadays it has become possible to measure the realization of an organization's strategic goals as well. In the early 1990s, R. Kaplan and D. Norton laid the foundations of the currently most popular measurement method in the domain of organizational performance measurement – the balanced scorecard (BSC) method [13, 14]. By means of a strategic map of goals and measures, this method enables the so-called strategic measurement, which focuses on measuring the success of a management's strategic hypotheses, as opposed to common diagnostic measurement conducted at the organization's tactical and operational level. Since it was introduced, BSC has developed into a method of management by measuring the realization of an organization's strategic goals, in other words, as the 'measure to manage approach’. The development of this method was extensively covered by various publications [15,16,17,19,25]. Although the BSC method appears natural and self-explanatory at its core level, and as such lends itself easily to supporting the management of both public and private sector organizations, ways of its implementation and its operative usage have not been fully researched. The interdependence between the BSC management model and the organization's information system has not been fully examined either [17,23]. This has led the Ministry of Science, Education and Sports of the Republic of Croatia to finance a scientific project aimed at establishing
a natural and clearly defined method of implementation of the BSC model in organizations, with the support of the appropriate software [8]. Having worked together for several years, the members of the project team have devised a unique methodology of the BSC management model development [26] and implementation. This methodology was tested on concrete organizations in the private and public sector equally. Currently two workshops on the application of the BSC method are being conducted at the Ministry of Defense of the Republic of Croatia. In addition, the authors of this paper are participating in a project in which the Mykolas Romeris University in Vilnius, Lithuania, is involved as the project holder [5], aimed at determining the guidelines for developing e-government in Lithuania. Here is presented one of the outcomes of the afore-mentioned activities, especially in the segment of the operative usage and implementation of the BSC method.

3.2. Operative usage of BSC model in strategic planning cycle

The way of using the BSC model in public sector organizations is best described if shown through the appropriate activity flow diagram (figure 5). There are four positions (functional roles) defined within the model: the Government/the Strategic Development Agency, the Manager of a Public/State Organization, the BSC Model Administrator and the DB Administrator. Activities are either the starting points or the end points of particular information flows shown in figure 5 (in this section they are italicized).

At the beginning of each new strategic planning cycle the Management (e.g. the minister and his/her associates) conducts the activity called Defining the Vision of the Public/State Organization, that is, creating the overall framework of the organization to be achieved upon the termination of a strategic planning cycle. A Vision Proposal is delivered by the Management to the Government/Governmental Agency for consideration. During the activity called Vision Approving, the Government either approves the Vision and delivers it to the Management for further action or fails to approve the Vision Proposal and returns it to the Management for improvement. The approved Vision is also delivered to the BSC Administrator for BSC Model Updating. On the basis of the Vision, the Management conducts the activity called Defining Strategic Goals. The obtained Strategic Goals Proposal is delivered to the Governmental Agency for adoption. If this proposal is approved, Strategic Goals are delivered to the BSC Administrator, who enters them into the model by means of BSC Model Updating.

The Management estimates the organization's readiness for realization of Strategic Goals by conducting the activity called Identifying SWOT Elements. The S,W,O,T elements are entered into the model by means of BSC Model Updating, and the significance that individual elements have for realization of strategic goals is assigned to those elements by the Management through the activity called S,W,O,T Elements Ranking. The obtained S,W,O,T Rank is entered into the model by means of BSC Model Updating, and is used by the Management for Defining Strategies, so as to ensure that the obtained Strategies are sustainable and realistic. Strategies are entered into the model by means of BSC Model Updating. For each of the Strategies the Management needs to engage in Defining Activities for Strategy Implementation, whereby each individual strategy will be put into effect. The BSC Administrator enters the Activities into the model by means of BSC Model Updating.
Figure 5: Activity flow diagram of operative usage of BSC
Each *Activity*, regardless of whether it has already been performed in the organization or not, is aimed at fulfilling a particular goal. The Management engages in Defining Activity Goals. The *Goals* are entered into the model by means of BSC Model Updating. Their significance is twofold. Firstly, all the *Goals* are in mutual cause and effect relationships arising from the fact that the realization of individual goals affects the realization of some other goals. Owing to that, the Management conducts the activity called Defining Relationships among Goals, resulting in the *Cause and Effect Chain of Goals*, to be entered into the BSC model by means of BSC Model Updating. Secondly, for each goal its metrics need to be defined, to enable the tracking of the realization of that particular goal. The activity called Identifying Metrics, conducted by the Management, has two outcomes. Firstly, for each goal the following components of its metrics are identified: *Measure*, *Target Value* and *Responsible Component* as well as *Measurement Frequency*. These metrics components are entered into the BSC model by means of BSC Model Updating. Secondly, the *Metrics* as a whole, along with the *Cause and Effect Chain of Goals*, are used by the Management for Determining Relationships among Measures. The set of all these relationships makes a *Cause and Effect Chain of Measures* containing the entire logic of behaviour of the BSC model. It is entered into the BSC model by means of BSC Model Updating by the BSC Administrator. This is where the set of activities connected to the BSC model development is completed.

Another set of activities encompasses feeding the metrics with the appropriate measures (measure values). Metrics Feeding is conducted by the BSC Model Administrator when the model needs to go through the validation procedure or when the state of fulfillment of goals needs to be presented to the Management. The BSC Model Administrator selects the *metrics* from the model and searches the organizational database for its measure value by making a *Measure Value Query* against the database. If the database already contains the measure value, then the activity called Central DB Administrating, conducted by the Database Administrator, allows for the reading of the *Measure Value* to be taken. If a certain measure value is not held within the database, a *Request for New Data Source* will be made, on the basis of which the Database Administrator of the BSC model proceeds with Data Source Creating. The *New Data Source* created in this way is used by the Database Administrator for DB Functionality Extending. The outcome of this activity is a *Data Source Relational Schema*, on the basis of which the Database Administrator, by conducting the activity called Central DB Administrating, reports this relational schema to the organizational database management system.

The following set of activities encompasses BSC model validation. By using the *Cause and Effect Chain of Measures* and *Measure Values* from the organizational database, the BSC Model Administrator conducts the activity called Preparing BSC Model Validation. Through this activity, the Administrator compares the measure values obtained by means of the BSC model logic against readings of values of the same measures taken from the organizational database. The difference *Model vs. Reality* is the basis for Model Validating. If this difference lies within the predefined tolerance ranges, the *Model Correctness Confirmation* signals the Management to engage in Managing by BSC Model. If the difference exceeds the predefined tolerance ranges, the *Model Incorrectness Confirmation* signals the Management that the model is incorrect and therefore the activity Strategies Revision needs to be undertaken, with the view to determining the reasons for the divergence between the model and reality. For strategies to be revised, the Management needs to have the existing *Strategies* entered in the model at their disposal. The outcome of Strategies Revision are *Revised Strategies*, to be entered into the BSC model. These *Revised Strategies* are used by the Management for Identifying Activities for Strategy Implementation, aimed at defining
new activities to enable the implementation of the revised strategies. This is where a new cycle of the BSC model development starts.

When the difference between the BSC model and reality lies within the predefined tolerance ranges, the Management engages in Managing by BSC Model, whereby it starts to rely on the management model. This model needs to be periodically checked by comparing the measure values calculated by the model against real measure values from the organizational database or another similar source. The output of Managing by BSC Model are *Strategic Goals Realization Reports*, to be used by the Government for the activity called Determining Development Policy of the organization in the next strategic planning cycle.

4. Conclusion

If trying to improve the performances of public sector organizations, a certain scientific approach is needed. Just implementing a new ICT for the purpose of automating the existing business activities will not help much. What we really need is reengineering effort that will change the business processes in order to prepare them for the ICT implementation. This effort often requires challenging the very nature of organization itself. What we need in dealing with such a challenge is a certain scientific approach. Different areas and methods are available when trying to improve business processes. Some of them are explained in this paper and represent the real life experience in trying to implement science.

Different ICT vendors offer a wide range of "all –in-one" solutions that, if implemented will automatically improve the performances of the organizations. But usually that doesn't happen. One of the main reasons is that business processes, and the organization as a whole, are not prepared for such solutions. There is no single and at the same time concrete enough recipe that will help in all the cases of business process reengineer in public sector. More likely, each case requires more or less different approach and use of some scientific methods.

5. References


DEVELOPMENT OF PROCESS MODELLING 
FOR FACILITY MANAGEMENT 

Bartłomiej Śliwiński, Renata Gabryelczyk1

Abstract
In the thesis the evolution of perception in the field of real estate and Facility Management from an organization's activities point of view is presented. The risen issue is especially essential for the needs of organization management because of the parallel development of tools and information models. In the thesis changes are presented occurring to the perception of real estates in the line of economical processes, as well as the evolution of the information tools supporting Facility Management. The dependence of perception of real estate in view of company activities supporting the Facility Management processes will be shown on the level of a development of information tools. In the study relations between the basic processes of an organization with the connection to Facility Management processes are exposed. An attempt was made in this thesis to create a reference model in the field of Facility Management, which is based on general assumptions. The modeling of the Facility Management processes was realized through the aid of the ADONIS application toolkit system.

1. Introduction
Since the end of the 90's related to real estate issues in literature we can observe a closer perception to real estate matters only from the market point of view. The biggest attention is paid to issues concerning the relationship between commercial real estate and the efficiency of the organization’s activities. The necessity of restructuring the perception of real estate management issues is indicated, among others, by: Hayden and Pfnur [10], stating that “restructuring fields of real estates management will be conducted in the direction of adjusting to company processes”.

The studies conducted by Gibler, Black and Moon [7] showed that most of the real estate managers did not integrate their activities with other functional areas of the organization. At the same time most of the real estate managers were not included into decision processes of organizational changes. The issues of influence of the new management practices encompassing office areas were depicted, among others, by Gibson, Lizieri [8]. The issues concerning relations between organization activity and their infrastructure resources can be found under Teicholz [23].

Postulated, among others, by Hayden and Pfnur [10] and Roulac [20] were the matters of active management in the field of Facility Management, meaning the integration of decisions taken in the field of real estates with company activities in other fields. The issue Facility Management is also presented in researches in the context of outsourcing processes [6]. In those studies the necessity of

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adjusting demands, which are made to a subcontractor in the field of auxiliary process servicing, and which involves organization strategy is clearly indicated. Worth mentioning, is that so far, Facility Management issues regarding the approach to an oriented processes reference model have been relatively unpopular and usually limited to a technical area of FM, f.e. Neumann [17]. Information technologies have a strong influence in the field of FM in context of E-commerce applications [12].

2. Evolution as an approach to Facility Management

Contemporary management systems undergo presently fast evolution. Following company objectives are essential: high quality of service, avoidance of unnecessary resources costs and savings on the processes level. A real estate is a resource, which has to be subordinated to strategic objectives of a company, but also real estate strategy is an element of the operational strategy of a company's resource usage. Implementing a strategy set forth skillful management in the Facility Management of a company. The concept of Facility Management includes economical, technical and infrastructural aspects of a real estate usage, which are subordinated to the criteria of functionality and demands, made by basic economical processes conducted by real estate users. Resources provided by real estate become more and more important elements of business activities and – what is not less essential – by encompassing technological changes stronger integration of technological infrastructure with the basic activity of a company takes place. The specialization discussed here does not mean the specialization of a building only as an architectural object. It concerns a wider aspect: information networks, safety procedures, human and property resources management, etc. It causes the boundary of a real estate to be less and less visible among other branches of a company management. Economical sense in facility management is exactly relieving a real estate user from secondary problems (and enables concentration on the “core business” in accordance with main competence). In particular, the idea is also about the connections between quality of offered facilities and their cost from the benefits, which the company as a whole achieves. According to Sliwinski and Sliwinski [22]: The Facility management concept can be represented as taking in consideration real estates in the whole of management processes of a real estate user’s activity and an optimal adjustment of technical, infrastructural and economical structure to the requirements of other processes and not management of particular events.

In practice we can distinguish two kinds of FM services:

- non-requested – products and services where it is not possible or it is difficult to define the client or final user (f.e. a building maintenance process, energy supply)
- requested – products and services which are ordered by user and settled in their budget (usually settled by a defined division key to the particular responsibility center).

Introduction of a service valuation and a price for provided services on a responsibility center level creates a relationship between a FM service and an organization. This rule can be introduced independently to the fact, whether the service is provided by an external unit (external FM service provider) or by the own organization’s unit (internal FM service provider). According to Gibler, Black and Moon [7]: Although all corporations lease and own real property that they use to support their core business, very few use a strategic approach to acquiring, managing and disposing of real estate. Often corporate real estate officers and others in the organization, make daily decisions about facility location, building design, space layout and lease obligations without a plan of how those real property holdings could contribute to the company’s productivity and profitability. To be most effective, organizations should follow a corporate real estate strategy that is consistent with overall corporate strategy and coordinated with other functional areas.
3. Evolution of Information Systems for Facility Management

According to modern FM concepts the basic factor enabling a comprehensive presentation of the mentioned above aspects of real estate management are integrated information and telecommunication systems, whose usage basically widens abilities of a Facility Manager. On the other hand technology and telecommunications influence the environment in which people work. Facility Manager has a great opportunity to introduce changes and improvements to the environment where people work.

The development stages of systems supporting the FM field are, in significant extent, determined by the development and popularization of company management information technologies. Currently companies professionally managing their real estates deal most often with the third (CAFM system application) or fourth (integrated workplace management systems) generation of FM supporting systems.

According to the FMP [11] study, potential users of management systems expect these following functionalities from a FM system:

- space management (82%)
- tracking of physical assets (73%)
- interior design (81%)
- control and planning (maintenance) of renovations (73%).

The result of formulating expectations for assets managed in FM process are modern FM field management systems: “An integrated, centralized data base is here required for defining where all company assets are located, how they work, what contribution they have to the particular organization’s units, what is they market value and what costs are required for their maintenance and management.” [16] Such systems are classified to a category called Integrated Workplace Management Systems (IWMS).

The guidance for the implementation of IWMS in the field of FM are the following [3]:

- Know core business of your own organization
- Change the profile of your strategy to a workplace strategy
- Be advocate of integration
- Nurture and develop a more robust skill set within the leadership team
- Develop metrics and measures to assess the capacity of the integrated resources to enable work and optimize the portfolio.

Defining IWMS opens a market of applications for the business needs, which support business solutions in the area of real estate management, facility management, asset management and suitable support of processes, which occur in an organization.

This class of software absorbs and integrates information solutions, which have been achieved up to now in the area of Computer-aided facilities management (CAFM), Real-estate portfolio and transaction management, Project management and Computerized maintenance management systems (CMMS).

IWMS have to take into consideration the whole life cycle of a complex, from the moment of obtaining it until its liquidation (disposition). Systems based on a common database use advanced network solutions and architecture enabling defining the workflow processes.

Evolution of information systems occur in directions of integration with other management systems, which seems to be an inevitable tendency. Facility Management tasks are directly integrated within information systems and other functions of an organization. Changes of real estate user’s requirements (and their mobility) cause, that this resource has to be particularly flexible in adjusting to the users needs. It concerns especially the resource co-usage systems (i.e. hotelling or remote workforce support).
<table>
<thead>
<tr>
<th>Years</th>
<th>Generation</th>
<th>Applications</th>
</tr>
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<tbody>
<tr>
<td>Pre 1970</td>
<td>Generation I Mainframe based</td>
<td>TECHNOLOGY EVOLUTION - Facility inventory management - Requirements programming - CMMS - Facility master planning</td>
</tr>
<tr>
<td>1970-1985</td>
<td>Generation II PC – based</td>
<td>TECHNOLOGY EVOLUTION - Facility inventory management - Requirements programming - CMMS - Facility master planning</td>
</tr>
<tr>
<td>1985-1995</td>
<td>Generation III</td>
<td>CAFM, CIFM DBMSs</td>
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<td>1995-2002</td>
<td>Generation IV</td>
<td>THE INTERNET AND INFRASTRUCTURE MANAGEMENT - Integration with ERP systems</td>
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<tr>
<td>2002 and beyond</td>
<td>Generation V</td>
<td>„SMART ASSETS“ IWMS</td>
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Table 1: Phases of evolution of the FM area and IT systems supporting FM

4. Process Vision of FM

Evolution has also occurred in the field of process approaches. A transition from isolated reengineering projects of single processes inside an organization to a systematic look on processes in general has occurred for the last 15 years. The systematic looks on processes require, that they are connected with the strategy of an organization on the one side and with information systems on the other [14]. It also leads to the realization of comprehensive projects, which objective are the construction of architecture of processes, designing and implementation of processes and measurement of efficiency and constant improvement in reference to set objectives. However the construction of process management system occurs in companies gradually by the development of process awareness among employees and gradual imposing of processes’ structures on existing functional structures [4]. In literature we can find few models of process maturity of an organization, whose authors distinguish usually 4-5 basic phases of a process approach development (McCormack, Johnson 2001 [15]; Gruchman 2002 [9]; Cyfert 2006 [4]).

In the context of process management in the field of Facility Management a BPO Maturity Model by McCormack and Johnson [15] deserves attention. They distinguish four basic phases of process approaches in an organization:
- ad-hoc phase, where processes are found occasionally and an organization reveal strong functional characteristics
- defined processes phase, where processes become visible in an organization, formal procedures of changes in processes are being introduced
- linked processes phase, where process structures appear, process owners, system of effectiveness measurement. On this level, processes are subordinated to a vision of a company and aimed on strategy realization.
Integrating processes phase, where full cooperation on the processes level between an organization and their suppliers takes place. Organizational structures on this level are based on processes and controlling of process functions in an organization. For the evaluation of process maturity, reference models can be included, which are an essential element of standardization and are tools for the construction of process maps. According to Kasprzak [13] even if a company does not apply reference models, building organization-oriented processes, compel analogical forms, which are offered by the reference models process standardization. For example, displaying such a case would be the FM service provider.

Figure 1: BPO Compatibility Network for suppliers of Facility Management services
5. Process Modeling in FM area

Constructing architecture of processes and mapping processes in the FM field should be adjusted to observed trends of development process approaches as well as the discussed Facility Management evolution.

Building organization oriented processes, can often lead to success. Crucial therefore is to understand that process modeling (mapping) can be seen, on the one side as a process used for depicting a real world (As Is), on the other side as an active creation, which depicts as well possible future states or processes of an organization (To Be) [21] [15].

Process maps are a starting point in the management of processes, they are a graphic presentation of a process specification. Kasprzak [13] compares them to the maps based on overlapping air photographs. Depending on the level of detail of such a map it can be differed between process architecture to obtain a general view on process structure or according to needs, to get a better inside into processes presenting work course in a company, sub-processes or actions, which are components of processes. A constant trend in the development of information systems and most of all understanding companies for the need in building information systems based on processes, caused a need for modeling standardizations. An answer to the need of construction systems based on business processes are information reference models. They refer to a certain standard of modeling, not taking specific cases into account. Reference solutions are a representation of organizational knowledge, which can be used according to an applied model and provide construction and methodological frames for modeling of information systems. In the process construction context, branch reference models include methodological knowledge concerning economical connections, which occur in individual branches [18], they occur typically for branch processes. According to Kasprzak’s study [13] reference models refer to best practices, like those in benchmarking projects. Applications of best practices in organizations should have a character of methodological proceedings, they should undergo an evaluation and bring a user better results.

In practice of reference solution applications two basic issues are essential: construction and the reference models application [19] [5]. The aspect of reference models construction considers the construction of methodology of a reference solution creation and indicates a necessity of defining the methods of the reference demands description. The application aspect notices the problematic areas, where most often reference models are applied.

Within the GoM (Grundsätze ordnungsmäßiger Modellierung) [2] project, which objective is the improvement of modeling quality of information systems of an organization, a model of procedures has been constructed, which supports the construction of a reference model [2]. In view of the procedure models for constructing a reference model, 5 phases have to be distinguished:

- problem defining
- construction of model framework
- construction of model structure
- consolidation and completing of the model
- application of the model

Below the management levels for the FM area are presented, which are a starting point for the completion of individual processes in the framework of the process map. The individual processes are described on an operation level. Here they are also completed. On the higher level of management supervision procedures of results operational processes, their prediction and monitoring of a KPI level (Key Performance Indicators) are created.
For the purpose of presenting the FM management levels the ADONIS toolkit system [1] was applied (Fig. 2) to design process maps. In ADONIS a course of an example of the technical process of the FM on the operational level was modeled – a process of reporting a failure of a building system (Fig. 3).

Process description methods offered by ADONIS allow to define a hierarchy of modeled processes, read a process course, its basic characteristics and logical connections with other processes on various levels of details. Process maps created with the help of information tools gives an on-line picture of an organization, allow navigation among individual processes, enable for fast updating of models, their analysis and simulation and are a starting point for building organization oriented processes.
Figure 3: Process of a failure reporting for a facility – as modeled in ADONIS
6. Conclusions

The evolution of solutions in the Facility Management area which occurred during the last 20 years is very crucial. Although in a significant extent it is a result of challenges, which were made by people responsible for organizational and technological changes occurring in their organizations, Facility Managers is perceived as a performer of building user’s demands. Those demands have to be fulfilled as fast as possible and with lowest cost. Such a service location in this area disables taking advantage of the rationalization potential remaining in the auxiliary processes, but insulating this area can lead to a significant loss of an organization efficiency, because of lack of integration between efficiency and workplace organizations. Development over the last years of systems supporting Facility Management occurs explicitly in the direction of process approach and the integration of FM areas into ERP systems of companies. Therefore there is a need for process modeling and reference model creation. Thanks to them benefits will be visible not only in the level of service providers (external as well as internal), but – thanks to the modeling possibility – at the service receiver as well, which an organization is. In the thesis an attempt to describe a part of technical FM areas with help of the ADONIS methodology was presented, which, thanks to its systematical and clear semantic structure, becomes a perfect modeling tool for designing, building, simulating and analyzing processes in this area.

References:


DATA WAREHOUSE STRUCTURES FOR AML APPLICATIONS

Jerzy Korczak¹, Błażej Oleszkiewicz

Abstract
In the paper a new idea of system architecture for money laundering discovery is presented. The considerations relate to the software platform, called SART Analytical SQL Server, that is used to build complete anti-money laundering (AML) applications. This software platform is based on the data warehouse technology and contains advanced analytical functions. Using SART we show how to build data warehouse structures to identify efficiently suspicious transactions and objects, based on the concepts of multidimensional, heterogenic ROLAP cubes and transaction chains. In conclusion, the advantages of the proposed solution are summed up in the context of new trends in OLAP as well as in Business Intelligence research and development.

1. Introduction

The problem of anti-money laundering remains open in spite of large number of research work [1], [5], [6] [8], [9] and software solutions (SART², DiMon³, SPERT⁴). According to the Financial Action Task Force (FATF) [10] money launderers use increasingly sophisticated techniques to provide advice and assistance in laundering criminal funds [7]. From economic point of view, money laundering is now one of the world’s largest trades (Financial Crimes Enforcement Network). Therefore the research on new computational and intelligent techniques to discover money laundering transactions becomes critical [3], [9].

The important factor of the efficiency of money laundering detection are techniques and methods applied in bank information systems [2]. However, existing solutions concerning discovering money laundering transactions show a number of weaknesses, notably:

– frequently, such systems are not built on data warehouse technology;
– systems do not support advanced tools for analysing transaction chains;
– lack of support for efficient identification of suspected objects, particularly in the layer of data warehouse structures;
– finally, there is no uniform model for defined and archived analysis as well as for constructing scenarios of analyses.

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2 SART – System for Analysis and Registration of Transactions (in Polish: System Analiz i Rejestracji Transakcji – SART), AML software based on Analytical SQL Server developed by TETA SA Company.
3 DiMon –AML software developed by Signity Company.
4 SPERT –AML software developed by BSB Company.
This paper is aimed at presenting new data warehouse structures and functionalities to solving the above mentioned weaknesses of commercially available AML software. In the first section the idea of integrating application layer of AML system with OLAP data warehouse is presented. We will also point out the aspect of identifying analysed subjects including structures of OLAP data warehouse. Functional specifications of AML SART system will be provided in section 2. We will discuss only financial institutions, but the proposed solution can easily be adapted to other types of activities. The last section is a summary of ongoing project and describes future research on AML systems.

2. Data Warehouse Scheme of the SART System

Data warehouse structures and functionalities presented in the paper have been already implemented in the System of Analysis and Registration of Transaction, called SART developed by TETA S.A [4]. SART is one of the first integrated systems on the market; it belongs to the class of Business Intelligence systems, known in financial applications (e.g. controlling, budgeting, forecasting activity, MiFID), banking trade (BASEL II, AML), insurances (Solvency II), industrial applications, medicine and health services. Extensions of Business Intelligence concern relational OLAP (ROLAP) with full support for multidimensional data processing (MOLAP). Integration of these two technologies (ROLAP and MOLAP) is directly transposed into facility of modelling and processing multidimensional data using standard SQL interface. This is rarely available in other solutions.

Undoubtedly the biggest challenge that SART system had to face was the definition of data warehouse model and OLAP cubes that would take into account heterogeneous dimension of General Ledger. It is worthwhile mentioning that presently used data warehouse models do not take into account heterogeneous dimensions in their specification.

In Figure 1 the heterogeneity can be seen in two encircled dimensions that differ in terms of the structure of the hierarchy; we can see that both hierarchical structures:

- [PK, KS, KS, KS, KA] for a KA “Cash in hand in PLZ (ID: 339 in column KNT_ID);

are different from each other in terms of the structure of the hierarchy.

Another issue concerned the requirements to identify all analysed objects (including warehouse measurements and Cartesian products of OLAP cubes). Technically speaking, this implementation problem is currently solved in two ways: by description of data included in data warehouse and OLAP via metadata (e.g. XML) or by direct identification of objects included in data warehouse and OLAP.

The problem can be described using evaluation of OLAP cube as an example. On the basis of information obtained from bank’s information systems, the following basic measurements of data warehouse dimensions have been assumed: bank’s General Ledger 60 000 entries, bank customers 500 000 entries, the duration of operations 3600 entries (10 years), number of measures in OLAP cube is 5. Approximate calculation of the indicated OLAP cube’s size shows that it is not feasible

\[60 \times 500 \times 3600 \times 5 = 0.54 \times 10^{15}\]

Considering the minimum size of data stored in OLAP cube (4 bytes dimension identifier, 8 bytes measure’s value) this value should increase by 3 \times 4 \times 5 \times 8 = 480 times that is 259.2 \times 10^{15} data bytes (23.5741TB, 230.2 PB). Above presented calculations do not take into account the size of OLAP cube data table indexes.
to store OLAP data without compression – approximate size of OLAP cube of 230.2 PB exceeds considerably size of disc matrixes available on the market.

Another specific task was the delivery of functionality that would allow to merge the decrees into bank. This problem was to enable transformation of data saved as accounting decrees (list of endorsement operations along with DEBIT and CREDIT) into a form of bank transaction (source and destination accounts, and transaction amount). This problem will be detailed later in the section. It is worthwhile emphasising that such functionality should integrate information coming from General Ledger dimension (identifier of source and destination account of bank transaction) in order to maintain the consistency of data between bank transactions table and facts table (decrees) of data warehouse.

Data coming from the individual sources are loaded into SART system via import tables and then integrated into one coherent repository of data that includes data warehouse measurements (clients, General Ledger, exchange rate), facts table (decrees) and auxiliary tables (NRB numbers, ELIXIR announcements). It is important to notice that model of data loading is completed in accordance with ELT convention (Extract-Load-Transform), thus allowing for considerable flexibility of system in the aspect of data source identification and full control over the process of data warehouse loading.
The solution that has been implemented links the data warehouse scheme with multidimensional OLAP cube with the following characteristics:

– OLAP cube model: partial, multidimensional, incremental OLAP ASQL cube;
– OLAP cube’s dimensions: time dimension, clients, General Ledger;
– 5 OLAP cube’s measures.

Partial, multidimensional, incremental OLAP ASQL cube defines model of OLAP cube in which only ensuing facts from the facts table (incomplete) along with all overriding sub-dimensions of given dimension (multidimensional) are calculated in incremental manner (only new facts are calculated). The concept of “multidimensional OLAP cube” in this project requires additional comment: the model of OLAP cube in ASQL server stores aggregated data for the Cartesian products of all sub-dimensions of OLAP cube (Figures 2 and 3).

The system performance has been evaluated on an application where imported data described 57 952 operations (decrees). The following measures have been noted: computing time of OLAP table (one process) takes 250 seconds; number of OLAP operations carried out: 5 275 770; and number of lines created in OLAP cube: 991 675, average number of calculated decrees in facts table was 231.8 decrees/second, average number of OLAP operation was 21 103.1 operations/second and average number of calculated Cartesian products per decree was 91. According to the functional requirements the system performances were considered acceptable.
3. Transaction merging in SART

Transaction merging in SART delivers the functionality that includes transformation of data from accounting system (decrees of bank’s General Ledger) into bank transactions data model. In the implemented solution the process of transactions merging uses table of dimensions of data warehouse General Ledger as a dictionary table for identifying accounts of transactions parties.

Taking into account logical aspect we should point out the importance of the fact of implementing OLAP cube that deals with heterogeneous dimension of General Ledger. To our knowledge, structures of such type have not yet been supported in currently available models of OLAP data warehouses. Functionality of incomplete OLAP ASQL cubes coincides completely with functionality of complete OLAP cubes.

![Figure 3. Example of OLAP report with a view of General Ledger as heterogeneous dimension with enabled filling of partial OLAP cube (shadowed row)"

Considering functional aspect of data warehouse, it was feasible to build a repository of data that fully illustrates structure of General Ledger’s decrees. It should be noted that it is essential in data analysis because the primal categorisation of bank operations basing on General Ledger has been maintained. Therefore it was possible to obtain on the one hand automatic categorisation of bank transactions, and on the other – manual aggregation of data in accordance with General Ledger. It is important to emphasise the fact of integrating two different logical models (accounting and transactional) into one coherent application model.

Another essential aspect of this issue concerned the full exploitation of the functionality of ROLAP Analytic Server SQL. In the implemented solution this functionality has been used during definition process of bank transactions in respect to General Ledger data. In general, model of OLAP relational data warehouse included in Analytical Server SQL enables to use tables of dimensions as tables of relational database in the application layer. Thus, dimension of General
Ledger data warehouse has been used as a dictionary table during defining transactions in the entries concerning source and target accounts. This lets us obtain full integration between analytical layer (data warehouse and OLAP) and application layer in SART system. As a consequence of analysing bank transactions we can easily move to OLAP analyses of General Ledger’s decrees and back again. Interaction between those two logical data models is essential during verification of analysed areas, for example: does the number of cash transactions selected for reporting contain all operations carried out by the bank including appropriate limitations (it can be checked in the OLAP cube through comparing number of appropriate decrees)?

Figure 4. An example of transaction definition

Figure 5 shows an example of integration of two different data models:

A. Accounting model that concerns individual operations on the positions CR and DB;

B. Transaction model, in which data record contains information about accounts (number 1 in Figure 5): source (ID decree: 281 187), target (ID decree: 281 188) and the amount of operation (number 2 on Figure 5).

Merging two different models is possible using OLAP object identification function and General Ledger as a dictionary in the application layer.
Figure 6 indicates the position of the aggregated turnover on the account “Current account in PLN” (account ID: 460), which was listed in Figure 5A (the first item, account ID column “TDD_IDKT”). Thanks to applying object identification function, one can easily move from analysis of banking transactions (Figure 5B) to OLAP analysis of decrees based on General Ledger.
As a result of applying functions described in this article, system SART is able to analyse and discover money laundering transactions through selection operation; due to extraction criteria indicating transactions of above 15 000 euro and through aggregation operation, enabling classical OLAP analysis. In addition, it allows grouping predefined objects and analysis of chains of transactions.

4. Conclusions

Presented in the paper data warehouse functionalities have been already tested on real data coming from a bank information system. A major strength of the system is that grace to data warehouse structures and advanced OLAP operations can efficiently detect suspicious transactions and objects. It allows a user to easily perform a wide range of data mining operations. It makes possible to build and discover transaction chains containing

In general the system performance is very high, the system is scalable and extensible. It should be noted that in standard configuration SART system does not need any supplementary components, application licenses or dedicated server licenses (e.g. ORACLE, IBM DB2 or MS SQL Server or extra Windows server licenses etc.).

To summarize, the presented data warehouse model offers new possibilities to build dynamic, adaptive and efficient systems capable to discover money laundering transactions.

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References

APPLICATION OF INFORMATION SYSTEM DEVELOPMENT TOOLS AND METHODS - SOME EXPERIENCES FROM INDUSTRY AND RESEARCH PROJECTS IN SERBIA

Ivan Luković

Abstract
For many years, a software industry has been using methods, models and tools that allow a system to be precisely described at the appropriate abstraction level without unnecessary details. From 1990, till now, the author of the paper has been involved in many research projects in Serbia with a goal to develop an approach to the process of information system development, with an emphasis to the design and integration of complex database schemas, as well as generating software prototypes. Apart from the theoretical model of the approach, we also developed a CASE tool, named Integrated Information Systems*Case (IIS*Case), which enables its practical applying.

At the same time, the author of the paper, apart from his academic activities, has also been involved in a number of software development industry projects, as well as training programs for various software development centers, not only from Serbia, but also from other countries of the former Yugoslavia and Soviet Union, as well as Germany. One of the common concerns of all those projects and training programs was how to create and apply methodology principles and CASE tools in the software development process. A goal of the paper is to briefly outline the IIS*Case tool and the characteristics of our approach, as well as to present personal author's industry and research experiences from early and mid 1990s in comparison to the experiences from mid 2000s.

1. Introduction

For many years, a software industry has been using methods, models and tools that allow an information system (IS) to be precisely described at the appropriate abstraction level without unnecessary details. In the last decades of the 20th century, models and the appropriate Computer Aided Software Engineering (CASE) tools were used primarily for documentation purposes only. Designers were able to create a number of IS specifications at the various abstraction levels, describing a system from various view points. Unfortunately, at that early stage of applying the software engineering principles, it was not possible to fully utilize models and CASE tools in the generation of the software applications of an IS. By this, a majority of software code was supposed to be written "by hand" from scratch. In better case, designers could expect to utilize some kind of code generators. Nevertheless, a majority of the generated program code should also have been amended "by hand", again. In this way, by the rule, a final program code of software applications

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became, during the time, even more unsynchronized with the created IS specifications, despite that it was strongly against the basic methodological principles of the software development process. As a consequence, the efforts needed and costs of software maintenance had considerably raised, and it could have been one of the reasons leading to higher risks of the failures of complete software projects.

The main assumption of the model-driven approach to software system development, appearing at the beginning of the 21st century, is that software systems of large complexity can only be designed and maintained if the level of abstraction is considerably higher than that of programming languages. By means of models, a semantic in an application domain can be precisely specified using terms and concepts the end-users are familiar with. The focus of software development is shifted from the technology domain toward the problem domain. A complex system may consist of many interrelated models organized through different layers of abstraction. Since computers can only operate at the lowest possible level of abstraction, those models need to be transformed into the language that the target platform can understand and perform. Therefore, a chain of transformations can be executed starting from the initial model at the highest level of abstraction, through the less abstract models, ending up with an executable program code representing a model at the lowest level of abstraction. Therefore, software development tools should automate as many as possible tasks of models construction and transformation requiring for that the smallest amount of human interaction, and keeping the program code synchronized with the model at the same time.

From 1990 till now, the author of the paper, with a number of his colleagues, has been involved in many research projects in Serbia with a goal to develop an approach to the process of IS development, with an emphasis to the design and integration of complex database schemas, as well as generating software prototypes. Apart from the theoretical model of the approach, we also developed a CASE tool, named Integrated Information Systems*Case (IIS*Case), which enables its practical applying.

Almost twenty years ago, IIS*Case was designed to be a "classic" CASE tool that provided modeling and documenting the database schema and transaction programs of an IS. It comprised an SQL code generator that was able to create only a skeleton of SQL DDL commands. An important paradigm shift in the field of software engineering towards model-driven approach initiated us to extend and reformulate the basic principles of IIS*Case. In this way, our main motives for the development of IIS*Case became: (i) to provide the generation of database schemas and fully operational application prototypes without manual coding of programs, or even without knowing the syntax of a particular domain-specific or general-purpose programming language; (ii) to enable designers and end-users to model the semantic of an application domain in a natural way, using the concepts they are familiar with; (iii) to preserve the formal correctness of the transformation process of initial designers' specifications into the target program code; and (iv) to define a comprehensive methodological approach that supports usage of IIS*Case not only in small, but also in large-scale projects. We believe that the conceptual capacities of IIS*Case allow relatively easy evolving to the upcoming software engineering standards. Although we have retained its original name for traditional reasons only, we keep going towards its stepping up to the model-driven approach to software development.

During that time, the author of the paper, apart from his academic activities, has also been involved in a number of software development industry projects, as well as training programs for various software development centers, not only from Serbia, but also from other countries of the former Yugoslavia, Soviet Union and Germany. One of the common concerns of all those projects and training programs was how to create and apply methodology principles and CASE tools in the
software development process. In some of those projects and training programs, we also utilized IIS*Case with our methodological approach.

A goal of the paper is to briefly outline the IIS*Case tool and the characteristics of our approach, as well as to present some author's industry and research experiences from early and mid 1990s in comparison to the experiences from mid 2000s. Apart from Introduction and Conclusion, the paper consists of three sections. In Section two we give a short description of IIS*Case and the main characteristics of our approach. In Sections three and four, some author's experiences from software development projects and training programs are presented and compared.

2. IIS*Case – A Brief Overview

One of the motives for the development of our approach and the IIS*Case tool was in the following. Using database design methodologies based on the techniques such as ER modeling or UML, and even the relational data model and an appropriate CASE tool, requires advanced knowledge, skills, and high perception power. Failing to find an appropriate number of designers that possess these properties may lead to a risk of designing a poor quality IS specifications. Besides, these methods and techniques are often incomprehensible to end-users. In practice, that may lead to problems in communication and to misunderstanding between designers and end-users.

As a rule, misunderstanding results in a poorly-designed system, because support of all the specified user requirements is not ensured. Usually, both designers and end-users become aware of that too late, when the IS specifications are already implemented. Therefore, it was a challenge to provide an alternative approach, and a CASE tool, which support an automated IS design that is based on the concepts end-users are familiar with. A designer who understands and follows the rules of creating design specifications imposed by such a tool would be able to create IS models more quickly and easily, even if their complexity extends beyond the limits of the usual human perception.

Initially, IIS*Case was developed to support an automated database schema design, based on the concepts that are close to the end-users from a problem domain. A central IIS*Case concept is the form type, which is an abstraction used to model the structure and constraints of various business documents (0, 0, 0, 0). Relational database schemas are generated using the form type specifications. The first versions of IIS*Case were developed under Cobol, on the VAX VMS platform in late 1980s. They were rather limited in their functionality, but provided modeling a conceptual database schema by means of the form type concept and an automatic generating of relational database schema in the 3rd normal form. IIS*Case V.3 was developed under Pascal and Prolog, on the PC platform during mid 1990s. The main advantages of that version were the following ones. The first time, IIS*Case provided: (i) basics of an approach to the design of complex database schemas that is based on a gradual integration of external schemas (0, 0, 0), (ii) an automatic generation of relational database subschemas 0, and (iii) an SQL code generator that was able to create only a skeleton of SQL DDL commands.

The next versions of IIS*Case were developing under Ingres Vision/4GL, Oracle Forms, and C++, with a repository implemented in the database management systems (DBMSs) Ingres and Oracle. The latest version, IIS*Case V.6 has been developing since 2003, under Java and Oracle JDeveloper, with a repository that may be implemented under an arbitrary DBMS providing an ODBC access. It comprises the largest number of features and functionalities. Currently, IIS*Case comprises tools for:
• specifying project structure and application systems;
• conceptual modeling of a database schema and external schemas by specifying form types, attributes, domains, constraints and functions;
• conceptual modeling of transaction programs of an IS, by specifying form types, and functions;
• conceptual modeling of transaction program user interface (UI) forms, by specifying display properties of domains, attributes, and component types;
• conceptual modeling of software applications, by specifying menus and calling structures of form types (i.e. transaction programs) and creating applications aimed to execute at a specific business unit;
• automated design of relational database subschemas in the 3rd normal form (by the modified synthesis algorithm);
• automated detection of constraint collisions between generated subschemas;
• automated integration of relational database subschemas;
• generating XML specifications of an IS;
• full implementation of database schemas under different target DBMSs, by using its own SQL Generator; and
• conceptual modeling of common UI models of generated application prototypes.

We also defined a methodological approach to the application of IIS*Case in the software development process. IIS*Case is based on a methodology of gradual integration of independently designed subschemas into a database schema. By this approach, the software development process provided by IIS*Case is, in general, evolutive and incremental. We believe that it enables an efficient and continuous development of a software system, as well as an early delivery of software prototypes that can be easily upgraded or amended according to the new or changed users' requirements.

We believe that IIS*Case and our approach are suitable for the end-user development (EUD), as it is considered in 0, 0, 0. After a proper training, representative end-users may become able to take part in the software development based on usage of IIS*Case, particularly in requirements engineering and system specification tasks, where initial design specifications are created, and also in testing of generated applications. Furthermore, IIS*Case has its own repository that can be implemented as a database under an arbitrary DBMS, where all the design specifications, created in the software development process, are stored and organized in projects and their application systems. These specifications may be used as application patterns in many projects in an application domain. Therefore, we also consider IIS*Case as a tool from the class of domain oriented design environments (DODE), as it is defined in 0.

In our approach we strictly differentiate between the specification of a system and its implementation on a particular platform. By means of IIS*Case, modeling is performed at the high abstraction level, because a designer creates an IS model without specifying any implementation details. Therefore, such a model may be classified as a Platform-Independent Model (PIM) of the MDA pattern 0, 0, 0, 0, 0, 0, 0, 0. In 0, we briefly describe technology independent concepts and models embedded into the IIS*Case tool V.6.6, and argue that IIS*Case is based on the IS development approach that shares the same basic ideas the model-driven approach relies on.

Detailed information about IIS*Case may be found in several author's references, as well as in 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0. A case study illustrating main features of IIS*Case and the methodological aspects of its usage is given in 0, 0, and accordingly we do not repeat the same explanations here.
Currently, a generator of the executable application prototypes for a selected target program environment is under development. Further development of IIS*Case is oriented to the introduction of new concepts, as well as the enrichment of the existing ones. Thus, we plan to cover some new aspects of the system, such as business process definitions and the system (hardware and software) architecture. Besides, a further research should also provide the algorithms for generation of XML Schema or object-oriented specifications of a database schema designed in IIS*Case.

Currently, the specifications of IIS*Case concepts are based on textual specifications with the first-order logic formulas, and on the repository definition used by the specific GUI oriented tools. In order to utilize the meta-meta abstraction level, our research efforts will also be directed to the Meta-Object Facility Specification (MOF).

3. An Application of Tools and Methods – Experiences form 1990s

In this section, some personal author's experiences from 1990s are presented, concerning academic education in software engineering, software development projects, and training programs.

According to the author's personal experience in an academic education in computer science and software engineering in Serbia, we may say that a considerably large room in various academic curricula, held by various faculties and universities from Serbia, was reserved for topics covering computer science and software engineering disciplines. Particularly, the courses concerning database systems, information systems, and software engineering were mandatory in such curricula and covered these topics in detail, despite that majority of the curricula were not primarily oriented to the software engineering and computer science. During all that time, those courses were continuously improved in order to include "hot" topics from the area.

In 1990s there was a considerable number of large and medium-size Serbian companies (and companies from the region) from banking, insurance, telecommunication, government, or production sectors, having their own informatics departments. The main goal of such departments was not only to support the maintenance of a company IS, but to really perform its development. Therefore, such departments were observed as software development centers employed usually not less than 20 people, but often 50 or even 100. Most of them were high educated engineers, mathematicians, or economists, with a very different level of knowledge and experience in the area of IS development. Therefore, such companies always invested a lot of money in various training programs with a goal to raise the level of technological, as well as the methodological knowledge necessary for IS development. At the same time, there was a lot of rather small software companies in Serbia specialized for IS development and outsourcing software services, employing sometimes not more than 10 or even 5 people. They survived on the market by making contracts with many other Serbian and companies from the region.

In this way, the author of the paper had many opportunities to take part in the creation and performing of many training programs and consultancy services, for a number of companies and their informatics departments. With respect to the managers' requirements, sometimes, those programs were predominantly methodologically oriented and covered the topics of IS and database design, and defining IS strategy. However, much more times, they were predominantly technologically oriented and covered techniques of usage particular DBMSs, program development environments and CASE tools. As it concerns CASE tools, the author had a lot of experience for many years in consultancy services and teaching, among others, various versions of: Oracle Designer, BPwin, ERwin, and also our own IIS*Case. Despite the fact that many of those training programs were technologically oriented, the common concern of all of them was how to create and
apply methodology principles and CASE tools in the software development process. The experience was that the main problem of many participants was not how to discover and use the technical tool functions, but how to utilize the tool in a methodological way to resolve a practical problem in an application domain. According to that, we may conclude that despite the predominant technology orientation of the training programs forced by managers' requirements, the participants themselves forced their shifting to a methodological arena, i.e. to a higher level of abstraction necessary to overcome the problem of creating system models.

Apart from participating in research projects founded by Ministry of Science of Republic of Serbia through which we have developed IIS*Case and the appropriate methodological approach, we also utilized IIS*Case and the approach in some industry projects during 1990s. In this paper, we present some experiences from a rather big IS project for a railroad building and maintenance company from Serbia. The project had the goal to develop and implement an integrated IS of a whole company. The project continued from 1993-1998, comprising a period of very bad economical conditions in Serbia, including mega inflation, never seen before in Serbia and the region. By the formally performed final acceptance, the project was evaluated as successfully finished by all its contractors. The author of the paper had various roles in the project: designer, system integrator, consultant and programmer.

Before the start of the project the company had only modest experience in using information technologies (IT). Therefore, most of the application systems were developed from scratch. At the end of the design phase, the integrated database schema contained 400 relation schemes. The implemented software of the information system included about 2000 screen form transaction programs, and 700 report programs. There were 20 application systems, covering the business processes concerning: common business entities, technology, building, maintenance, warehouse, commercial business, ledger and accounting, controlling, human resources, planning and analysis, and production management. At end of the deployment, the system supported about 100 users.

A selected development technology platform of the IS initially included Unix, DBMS Ingres, a generator of the program code Ingres Vision, and a programming language Ingres/4GL. After ten years and numerous upgrades, the information system is still in use with its principal design remaining unchanged. The structure of designed database schema did not change during that time, but only extended and currently comprises 650 relation schemes. The database is still implemented in DBMS Ingres and successfully used in daily business without any defects, troubles or crashes, practically without any DBA interventions. A great part of software applications is upgraded to the Visual Basic and NET platform, but there are also some Ingres/4GL applications that are still in use. By the analyses performed in the company, currently over 80% of the implemented IS functionalities are really used in a daily business. At the beginning of the project, the stakeholders, i.e. future end-users responsible for creating user requirements were not aware of the IS potentials. From this point of view, we may conclude that at that time, the maturity level of such end-users in anticipating IT potentials was rather low. Therefore, they expected to see in the IS only those functionalities that provide performing business procedures exactly "as-is". Currently, the same end-users are much more experienced in utilizing the IS software applications. They have awareness of the IS potentials and the possibilities for considerable system improvements, and force their management to initiate the IS reengineering project. Their usual words today are: "if we only knew ten years ago what the IS could have done for us, we would have been more innovative in formulating our requirements."

A selected design platform of the IS included our IIS*Case V.3 (Pascal version) and the data flow diagramer tool POSE. At that time, IIS*Case had a rather limited functionality in comparison to the current one. We applied an incremental approach to the life cycle methodology combined with
prototyping. A considerable advantage of the project plan was that we managed to contract with our customer a fee in project budget for the software development methodology. The stakeholders were completely aware of the importance of the project development methodology and they were ready to pay for it. The design and development team was heterogeneous with respect to the knowledge and the education levels. It comprised 14 people and 4 representative users from the company, with roughly half of them being well experienced, and the other half being either modestly experienced or inexperienced. Eight of them were supposed to use our design approach and IIS*Case for the first time. They undertook five days of training for the approach and IIS*Case. After that, they were able to perform requirements engineering and database schema generating. It took them approximately 10 man-days to design an application system. They found that the form type concept was easy to understand and convenient for communicating with the end users. Generating a relational database schema was an easy task, and the designers did not find any problems in reviewing the resulting database schema, detecting semantic errors, and finding their causes in the form types. The author of the paper performed the integration and consolidation of the database schema, through sessions with each of the designers. Resolving detected collisions was the hardest task at the beginning, because it was often hard to persuade a designer to make changes in the form types. But, as soon as the designers realized that the changes were reasonable, and comprehended how the collisions propagate from their source form types to relation schemes, they became able to anticipate the appearance of usual collision types in advance and to avoid them during the corrective form type design.

We gathered a similar experience using our design approach and IIS*Case in a number of other, smaller projects. Based on that, we are convinced that even fairly inexperienced designers supported by an expert and using the approach and IIS*Case are capable of producing an integrated database schema and application specifications of a high quality in a reasonably short time.

4. An Application of Tools and Methods – Experiences from 2000s

In this section, personal author's experiences from 2000s are also presented, with a principal question, what has particularly changed in those at least ten years, keeping in mind that many great changes have happened in the technology, education, economics and politics, not only in Serbia and the region, but all over the world.

As it concerns the academic education in computer science and software engineering in Serbia, we may say that the situation is much better than it used to be, but a lot of things are left to be done in order to better profile such curricula at our faculties and universities. Nevertheless, much more specialized courses concerning database systems, information systems, and software engineering are offered, including "hot" topics from the area. Such courses are included not only in the computer science and software engineering curricula, but also in many other also having a goal to raise the education level of the future end-users, which becomes a compulsory prerequisite for a successful application of IT and software systems in business.

Large and medium-size Serbian companies from various business sectors have mostly become just buyers of the software systems, and many functions of the former informatics departments have been outsourced, reducing their responsibilities only to a minimum of maintenance. The number and education profile of the personal staff of such departments has changed, too. Small software companies in Serbia specialized in IS development and outsourcing software services fill great troubles in surviving on market in competition with "big players" from all over the world. Sometimes, they leave their own software solutions and become business partners, resellers or just offices of large world software companies. Besides, new or "restructured" software companies that
take a part into the various outsourced software development projects owned by large software companies.

In such a situation, a much more may be expected directly from the academic education level. The academic staff people may offer more in various training programs, particularly concerning software development methodologies and tools, customized for a specific client, than it used to be ten years ago. Despite that, it seems that an interest in industry is falling down. It may be seen as a consequence of a predominant applying of pre-packed, ready-made software solutions, possibly followed by an outsourced service of further customizations. Even more, a lack of interest for projects that have a goal to define the IS strategy of an organization may be notified. On the other hand, one of the newest analyses of using IT in Serbian companies, published recently by Mineco Computers Company from Belgrade, has shown that in a majority of Serbian companies only up to 25% of staff uses computers in their jobs. There are only approximately 10% of analyzed companies in which over 75% of staff uses computers in their jobs. Only about 800 companies have some kind of IS in usage, whereas it is estimated that about 1000 companies plan to obtain it in the near future. Finally, the analysis shows that from the whole budget invested in various ERP solutions at the level of Serbia in year 2007, 45.5% is invested in buying only software licenses, 31.8% is invested in customizations of acquired software applications, and only 27.7%, i.e. about five millions of euros, is invested in software development (source: newspapers Politika, from November 17, 2008).

Further development of IIS*Case and our methodological approach is currently based on a two year technology development project founded by Ministry of Science and Technological Development of Republic of Serbia. The project has started in June, 2008. The contractors are three faculties from the University of Novi Sad, and University of Kragujevac, as well as the car company ZASTAVA Automobili Kragujevac, as a participant from industry, which has changed meanwhile to FIAT Serbia. Apart from further extension of IIS*Case functionalities, we also plan to perform various analyses that should quantitatively describe properties such as usability and efficiency of applying IIS*Case and our methodological approach in large-scale industry projects of IS development.

5. Conclusion

Although a vast number of approaches and types of transformations from higher level software models to the executable program code has already been well-studied and exploited in practice for a long time, the issue of an efficient development of entire IS, including the behavior, business rules, database schema, GUI and architecture, is still an evolving and open research field, not sufficiently exploited in practice. On the other hand, we observe that many software crisis "illness" in the software industry are still present, as it used to be many years ago. Therefore, we believe that an academic education system combined with customized training programs, as well as an application of model-driven software development methods with a utilization of domain-specific languages, has the considerable potential to offer more to the software industry than today.

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6. References


BRIDGING ACADEMIA AND INDUSTRY: A GOOD PRACTICE EXAMPLE FROM SERBIAN ICT SECTOR

Sanja Vranes¹

Abstract
This paper describes an illustrative example of successful technology transfer between academia and industry in the domain of information and communication technologies. The exemplary research establishment is the Mihajlo Pupin Institute from Belgrade, Serbia, which is the biggest and the oldest ICT institute in the whole SEE area. Although founded and fully owned by the government of Serbia, it is not institutionally funded at all. All the research contracts are won in open competition with other Serbian and/or European Universities and Research Institutes. Although it is rather successful in winning both Framework Program Projects and the Serbian Ministry of Science funded projects, it is even more successful in commercializing its research results, managing to earn more than 90% of its annual turnover selling its innovative products, technologies and services on the free market (both domestic and international). The main driving forces behind this success are its dynamic and flexible organizational structure, well established technology transfer chain and the software tools supporting this chain. The paper describes in detail all these three main pillars, contributing to successful technology transfer.

1. Introduction

Literature has identified formal and informal channels in successful technology transfer from academia to industry. While formal technology transfer typically involves a legal contract on collaborative research activities or on a patent or license, informal transfer channels refer the tacit dimension of knowledge transfer, based on personal contacts, previous history of successful collaboration, mutual trust and benevolence, and wish to preserve core competence in ICT at the national level (which is especially important in some mission critical application, like home land security). In the case of the Mihajlo Pupin Institutes (Pupin) both formal and informal transfer mechanisms, as well as the hybrid among the two, are exploited. We find these method complementary and mutually reinforcing, rather than competing or contradictory. Our experience and our results confirm that using both transfer channels contributes to higher innovation performance. The management of the Pupin institute strives to maintain close informal relationships both with relevant vertical industry sectors and public sector, in order to realize the full potential of formal technology transfer.

¹ The Mihajlo Pupin Institute, Belgrade, Serbia
The Mihajlo Pupin Institute is a leading Serbian R&D institution in ICT (Information and Communication Technologies), the biggest and the oldest in the whole South Eastern Europe area. The institute was founded in 1946 and has 450 employees. Recognized nationally and regionally for research and innovation, Pupin is a leader in the development of an innovative, knowledge-based economy in Serbia through science and technology, but also through successful bridging of academia and industry. At the Mihajlo Pupin Institute, apart from numerous research projects, ICT projects of critical national importance have been conducted, combining systems engineering and information technology to develop innovative solutions in the area of telecommunications and computer networks, management information systems, e-government, e-business, e-education, electrical power system management, water supply management, traffic control, knowledge and content technologies and applications, Web services, decision support systems, etc. For projects on a large scale, the Mihailo Pupin Institute assembles a team with the best mixture of expertise appropriate to that specific engagement. Pupin also provides a wide range of innovative products and services. Its service scope covers customized IT solutions, HW/SW outsourcing, technology consulting, engineering, prototyping, and system design and integration. ISO 9001 Quality Assurance Certificate that Pupin holds guarantees that it meets the value and quality expectations of its customers. Leading world companies such as Raytheon, BASF, NCR, Motorola and Philips benefited from MPI's solutions and services. Pupin is currently involved in three running EU FP6 projects (SARIB, PROMETEA and Web4WeB), two EC Interreg/CADSES projects (I2E and STRIM), seven running EU FP7 projects (RELECT, PERFECTION, AgroSENSE, WBC-INCO Net, HydroWEEE, ICT-WEB-PROMS, HELENA), and four bilateral research projects, with Greece, France (2) and Cyprus. Moreover, Pupin’s researchers are currently undertaking 22 national R&D projects, funded by Serbian Ministry of Science, where contracts have been won in competition with 60 other Serbian R&D institutes and 8 universities, after the open call was issued in autumn 2007. Currently, Pupin is coordinating the FP6 Web4WeB project, establishing at our Institute a centre of excellence for Web technologies for the whole West Balkan Region. However, all these research projects sum up to less than 10% of the overall Pupin’s turnover, while the rest 90% are earned via successful transfer of the R&D projects’ innovative results to the industry and public sector. This numbers launch the Mihajlo Pupin Institute among the top research establishments in the whole CEE sector, when it comes to successful bridging between academia and industry. The main driving forces behind the successful industrial outreach are

- Organizational support to technology transfer
- Well-defined technology transfer chain, reinforced by ISO-9001 standardization
- Plethora of technology intelligence and transfer tools

All the above aspects will be discussed in more details in the following sessions.

2. Organizational structure supporting technology transfer

Both the organizational structure and research priorities are selected by having in mind a feasibility of successful technology transfer and commercialisation of research results, both in the domestic and international market. The core of the onion-like organizational structure of the Mihajlo Pupin Institute group represents the R&D Institute, which also serves as the mother company to the seven daughter companies, fully owned by the Institute. The outer layer is made by a number of the institute’s spin-off companies, which are only partially owned by the institute, as well as numerous tenants (all in ICT sector) which are part of the Mihajlo Pupin Institute’s technology park. The seven daughter companies are established in accordance with the strongest research areas of the institute and the most promising industrial outreach. For instance, a number of institute’s research projects resulted in innovative SCADA tools, complex event management infrastructure, image-
processing based quality control, specialised, robust and redundant industrial controllers, etc., so all these innovative products and technologies are successfully applied by the Automation and Control daughter companies, that perform system integration and provide turn key engineering solutions in numerous vertical industry sectors as well as in public sector (automation and control of power production, transmission and distribution, automation of water factories, automated vehicle location and monitoring in utility sector, facility management in large infrastructures, like the Nikola Tesla airport, etc.). Innovative signal processing algorithms (for one of which the IEEE Signal Processing Society’s Best Paper Award is received) are successfully turned into different marketable products, both in Telecommunications and Computer Systems Department. One such algorithm is successfully embedded into an original, innovative product, and sold thousands of pieces at the UK market.

The partnership with industry, both national and international, is constantly growing, and our organizational structure is constantly adjusting itself towards the newest situation. For instance, at the time local manufacturing industry was strong, the institute had a daughter company called “Mechatronics” where the innovations in the area of mechanical engineering and computer aided manufacturing were turned into marketable products and successfully commercialized. However, when this sector shrunk for both global and local reasons - global decline of the sector, combined with local civil wars and UN sanctions, the Institute reorganized, dropping off the daughter company that lost its market penetration momentum. However, the institute supported its researchers from this area who believed that in some niche markets, they could survive the decline of the sector, and helped them create their spin-outs. Although the global proportion of the research sector spin-outs that succeed is very tiny, and even venture capitalist expect only 10-15% of the new businesses to generate wealth, we can proudly declare that all our spin-outs are successfully operating, some of them significantly outperforming the expectations.

Figure 1: Organizational structure

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The only resources the Institute is backing its spin-outs with, are the first class premises and the information infrastructure (internet, LAN, Data center, library, cantina, infirmary, etc.). Of course, the necessary precondition to be fulfilled by the spin-out major shareholders is the establishment of a clear and credible business plan. The same criteria are applied to the Institute’s technology park tenants. They must operate in the ICT sector, area complementary but not competing to the Institute’s daughter companies, and they should also present a credible business plan. What the Institute offers to them is the infrastructure, such as a suitable space on a science park to ensure credibility with suppliers, investors and customers, and optional business services (ERP, CRM, etc.).

The Institute’s policy to back entrepreneurial academics has paid off a number of times, and the failures can almost be neglected. Company incubation is supported by the two software tools, INVEX [9] and FIDES [9], developed by the Mihajlo Pupin researchers, that help apprise the investment into a new company, from numerous points of view. They apply multicriteria analysis, production rules and fuzzy logic in order to provide a holistic assessment of future company effectiveness, return of investment period, breakeven points, internal rate of return, etc. The Institute’s management takes care that academic entrepreneurs venturing out on their own consider the needs of industry and their potential market share. Experience has shown that it is not always viable to go for the scientifically most exciting solutions, so the precise cost-benefit analyses as well as other elements of business plan should be considered carefully. Other forms of more tacit, non-monetary types of support to spin-offs are provided, including setting up meetings with big players in industry, providing access to lawyers and accountants, and installing experienced chairpersons and chief executives to head new ventures. Examples of notable business success among our spin-offs are IMP Service Engineering, IMP Service Engineering, IMP ZeroWaste, etc.

3. Technology transfer chain

Although we are a research institute, we go out and talk to industry and find out what it is they are looking for, and meet those needs through the technology transfer process. Academics tend to concentrate on scientific research, taking into account only the so called “science push” factor, i.e. fashionable research trends, often completely neglecting the so called “market pull” factors, i.e. the needs of the industry. Instead of accepting such a passive role, we prefer to take an active, driving role in the business, selecting our research priorities in partnership with our potential beneficiaries from both industry and public sector. In full bidirectional partnership with industry, we define the priorities, we define the research concepts and objective, we apply for funding, test the concept in demonstration prototype (straw man, proof-of-concept prototype, mock-up prototype, etc.), and make it into a viable investment proposition.

We avoid being a passive producers of publications and patent applications and prefer the industrial outreach as the best proof of concept, when it comes to applied research, and the ICT is all about applications. One of the main decisions to be made at the outset is whether to license an innovative product, technology or service, or build a spin-out company around it. The decision of taking the best path to take is made on product by product bases. And, since it is widely recognized that the licensing path is easier and requires less resources, when we have a single product opportunity with a clear market player out there, the most sensible is to license the product.
When we find a partner that has a production line and the sales and marketing team in place to get the product to market quickly, than we are satisfied with the upfront fee and royalties when the product is sold. We opt for licensing also in the situation when a large scale production is necessary, when the dedicated business is necessary. Instead of performing a large scale production of our innovative products, we tend to look for new areas where research and development work would add value.

4. Technology Intelligence and Transfer tool

In a global economy the future belongs to those organizations that innovate, adapt to change and concentrate on their core competency. Employing advances in technology along with innovative concepts for information processing is a proven formula for success [2]. However, despite some country's exceptional scientific and research resources, industry in the same country is often failing to recognize this potential and use it for its own innovation. The frequently neglected need for innovation by businesses corresponds to solutions in the research world, already presented but simply not structured into available offers. In order to bridge this gap and to help its target beneficiaries from developing countries, the Mihajlo Pupin Institute is developing the eTT, the technology brokerage software tool, that could help communication between all sorts of stakeholders, technology developers, businesses, local, regional, national administration, research institutions, universities, etc. Like it has influenced all other aspects of our lives and business, the Internet has dramatically revolutionized both technology intelligence and transfer of technologies across borders and around the globe. In the last five years, there has been a dramatic growth in the number of companies facilitating the transfer and licensing of patents and technologies across cyberspace. Predictions abound over how this faster and more efficient method of technology transfer will affect the overall speed of innovation and development. Although there have been some initial concerns over recent declines in computer and internet company stock prices, industry insiders generally agree that the web-based model for technology intelligence and technology transfer is here to stay.

With the eTT software, the right foundations for permanent relationship between research and industry are laid, facilitating
• Dissemination of innovation, carried out on a continuous basis throughout the region, allowing immediate feedback regarding enterprises and their requirements.

• Encouragement and enhancement of interaction between entities seeking the technology and those offering them, partner search and match-making services

• Exchange of knowledge and creation of lasting scientific and industrial partnerships

• Quick identification of professional expertise and know-how that can meet the innovation needs of enterprises and institutions in the region.

• Online services that allow the retrieval of information, updating, and identification of new solutions that can be instrumental in business competitiveness

• Fostering business internationalization, technical and scientific co-operation, etc.

The eTT software will offer the following functionality:

• Categorization of demand/offer by domain of interest and by type of offer (new technology, product or service).

• Comprehensive data entry system, to gather basic information of the technology demand/offer (e.g. description, main benefits, list of clients, etc.).

• Effective search/retrieval of the data from the Web repository of technologies/products/services, using either technology name or any other keyword

• Upload/download of related documents (prospects, data sheets, brochures, references, case studies, press clipping, etc. in any standard format, like pdf, doc, xls, jpeg, gif, bmp, etc.)

• Different categories of users with different user rights (administrators, authorized users, guests, etc.)

Our long term goal is to create an integrated service package, that would also include technology intelligence tools (like technology foresight and technology assessment), feasibility analysis (INVEX, FIDES, RIO, PEGAS tools are already there [9]), finance syndication, life cycle analysis etc., to provide a full support to both our daughter companies and spin-offs and out technology park tenants. Our goal is to establish such an integrated service portfolio on Internet, that will resemble so called virtual technology incubators that have seen fast growth in the last few years, in order to guide or target beneficiaries through the whole process of their technology business development and link them to critical resources and service providers.
Technology intelligence aims to identify relevant information in the technology environment of a company by collecting, analyzing and communicating the best available information. Technology intelligence techniques like technology assessment and technology foresight are used in order to generate knowledge about current technological developments and to derive a complete picture of possible future trajectories. They represent major instruments supporting technology-related decision-making processes, both at governmental and corporate levels. As technology is a complex system with positive and negative faces, technology assessment has to be as holistic as possible and cover all aspects of technology implementation—technical, economic, financial, environmental, social, etc. Our holistic, internet accessible, multiparadigm decision support system brings together artificial intelligence, operations research, engineering, economics, and public policy concepts to help its user make technology investment decisions [7], [8]. It integrates knowledge and data from a variety of sources to facilitate users conducting multicriteria analyses of technology alternatives and to justify appropriate investments. With DSS, users in developing countries are able to make rational choices among technology alternatives by using their specific subset of criteria and their relative measures of importance, among a huge set of criteria concerning technical performance, economical feasibility, environmental soundness, socio-economic impact, etc.

Another technology intelligence service is a provision of a software tool assisting in technology foresight exercise. The technology foresight process seeks to identify those technologies that will be key to national and-or regional sustainable development in the longer term and to make recommendations to address the opportunities and challenges associated with these technologies. International experience demonstrates that technology foresight is rather complicated and also time and resources demanding. Therefore, the technology foresight exercise of one type or another has been undertaken mostly by the leading industrial countries, while the developing and transition economy countries were left aside of the process [1], [3], [4]. Using our via-net intelligence software (CyberDelphi) it is possible to include a diversity of actors and inputs, with acknowledged diversity of visions, to ensure full transparency, openness and bottom-up spirit, and facilitate interactivity among participants and appropriation of the process to actors and stakeholders. The software enables collective learning in the technology–related arena via interaction between industrial, academic, governmental and social actors. It operationalises interactive processes aimed at exploring openly and collectively possible futures. In this way, it both increases and distributes
strategic intelligence among social actors on emerging technologies and innovations. Such processes help formulate and co-ordinate the forward-thinking of institutions concerned with (technological, social and organisational) innovation, thus enhancing their strategic capabilities. Our technology assessment and foresight tools aim at permitting a company to anticipate future developments in its sector or industry and prepare itself for possible problems.

The possibility for various stakeholders to take part in the exploration and assessment of the technological trajectories which shape innovation, make the associated policy making and decision processes transparent, credible and acceptable, and gives the democratic dimension of science, technology and innovation. It is important to note that this e-democracy dimension concerns not only governments in their public policy role, but also public and private sectors in their research and innovation strategic choices, universities and public research organisations and the citizens themselves. The best way to introduce this e-democracy dimension is to provide the means for all the interested parties to be involved in the technology foresight and technology assessment exercises, and the best possible means nowadays are global network and network based intelligence tools, like the one being developed by our Institute.

Of course, although above mentioned innovative web-based technology transfer services are definitely here to stay, they are complementary (not competing) to more traditional forms of technology transfer that we intend to keep, like

- Conventional training courses (in spite of e-learning facilities, in certain areas so-called “in the field training” or “face to face” training seem to be indispensable)
- Expert meetings between academia and industry (might be convenient for brainstorming and faster consensus reaching in spite of modern teleconference facilities)
- Support services (technology/business studies, contract negotiation, finance syndication, etc.)
- Advisory services related to the technology transfer process
- Publications (Course materials, Tutorials, Case-studies, Technology transfer periodicals, etc.)
- Catalytic financial support (small financial incentives, seed money).

While some critical services can still be provided face to face only, many of the above mentioned business support and mentoring services can be effectively provided through Internet and will gradually migrate to Web-based service portfolio.

5. Concluding Remarks

Rapid technological developments and need for timely anticipation of new opportunities and threats have also intensified the search for suitable and innovative technology intelligence and transfer tools to face these challenges. The Mihajlo Pupin is among the early adopters of these trends. It started developing its own technology intelligence and transfer tools, some of which were presented in some detail in this paper. To overcome major geographic, political, and social differences among major players and stakeholders, we opted for Internet based means for both technology intelligence and transfer, since the Internet has revolutionized the transfer of technologies across borders and around the globe. It offers a number of advantages in terms of cost, the numbers of service recipient that can be targeted, and the ease-of-update of information presented and rapidity with which enquiries can be made and responded to. While our Web based technology intelligence services
(technology foresight and assessment) are in their mature phase, the innovative web-based technology transfer service portfolio is still emerging. Once developed, it will be constantly kept up-to-date to maintain user interest and to ensure rapid access to the information and services they are interested in. It will be backed-up by systems and infrastructure to ensure that all enquiries from users are handled quickly and efficiently.

However, although the above mentioned innovative tools are still in their prototype phase, owing to our two other driving forces, flexible organizational structure and well established technology transfer chain, we can state that we are already quite successful in our attempt to bridge the academia and industry. The best proof of the successful technology transfer performed by the Mihajlo Pupin Institute are quantitative indicators, namely the number of new jobs created either by selling licenses for innovative products, technologies and/or services, or by establishing spin-off companies fostering faster take-up of new products.

Our analyses have shown that by the end of the year 2008, around 500 new jobs are created around the technologies transferred by the Mihajlo Pupin Institute to industry and public sector. At the same time, substituting the import of equally performing products and/or technologies from abroad, the savings achieved in Serbian industrial and public sector are around 50 million EUR. The saving are calculated rather precisely, taking into account the costs of secondly ranked bidders in public procurements of goods and services, where Pupin won the contracts. According to our business plan, the curve should be even steeper in the years to come. Our forecast is included in Figure 5.

Figure 5: Quantitative indicators of TT success (job created - left, investment saved - right)
6. References


IMPACT ON INDUSTRIAL PROJECTS
Abstract
The student IT training is one of the most important educational tasks influencing the modern economy. The countries of Central and Eastern Europe, which still need to catch up with the more advanced European Union members, must focus on the former to meet the requirements of the informational society. The paper presents the educational structure of the IT training aimed at the agricultural sector based on the example of the newly formed Faculty of Applied Informatics and Mathematics, Warsaw University of Life Sciences. The premises to create such an organisational structure will be presented as well as the structure of the study programme. Finally, the additional aspects, such as scientific cooperation between the faculties will be explained.

1. Introduction

The modern economy and science went into the most advanced stage so far, relying heavily on the information technologies. The latter are delivered traditionally by the computer science specialists, formed at the technical universities and trade schools. However, the number of the domains that must resort to the informatics and derivative sciences increases rapidly. These include environmental sciences and industry branches presented in the rural areas. Therefore there is the need to introduce the new set of applications of computer technologies, usually requiring the cooperation between the specialists from different domains. In the countries that lately became members of the European Union (such as Poland) this tendency is even stronger, as the networking infrastructure is not as developed, as in the west [1].

As the Polish industry requires additional investments in technologies in order to be able to compete with the western companies, structural changes must also be made in the educational sector. The main drawback of the educational path in Poland is a small synergy between the universities and the industry, so the graduates can not be satisfactorily prepared to work there. Also, the scientific cooperation between these two is relatively rare, resulting in the suppressed development of both domains. To change that situation, multiple modifications in the structure and directions of the Polish educational sector must be made, apart from the financial investments.

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situation in the agricultural universities is even more challenging, as the science and education developed there were relatively far from the modern IT technologies during the last decades. Therefore a task to integrate these domains must be made in order to introduce the rural areas to the 21st century technological solutions [2]. The support from the European Union (for example PHARE programme) gives an opportunity to accelerate the development of these areas [3]. Additional problem is the economical heterogeneity of the Polish society with strong centres in the largest cities and weak and slowly developing countryside. To overcome this hindrance, the role of the metropolitan universities is to educate the business and IT specialists that will be able to operate in these areas.

The paper presents the educational and scientific profile of the Faculty of Applied Informatics and Mathematics newly established at the Warsaw University of Life Sciences, Warsaw, Poland. Its mission is to educate the students working for the rural economy and to support the environmental sciences with the computational methods and hardware solutions that can help solving multiple problems. To do that, a close cooperation between the organizational units is required. The paper is organized as follows: in section II a short presentation of the experimental site is made to explain the main tasks of the Faculty and its initial position among the other structures of the university. Section III contains the implemented program of studies, which reflects the point of view of the university authorities on the further development of computer science in the environmental studies. The laboratory structure and additional requirements are also presented here. In Section IV the proposed and already performed cooperation between the Faculty and other units, as well as the industry is explained. Section V contains conclusions and future prospects.

2. Characteristics of the Faculty

2.1. Mission of the faculty

The Faculty of Applied Informatics and Mathematics was established on January 1st, 2008, by the decision of Rector of the Warsaw University of Life Sciences (WUoLS). The unit was founded based on the formerly existing Interdepartmental Study of Applied Informatics (formerly known as the Interdepartmental Study of Informatics and Econometrics). The decision about establishing the faculty was based on the following premises:

- the need to develop the computer engineering science aimed at the needs of the environmental sciences,
- the need to produce the IT specialists prepared to work in the rural areas and understanding their requirements,
- the need to foster the cooperation between the faculties and create new scientific problems and solutions.

The traditional educational model in Poland does not assume the cooperation between the faculties, or universities. Therefore the most powerful technical universities (such as Warsaw University of Technology), rarely cooperate with other units. The typical agricultural university must face problems and solve them on its own, mostly without help of the IT specialists. The problem is more important, as there are multiple domains, where the problems cannot be solved without the aid of highly trained computer specialists. These include:

- bioinformatics (analysis of the gene patterns, storing and processing the data obtained from the living organisms, biomedical image recognition). The examples of this can be the microarray experiments (used to analyze the impact of the tested medicine on the living organism) [4],
- implementation of artificial intelligence and machine learning methods to decision making, classification and prediction of diseases based on symptoms [5],
- implementation of computer technology solutions in laboratories and test sites for the environmental studies, for example in the geotechnical measurements [6].
- design and management of computer infrastructure in agricultural industry, in the fields such as cattle, pork and dairy production [7], farms management, plant crops optimization, etc.

2.2. Educational profile of the faculty

The educational profile of the faculty covers two programs of studies:
- informatics and econometrics – the older, well established and focused on the business informatics and financial engineering. The speciality is run by the econometrics and financial engineering staff previously employed in the Faculty of the Economical Sciences.
- informatics – newly established, currently the first graduates are being prepared. As the computer science is not in the profile of the agricultural university, new staff (consisting of the engineers from the technical universities) had to be employed and new organizational structures had to be assembled.

The former prepares the graduates to serve in public institutions, such as banks, offices, managing bodies of large companies, etc. The main focus in this program is put on the economical aspect of the modern economy both in the metropolitan as well as the rural area – see Fig. 1. The information technologies perform a supportive role here and do not require any special equipment or approach. The first level studies are 3-year Bachelor studies with the final exam at the end. The second level studies are 2-year specialized studies with the following specializations: Econometrics and Statistics, Financial Engineering and Information Systems in Management (the latter has two realizations, in Polish and English, making it accessible for foreign students). As can be seen, the first two specializations are important for the economical sector of the government and although the basic program in informatics is presented here, the main focus is on the business activities. Note that the Information Systems in Management specialization is the most IT-oriented one, including the basic courses of software engineering, telecommunication and computer systems architecture.

![Figure 1: Structure of the informatics and econometrics study program](image-url)
The latter program of studies had to be prepared from scratch and required the input of IT specialists. To meet the requirements imposed by the university authorities and produce an engineering study program, the following strategy was prepared:

1. The graduate profile was formed. It was planned to be the universally educated specialist, able not only to program computer systems, but also ready to design and maintain the computer networks, work with embedded systems, being able to perform electronic measurements and manage the telecommunication equipment. The graduate must then be highly skilled and versatile enough to perform all the basic operations in the rural area, where he is the only specialist in the vicinity. Therefore in the program of studies, a large impact of “hardware” courses was assumed. This way the graduate could become a specialist.

2. The constraints of the Polish Ministry of Science guidelines were implemented to insert into the engineering program all the required content [8]. Beyond that, the specialties were designed to reflect the individual needs of every student.

3. The structure of the faculty was modified to adapt the requirements of the study program. The faculty was established based on the departments of informatics, econometrics and statistics, biometrics and applied mathematics. To cover the new study program, additional structure had to be created, and made responsible for most of the courses belonging to the informatics specialization. The department of applied informatics was created and consists of the technical university engineers, who ensure that the character of the program is close to the style of the technical university.

The result of the program preparation and implementation are 3,5-years engineering-level studies with the planned 1,5-year MSc studies (not yet implemented, as the informatics studies are too young), both including specializations. Their profile is more technical university – oriented, because of the need to produce as versatile specialists, as possible.

3. IT Studies Program

The program prepared for IT studies is in some aspects similar to the one of informatics and econometrics. The impact of mathematics is strong in both programs, some programming and algorithmic courses are the same or similar (which is imposed by the guidelines of the Ministry of Science, such as the programming fundamentals or algorithms and data structures). However, the main difference is the significant input of courses in electronics and specializations related to the computer networks and telecommunication.

3.1. General courses

According to the ministerial requirements, the studies in information technologies are based on mathematics, so the first two semesters include mathematical fundamentals, both general (linear algebra, analytical geometry) and aimed at the engineers (probability and statistics, discrete mathematics) – see Fig. 2. The main computer technology courses are then implemented (introduction to programming, algorithms and data structure, object programming, numerical methods). Simultaneously, the students are acquainted with the advanced informatics courses, i.e. computer systems architecture, software engineering, database systems, computer networks, computer graphics and artificial intelligence. The latter are the introduction to specializations. A separate attention is required for the “hardware” courses, which begin with the physics fundamentals, electronics fundamentals, digital electronics, and digital techniques and embedded systems. These are not only to prepare the students for certain specializations, but also to develop deeper knowledge of the hardware used in computer science. This way the engineer should be able
not only to operate the personal computer, but also to know and to control the additional equipment – oscilloscopes, measurement devices (multimeters, computer network cable analyzers etc.). To stress the characteristics of the agricultural university, multiple courses considering agricultural business are also present, namely agricultural market organization, introduction to agriculture, or organization and finances of the local government.

3.2. Specializations

Although in the informatics and econometrics program the specializations are present only in second level studies, informatics has specializations in the first level of studies, since the fifth semester. They were designed to some part of the IT applications in the rural industry. On the other hand, they are broad enough to be attractive also for students aiming at working at the mainstream of the IT industry (in the metropolitan areas). The specializations form four education streams, each backed by one course in the main stream (see Fig. 2). The topics covered by these specializations are:

- database engineering – the students are acquainted with the methodology of the database systems and design of the information systems. The topics covered here are data warehouses, data mining, business intelligence and their application in the industry.
- engineering of information systems – this specialization is focused on the design and implementation of information systems, i.e. sophisticated data acquisition and processing systems, so important in the modern economy.
- multimedia systems – the students become engineers skilled in internet programming and computer graphics and animation.
- telecommunication and computer networks – this specialization is especially important for students who arrive to Warsaw from the countryside, gain knowledge and skills required by the universal specialists and return to their homes to become experts in as many aspects of IT, as possible.

All the specializations have the obligatory courses and additional elective courses. The diverse offer of the latter supports the individual studying regime of every student.
3.3. Organizational support for the courses

Informatics and econometrics studies require very little additional equipment, including only computer laboratories for running the software (standard Microsoft Office, programming language compilers and specialized applications, such as SAS or Oracle database system). Therefore the only effort from the organizational point of view is delivering the software licenses in the computer laboratories. Because of the more hardware-based character, the studies in informatics require much more equipment and specialized laboratories. These include so far:

- laboratory of fundamentals of physics – the first hardware laboratory, being the introduction to the physical phenomena utilized in the electronics, especially the computer hardware circuits,
- laboratory of fundamentals of electronics – the laboratory that allows students to understand the principles of taking electrical and electronic measurements and using the specialized equipment for that purpose,
- laboratory of the analogue and digital electronics – this laboratory is an introduction to the most popular elements of the electronic circuits used in computer systems and equipment used in telecommunication,
- laboratory of embedded systems – this is the last laboratory in the “hardware” course. Skills obtained in the electronic laboratories can be used here to design and program the embedded systems, including microcontrollers used virtually everywhere,
- laboratory of telecommunications – the laboratory is aimed at teaching the students the skills of the telecommunication engineer. It includes practice using modern professional devices, such as Aurora Tango Gigabit Ethernet [9] for testing fast local area networks, modules for checking the continuity and transmission characteristics of network cables, according to the contemporary norms [10]. On the other hand, educational modules, allowing exercising with the ISDN, RFID or GSM technologies without the communication infrastructure,
- laboratory of computer networks – as the thorough course of computer networks requires specialized hardware, the laboratory was designed and implemented using CISCO Systems equipment, namely CCNA and FWL modules, making it fit not only to the study program, but also for the Cisco Academy. This way it is possible to perform the full course in managing the network hardware and networking services of the operating system (such as Windows 2003 or BSD).

Although the university finances are limited, to establish some of the presented laboratories, specialized equipment was purchased – especially for computer networks and telecommunications laboratories. The idea was to get the student acquainted with the professional equipment. The electronic laboratories were designed using the standard educational sets, delivered with the full course of exercises. The balance between professional equipment and educational modules allowed to design fully equipped laboratories for a reasonable price. The networking equipment is also used in the CISCO Academy, which makes the faculty’s offer richer and increases financial income.

The software used to support the didactic process includes also the e-learning platform Moodle, used to store information about courses, teaching aids and to monitor the students progress. Also, with the incoming MSc studies, additional teaching aids are planned, for example virtual and remote laboratories. Such attempts are currently made [11].
4. Students profile

Because of the university profile, the educational offer of the faculty was prepared for the candidates from the countryside. However, the first years of studies revealed that the students come mainly from metropolitan areas. The exemplary structure of the students’ origin (the particular district of Poland) in the faculty (excluding foreigners) is presented in Fig. 3 (only the districts represented by at least two students are described). Note that the capital district (mazowieckie) is represented twice – thirty two percent from Warsaw, and forty three percent outside Warsaw, which gives over seventy percent of the overall student population from the metropolitan area. This means that although the studies are aimed at the students from the rural areas, the main interest comes from the students from large cities (very few are from villages). This is one of the main problems in Poland: as there is a large gap between the education level in the rural and metropolitan areas, very few attempts are made by people from the latter to get a proper education in larger cities. This is going to change during the upcoming years, but currently the initiative of creating the IT program for the students from countryside is not yet fully exploited.

Figure 3: Geographical structure of the students of the Faculty of Applied Informatics and Mathematics

5. Scientific cooperation

One of the most important aspects of the newly established faculty is the cooperation between computer scientists and environmental scientists. This can happen on different levels, starting from common participation in projects and ending at the participation in the Seventh Framework Programme. Currently, there are a few initiatives concluding in the cooperation between the faculties, one of them is the grant for the Faculty of Engineering and Environmental Science founded by the Polish Ministry of Science introducing the artificial intelligence methods used in
the analysis of soil structure [12]. Further prospects include cooperation with the Faculty of Veterinary Medicine and Faculty of Agricultural Economics.

Additionally, the long-term impact of cooperation between the faculties lies in the educational process. Although currently the main contribution of other organizational units lies in the courses closely related to the agriculture, the prospects are to introduce new courses as the effect of mutual research. These courses are planned to cover the application of computer technologies to the environmental sciences, such as bioinformatics or biology-inspired computations. The close cooperation between the faculties in the WUoLS gives an opportunity to design new courses with the content impossible to attain in other universities. These include applications of computer algorithms to the environmental sciences, as well as information systems applied to the lightweight (woods, farming, animal) industry.

The cooperation with the industry is still in its early stages of development, although the first attempts (for example, with wood industry companies) were made. As the cooperation between science and industry sectors is not common in Poland, additional effort is required to create research divisions.

6. Conclusions

The aim of creating the Faculty of Applied Informatics and Mathematics in the agricultural university was to establish a base for computing methods and algorithms that can be easily utilized by the organizational units of the same university. This allows a close cooperation between scientists of different domains. Moreover, as the Faculty’s task is to develop new IT methods and techniques, the field of applications is ready for testing. The foundation of the faculty is the confirmation of the tendency of increasing impact of computing methods on other scientific domains. This way the faculty can serve as the expert board in the IT technologies for all other organizational units.

The response from students and the number of candidates for the studies indicate that there is a strong need for such an educational path. IT engineer is currently one of the most required occupations and although these studies are regarded to be hard to complete, the number of candidates is steadily increasing. Although the studies, because of the university profile are mainly aimed at the students from the countryside, significant interest from Warsaw and other large cities dwellers indicates that the study program proposed by the faculty is attractive enough to draw their attention. As the country development will impose fast computerization of the countryside, specializations proposed in the Warsaw University of Life Sciences will be required to change the face of rural areas.
7. References


ICT STRATEGIES FOR CEE-COUNTRIES TO GO INTERNATIONAL, THE ROLE OF VIRTUAL ORGANIZATION AND VIRTUAL TECHNOLOGY

Jerzy Kisielnicki¹

Abstract

The article presents hypothesis in which ITC application strategies and effective tools, especially the building and usage of virtual technology and virtual organizations, can support CEE enterprises in transforming into international enterprises functioning in the global market. ITC applications have a major share in the transformation of industrial society into informational society based on knowledge management, and thus contribute to the elimination of differences between CEE and EU enterprises. Enterprises can take up a development strategy, which will make them competitive in the global market, due to virtualization seen as a transformation process. Virtualization allows enterprises to start strategic alliances with similar enterprises. The presented paper focuses on theoretical and practical issues of the ITC implementation as a new strategy of a business cooperation. An example of a genuine successful company, which implemented ITC solutions and management tools, will be presented in this paper.

1. Introduction

Transformation processes that have started in the 80s in CEE countries require a constant support and monitoring. Polish enterprises, as well as some from other CEE countries, were not very modern and the technology used was obsolete and not competitive in relation to other European Union countries. The outcome is a result caused by the delay in using modern technologies and usually old management systems. Various methods and techniques of organizations are used in transforming and integrating processes and in most cases are connected to the ICT technology. These tools allow the connection and transformation to modern technologies.

Thanks to ICT solutions many enterprises functioning in the EU market join together. ICT technology allows both to monitor the transformation processes and to predict future events. Virtual technology and especially the possibility to create virtual organizations play a special role in the process of transformation [2] [3] [8] [15] [17] [18]. Virtual technology contributed to the creation of new society development possibilities and the early recognition of emerging barriers[5] [6],[10], [13], [17], [17], [18],[23],[24]. In this context P.Drucker [6] states that due to virtual technology there are no undeveloped countries. There are only countries with not developed management. Therefore the following hypothesis can be assumed:

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Hypothesis I: Virtual technology and virtual organizations are offering totally new and improved tools to the CEE enterprise transformation, especially to small and medium enterprises (SME), which are internationally, competitively fully functional on global markets.

Hypothesis II: ICT implementations have a considerable share in the transformation of industrial societies into informational societies based on knowledge, which leads to a decrease of distance between CEE and European Union countries.

The aim of this article is the attempt to answer questions connected with the use of virtual organization and virtual technology solutions in the process of the CEE countries transformation. The questions are as follows:

- Whether and how virtual technology influences global transformation processes in CEE countries and its influence on knowledge management?
- Does it influence different areas of activities such as business, education, administration, self-government, culture?
- How will it be possible to decrease the distance in innovation and modern technologies between CEE and UE countries with the use of virtual technology?

The attempt to answer these questions will be realized on the basis of self study and elaborations in the area of virtual technology applications in management practice. Considerable experience of the author in this matter was gained during the coordination of a creation project on the encyclopedia about creation and application of virtual technologies.[19]. About 230 scientists from different countries took part in this initiative.

An example of an enterprise, which transformed into a global company due to virtual technology, will be presented. This enterprise functions and competes in the global market of delivery services and internal transportation in the automobile sector.

2. Virtual Technology and Virtual Organization - concepts, elements

There is no single and clear concept of a virtual technology presented in the literature [5]. The word “virtual” was probably defined by an American philosopher, Charles Pierce, in 1902 [21]. He used the word virtual in the following way: “A virtual X (where X is a common noun) is something, not an X, which has the efficiency (virtus) of an X”. The word virtual is usually assigned with multimedia technologies, which are the consequence of personal computers availability, development of internet, computer graphics and IT technology. Its meaning evolved greatly over the years. Philosopher Michael Heim [8] defined “virtual” as a philosophic term that means unreal, but existing under certain conditions. One can assume that the word “virtual” was used for the first time in 1980 by Theodore Nelson (inventor of the “hypertext” concept) to describe interactive computer systems. In the 90s Paul Levinson [21] described “virtual” X as what you get when the information structure of X is detached from its physical structure.

Listed concepts contributed to the creation of theoretical basis for virtual technologies as well as the rules for the creation of virtual organization. The theories, which led to the development of virtual technologies, included also:

- Virtual Reality[8], [23]
- Virtual Word [24]
Cyberspace [27], [28].

The creation of the greatest market in the history of our civilization – the e-market [20], was also achieved by the results of the virtual technology. This technology applied, is used to create virtual organizations as well as providing products and services, real or virtual. It uses tools that differ from the classic approach, such as: virtual machines, modeling, and simulation.

Virtual technology can be considered in two aspects:
- Technology used for the creation of virtual products
- Tools, which allow replacing traditional tools with more efficient and effective ones

However, it also encompasses knowledge that concerns the creation of virtual products such as: virtual organization, virtual education, virtual teams and virtual reality [1], [7]. In order to create such products, ITC knowledge is necessary, especially about communication platforms, multimedia systems and portals [4],[25],[27]. Using virtual technology also allows the influence on real environment controlled by the computer or computer emulated. The latter aspect leads to the application of computer simulations that replaces traditional reality with virtual reality. As a result we can efficiently study a problem without taking personal risk (thermo-nuclear reactions, radioactive pollution and other subjects like stock market simulation without the risk of loosing financial assets).

Modeling allows broadening the possibilities of our activities in the changing environment and to become more competitive as well as gain new experience without the necessity of acting in the real world. One can check how a CEE organization would function in the EU market without the need to risk of genuinely creating it. Such an organization would bear the name of a virtual organization. There is no single definition of this concept in the literature. The author performed an analysis of concept definitions in earlier publications [13]. In the article, as well as in literature positions mentioned earlier, the definition is as follows:

Virtual organization is a type of organization, which is created on the basis of voluntariness and its participants are connected with various kind of relations to reach a common goal. Time of the relation is determined by every participant who creates the organization. Decision about elimination is made when one of the participants decides that the existence of given relation is not profitable for him or her and decides to terminate the relation. Virtual organization exists in the cyberspace and its functioning requires ITC. Functioning of the organization in the modern, global, competitive market is possible due to the existence of virtual organizations and the Internet. CEE organizations can interact in this way with many other EU organizations.

Virtual technology gave a new impulse to CEE enterprises. While using virtual technology one functions in the cyberspace. To build a cyberspace these two criteria have to be taken into account:

- heterogeneous computers localized in different places of the physical space that are able to receive and transfer information,
- global computer networks able to transfer information.

Relations existing between these criteria have the form of various relationships and are determined with existing procedures and communication protocols. Lack of possibility to determine the boundaries with physical measures and multi-directions of relations are the main characteristics of the cyberspace.
Computers in the cyberspace are mainly connected with WWW network, Electronic Data Interchange, multicast, P2P (peer to peer) and other solutions.

Time of data transfer and knowledge transfer from different databases as well as the decision making process time is usually very short and measured in milliseconds in the cyberspace. As a result, main issues in man\textsuperscript{[12]}, \textsuperscript{[20]} agreement with limited resources are solved with the use of new forms such as:

- virtual market, new form of market
- virtual organization a new form of organization.

A new situation in the scope of management causes both gaining new, unexpected effects and the preparation for losses and new kinds of criminal activity. Knowledge in this approach can be used both for social services and against the society in the form of cyber terror\textsuperscript{[9]},\textsuperscript{[14]},\textsuperscript{[22]}.

When writing about applying virtual technology features it should be pointed out, which distinguish solutions, which can be achieved with the use of traditional technology. These features have both micro and macroeconomic character.

Main macroeconomic features include:

- tools supporting the transformation process in the development of information society based on knowledge, which can be later referred to as the virtual society,
- creation of new electronic forms of global organizations and the global market, which through transformation replace traditional structures and cause cultural changes in management systems – knowledge based intercultural management.
- creation of tools and procedures for the transformation of small and medium enterprises into competitive international organizations.

Main microeconomic features include:

- direct knowledge and data transferring systems, which eliminates intermediaries through creation of hubs allows decentralization and democratization of management, elimination of classical hierarchical organizational structures,
- creation of flexible organizational forms, so called virtual teams, which are directed at knowledge sharing in task realization, independently of the geographical location of team members,
- different from the traditional approach formulation of basic elements of economic calculations such as: investment expenses, boundary production costs and relation of these costs to the scale of production,
- use of such knowledge management methods and techniques, including expert systems, which allow fast decision-making in constantly changing environment.

Virtual technology have allowed CEE enterprises to reach new quality in the management process. The most significant elements of these organizations combine global computer networks, large and dispersed databases, data warehouses and knowledge bases, which function independently of existing country boundaries. The World Trade Forum discussed in 1997 the topic “Building of networking societies” \textsuperscript{[18]}. Even though over ten years have passed since that event, issues and problems signaled then are still significant and important. Creation of global networks and knowledge bases is a chance for the development of different organizational forms as well a chance
for individual society members [28]. Currently large fully accessible knowledge bases are built in many countries individually and in cooperation. The European Union accredits the “E-Europe Strategy” as one of the virtual technology initiatives. This especially concerns productivity increase with the provision of knowledge about new markets and public services. Using international knowledge bases gives CEE countries an equal chance in the access to knowledge, thus stopping in being an egalitarian good but starting to become an accessible good, stored either as a hidden knowledge or an open knowledge. Access to the gathered knowledge requires proper preparation of the users. Virtual environment offers these advantages: “My knowledge base is where my laptop is and I can use it whenever I need it” and “I am using the necessary knowledge in suitable time”.

3. Chosen uses of virtual technology and its role in the transformation process

The basic methodological question in evaluation of new options is: Why are we doing it? What effects do we predict? What threats will emerge?

New solutions are new possibilities given by virtual technology, which do not appear in traditional solutions. Examples of such solutions are presented in the literature collected in the end of the article. Table 1 collects selected possibilities given by virtual technology and can be considerably extended, especially in areas such as medicine, transport, agriculture.

<table>
<thead>
<tr>
<th>Area of activity</th>
<th>Business</th>
<th>Administration</th>
<th>Education</th>
<th>Culture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human</td>
<td>Electronic banking, Management cockpit</td>
<td>Tax return</td>
<td>E-learning</td>
<td>Movie selection</td>
</tr>
<tr>
<td>Organization</td>
<td>Virtual team, Virtual organization</td>
<td>Participation in offer bidding</td>
<td>Virtual University, E-learning</td>
<td>Virtual museums and art galleries</td>
</tr>
<tr>
<td>Organization system</td>
<td>E-market</td>
<td>E-government</td>
<td>Virtual, global librarian collection</td>
<td>Virtual, global museum collection</td>
</tr>
</tbody>
</table>

Table 1: Examples of virtual technology appliance (Source: Self study)

The success of particular people or organizations often depends on the access and ability to effectively use the virtual technology. For example, virtual technology changes the manner of business contact and negotiation between the transaction participants. Traditional contact for example is different between the purchaser and the salesman, realized via MRP/ERP system or with CRM (Consumer Relation Management).

Functioning communicational systems have the greatest influence in realized uses of virtual technology. Traditional systems of communication are often replaced with virtual technology or modified with the use of it. In contrary to still commonly used traditional systems; new communication systems function in the cyberspace.

One of the main features of the cyberspace is that the place, time and way of transaction realizations are not relevant. As mentioned before E-Commerce is one of the virtual technology appliances.

E-commerce can be presented as a building (Fig. 1), of which:

- „Foundation“ is the virtual technology.
- „Walls (pillars)” are people, organization, procedures, corporate culture, economic and social policy,
 „Roof” consists of to particular appliances in banking, trade, industry and marketing - see Table 1.

Figure 1 indicates shows the relationship between the presented “foundation” and the “roof”. These relations take form of the “Pillars”. This indicates different approaches to problem analysis, for example the influence of the human factor on the use of virtual technology in certain appliances e.g. banking, administration or trade. Communication system is the bond that joins the appliances - “roof” and the “foundation” with virtual technology.

Therefore, according to applications we deal with different properties of the communicational system. A communication system used in business appliances is characterized by its extreme pace and directness of realization (elimination of intermediaries and activities). CEE enterprises need to adjust to these relatively new conditions if they want to become a part of the EU e-commerce market. Relation analysis between e-commerce and the traditional market indicates that the role of the first ones in the EU is constantly increasing.

The most significant uses of virtual technology are estimated as:

- macro-scope – application in two areas: virtual organizations and e-government,
- micro-scope – virtual banking and virtual teams

The future will bring a significant development in a broad scope of applications of which the most relevant one will be e-learning (supportive, individual), which is emphasized in the international literature.

![Figure 1: E-commerce structure](image-url)

Virtual organizations are one of the most effective applications of virtual technology in CEE countries transformation processes. The creation of such organizations forced the necessity on revising many traditional paradigms of traditional economics and their management [Kisielnicki, 2004]. Virtual organizations allowed the full use of virtual technology possibilities. Intelligent organization based on knowledge management are used as one of the synonyms of virtual organizations.
Three levels of functioning can be distinguished in virtual organizations:

• **Development of business functions realized through the traditional organization.** Takes place when the organization wants to be closer to the customer and does not have proper financial resources to realize this target. For example a traditional organization that is equipped with modern technology is localized in Vienna and creates different branches, with the use of modern virtual technology, in Warsaw, Bratislava, Sophia. In every branch customers can view the rich and detailed offer through a multimedia computer with dedicated software. Another expansion of offered services can be realized through sales via kiosks and internet stores. Electronic banking is one of the applications included in this trend (my bank is where my laptop is).

• **An organization that is created to realize a specific project (projects).** For example a company that wins an international bidding for a realization of a global project. To realize this project, the company can even create an international organization, which stops to function after the project is finished. In Poland such solutions are used in the realization of the Euro 2012 project (Euro Cup in football).

• **Virtual organization built for training purposes.** Physically meaning a computer or a computer network which are equipped with specific virtual technology tools. The main task of such a virtual organization, created for e.g. students, employees or managers, is to train and improve business and managerial skills. Usually it is a computer with suitable software, which includes virtual technology solutions. Such an organization can take the form of a virtual university or a e-learning platform.

When writing about virtual technology one needs to mention the e-government application. In this case virtual technology serves the triad: “Public Administration – Citizens – Enterprises” (Fig.2). Therefore according to the European Commission [e-government indicator for benchmarking eEurope] the collection of social services included in European e-government consists of twenty services performed with Virtual Technology. Twelve of these services are concerned with individual subject services and eight of them with concerned corporate clients. E-government services can be divided into four main groups: tax and fee services, applications and registrations, allowance payments, permissions and licenses. All of these initiatives are aimed at the creation of the foundations for the information society.

To finish this review of virtual technology applications, its role in human resources management improvement will be presented. It includes: Virtual job expos, Virtual educational expos and Virtual learning.

Virtual expos realized in CEE and other EU countries are attractive for university graduates and people searching for employment as well as employers seeking employees. This way CEE enterprises can present their offer and find worthy employees from prestigious UE universities. This is a two way process, because EU university graduates can find employment in major international enterprises.
Virtual educational expos, similarly to virtual job expos are an internet market space, where universities, language schools, MBA programs, post graduate studies, trainings, trainships and international internships advertise themselves. With proper permission, laptop, software and Internet access one can become a dean of his own university, which size is determined only by the effectiveness of the computer and network capacity. Therefore CEE countries equipped with computer centers can manage and get to know thousands of students, train personnel with the use of the latest software and update materials from the most prestigious universities in EU. Traditional large libraries, which nowadays start to look like book museums, are not necessary. Currently modern universities can present electronic libraries, instead of traditional libraries, as an element of educational infrastructure transformation.

4. Effects and barriers of virtual organization functioning and virtual technology applications in CEE enterprises transformation processes

Effects reached through virtual technology can be evaluated in relation to different criteria. If different kinds of effects are taken as the basis we can divide them into: technical, economic, organizational and social with psychological.

First of all, the technical effects base on the access to information resources and knowledge, increase of data and knowledge processing speed as well as the increase of its detail, accuracy and adjustment of the printout layouts to the requirements of different users. Also the expansion of the knowledge bases usability limit from individuals to many users is an example of a technical effect. We can speak of a truly informational EU society when, due to virtual technology, all language barriers are eliminated and creation of a virtual translator is possible. Then we can reach for further appliances of virtual technology. It is an extremely difficult field of study, which until now was only developed in science fiction books and films. However, it is believed that virtual technology will allow not only realizing the “Jurassic Park” movie assumptions but also offering to every
human the possibility to have a direct access to Japanese or Thai databases without the knowledge of the language. This can be also used in the process of CEE country transformations.

**Economic effects** include necessary supporting activities of virtual technology for business performance results improvement. It includes a current supervision of the enterprise’s performance, market analysis and competition analysis. It can be achieved through the realization of the “management cockpit”. Due to the functioning of the cockpit, it is possible to have a current overview of both strategic and day-to-day transformation processes. Virtual technology allows supporting the decision making processes through the creation of virtual organization or a virtual sector model. With the necessary model one can perform a simulation or optimization as well as predict the changes of key performance indicators in the future. It is especially beneficial to use virtual technology in stock market simulations.

**Organizational effect** includes the improvement of management structure and processes. Virtual technology for the first time has allowed building a model of the whole organization or its elements, which can lead to determination of the most proper transformation directions of the organization. This group of effects includes also documentation flow and elimination of not value adding organizational operations. It allows to implement and develop the possibilities brought by organizational techniques such as reengineering and x-engineering, critical path analysis, management by objectives and many others. This scope puts special attention to effects that are gained through the replacement of traditional teams with flexible virtual teams.

**Social with psychological effects** allows having a better understanding of social needs and feelings of the employees, due to the use of virtual technology tools. Virtual Technology draws special attention to these solutions, which allows building a virtual model of organization or the virtual image of the market. People can test themselves on the models of different situations that can be found in real life or during transformation processes. This allows entering the real situations without any conflict and with a better timing than with the use of traditional technologies. Psychological effect that has a direct translation to economical effects is the possibility of cooperation of different partners, which would not cooperate in traditional technology because of e.g. culture differences.

It is important to remember that virtual technology also creates barriers that could never be found in the traditional approach. Similarly to the effects, the barriers can be divided into four groups:

**Technical barriers** are the most noticeable ones for the users. Use of the virtual technology requires the use of suitable technology and software. CEE countries are quickly catching up with the EU countries, what was revealed by the Eurostat data. Lack of proper manuals and textbooks is also one of the technical barriers.

**Lack of synchronization** between particular system elements can be another technical barrier. One of the necessary factors to realize this task is also having suitable tools and software, because virtual technology allows to model real world to a great extent. It is especially crucial to be equipped with proper hardware to build graphical models.

**Economical barriers** can be the lack of proper financial resources to implement virtual technology. Because of many tasks to realize in the transformation process, CEE countries have limited resources to build up proper management infrastructure. Lack of resources for buying proper software and hardware, forces us to limit the use of this economically and socially acclaimed solutions. Usually an enterprise, which cannot afford virtual technology, decides to lease it. This
form of virtual technology application should be developed in CEE countries. This way allows the enterprise to use virtual technology with limited financial resources for the software and hardware.

Organizational barriers. Many applications of virtual technology were not implemented, because the organization was not properly prepared to use them. Therefore when using virtual technology models of the real world, one should bear in mind the need of constant update of the proper databases. This requires creation of proper procedures that would include maintenance of the software and updates of existing databases with new and relevant knowledge.

Social and psychological barriers are connected with the resistance to change what usually appears in organizations. Such an event can be called an immunological reaction. Sociology in such cases uses the term negative cooperation, such as change discrimination and activities that lead to limit or stop the changes. It is relatively dangerous in CEE countries, because the transformation processes were performed as a step change, with no previous experience in this matter. Therefore if the use of virtual technology leads to job reduction, endangered employees will try to discredit this technology, showing it as unethical and senseless.

Different stages of development of various countries should be taken into consideration during the evaluation of effects and barriers. In the ITC area there are many major differences between the CEE and EU countries. There are also many legal boundaries and limitations, such as lack of legislation for the functioning of virtual organizations and virtual products.

5. Transsystem SA enterprise as an example of CEE countries transformation with the use of ICT and virtual technology

TRANSSYSTEM is a medium Polish enterprise specialized in automotive industry technological transport systems. ICT applications and change of management methods, including change to project oriented activities, became one of the major enterprises success factors. The success corresponded to the 80% sales increase in 2001 (the year of the enterprise’s transformation) in relation to 1996, with the 96% share of export, creation of 500 job positions and renewal of management, production and information infrastructure. This happened when the unemployment rate in Poland was equal to 17% and many enterprises had major financial problems. The growth was maintained until 2003. Currently the company takes part in 50 different projects for different brands in the automotive industry in 20 different countries on five continents, with a corresponding sales growth of 8 – 10% per year.

The organizational scheme of the enterprise and the role of ITC are presented in the Figure 3.
The successful transformation process of the company was confirmed on the World Congress of Project Management held in Berlin (this transformation was defined as a pioneer activity) in 2002 with the project management development award.

6. What next: The strategy of ITC solutions appliance development in transformation processes

ICT development as well as the appliances of virtual technology and creation of virtual organizations in CEE countries are developing in the following directions:

1. Developing through new and more difficult appliances. Near future will bring a possibility of fulfilling all possible needs in the real world or, if not, in the virtual world.

2. Tool development to solve new and more complex and complicated issues, which also includes the increase of the accessibility of the tools and lowering their prices.

3. Different solutions and factors decide about the success of an enterprise. ITC plays here an essential role. However success cannot be dedicated solely to modern technology, it must be supported with activities of a creative personnel. ITC is definitely a factor that participates in the strategy development of the enterprise’s development. It is also a new factor in the change direction of organizational theory and management. It enables creation of new organizational forms through virtualization.
Virtual technology is definitely an effective transformation tool to build an information society based on knowledge management. It is also a way to the common and accessible education. Every citizen of CEE countries with computer access will be able to increase his or her knowledge, due to virtual educational platforms dedicated for common use. Education will become common for everybody. Even though virtual technology already created the biggest known market in the history of civilization, it will also create the biggest educational and knowledge systems. Unfortunately CEE countries still have limited access to computers and the Internet. However the statistical data, provided by international enterprises and the United Nations, indicates that the access to ITC as the basis for modern infrastructure changes rapidly.

When analyzing the ITC role, one should draw attention to its two parallel development directions:

The first direction concerns the role in SME functioning. IT development favors the cooperation level increase within the organization; it also decreases the barriers between particular enterprises, which later creates one organism – virtual enterprise. The enterprise achieves common goals and acts as one organization, even though it may function in CEE or EU.

The second direction concerns major enterprises, which enforces their management structure with the ITC system. It leads to the creation of “medieval castles” which are separated by walls made of electronic computer security.

It can be assumed that future will bring a more common creation of virtual enterprises into the ITC platform, which will reduce the differences between the potential of both kinds of organizations and lead to the elimination of barriers between SME and major enterprises as well as outweigh differences between EU enterprises.

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INTRODUCING BUSINESS CONCEPTS TO STUDENTS IN COMPUTER SCIENCE AND INFORMATION TECHNOLOGY THROUGH A VIRTUAL BUSINESS INCUBATOR

Ioana Moisil

Abstract

The goal of this paper is to present a pilot study concerning a solution to efficiently introduce business concepts to students in computer science and information technology. The pilot study is carried out at the Faculty of Engineering, Lucian Blaga University of Sibiu. A virtual business incubator is used in order to attract students from the target group to apply directly what they have learned at the software engineering, management and marketing courses, on one side, and on the other, to learn to work in an interdisciplinary team. The pilot study is running and the first results are encouraging, but further evaluation is needed.

1. Introduction

Computer science and information technology are among the most favoured specialities chosen by young people. Every year more than 150 are enrolled at our university attracted by the glamour of computers. Their dream is to become good programmers and eventually to open their own software development company. For more than 40% this remains a wishful thinking. They graduate but have no idea, except maybe for web applications, what are the trends in software development, what kind of applications they will have to develop. Moreover, in spite of the mandatory courses in software engineering, management and marketing, many of them are not making in practice the connection between what they learn at these courses and the software development process.

Two years ago we have started a research in order to find solutions for the above mentioned problem. The research was based on two key ideas. First, to use a solution-oriented approach, applying the learning by doing paradigm, students involved in the project being lead to experience all phases of software development, from early analysis down to the actual implementation and in the same time to apply business concepts. Second, the students’ team had to be an interdisciplinary one; students from computer science and information technology working together with students in economy from the very early phases of requirements analysis, thus allowing for a deeper understanding of the environment where the software must operate.

1 Lucian Blaga University, Hermann Oberth Faculty of Engineering, Romania
Our steps were guided by friends from Netherlands, Daniella Gidaly and Liesbeth Ruoff-van Welzen from the Roumanesc company, experts, with great experience in entrepreneurship that came to our university and gave lectures, organized meetings between students and young entrepreneurs. After evaluating several scenarios we concluded that we must start with a virtual business incubator. The incubator must be developed by students, maintained by students and must address students. Once this decision was made, it was proposed by the author as a graduation topic the development of a virtual business incubator to serve the students at the faculty of engineering, mainly those that are enrolled in Computer Science and Information Technology. It had to offer free web hosting, free access to resources and business consulting to all students that are able to present a viable business plan in IT. Several students were interested by the topic but they cannot pass over the reticence to work with business concepts, to have to ask for consultancy in other fields as computer science. Eventually, after attending several meetings, one student, Otniel Prejban, took the challenge [1]. In the following some general ideas about business incubators will be presented, our IT Virtual Business Incubator and the pilot study organized around this one.

2. An overview of the business incubator concept

2.1 History and Definitions

Incubation first emerged in USA, the first known business incubator, the Batavia Industrial Center, being launched in Batavia, New York, in 1959. There were little developments until the 1980s when developed countries embraced the concept so that today the annual growth rate for new incubators is about 20 percent [4]. Year 1999 was the moment when Internet incubators enter the stage. Today it is estimated that there are more than 7,000 incubators all around the world and their number is growing fast.

According to the European Commission, a business incubator is a limited location where new born enterprises are hosted. The incubator aims to give small enterprises more chances of survival for a longer time, mainly by providing at very low cost physical or virtual spaces to run the new business. The idea of business incubators is strongly connected to local development, while technological aspects are not considered to be a priority.

In fact there is a large range of definitions of business incubation, depending on the context in which and for which the incubation is developed, and also depending on the vision of the definition’s authors. Several international forums for business incubation have proposed their own definition.

For example, the SPICE Group (http://spice-group.net) in its Incubation ABC is giving the following definition and characteristics (settled up in 2003 at the International Summit of Associations in Richmaond USA): A Business Incubation Program is an economic and social development process designed to advise potential start-up companies and, through a comprehensive business assistance program, help them establish and accelerate their growth and success. The main goal is to produce successful businesses that will leave the program, in a timely manner, financially viable and freestanding. These graduates create jobs, revitalize communities, commercialize new technologies and create wealth for local and national economies.

At the infoDevGlobal Business Incubation Forum in Delhi, October 2004, the Global Summit of Business Incubation Associations met and adopted a new flexible definition for business incubation recognizing a variety of different environments and processes:
• The *business incubation environment* is the wider context which should be conducive to the sustainable nurturing of growth potential and the development of enterprises.

• *Business incubation* is a public and/or private, entrepreneurial, economic and social development process designed to nurture business ideas and start-up companies and, through a comprehensive business support programme, help them establish and accelerate their growth and success.

• The *business incubator* is a physical space or facility that accommodates a business incubation process.

Another definition is the one of the UK Business Incubation organisation: "*Business incubation is a unique and highly flexible combination of business development processes, infrastructure and people designed to nurture new and small businesses by helping them to survive and grow through the difficult and vulnerable early stages of development.*" (© UK Business Incubation Limited 2008).

Reading carefully the above definitions we can see that they are very close to the EC definition.

The concept of business incubator is well developed in all EU countries and many of them have supporting structures (associations, forums, national authorities, etc.) [2].

In Germany the *ADT – Association of German Technology and Business Incubation Centres* (Arbeitsgemeinschaft Deutscher Technologie- und Gründerzentren) was founded twenty years ago, in 1988. There is an impressive number of Business and Technology Incubators, and Science and Technology Parks. A similar situation is in France, where we can find a great number of Business Incubators and Technology Parks. In Austria there are ten business incubators, many science and technology parks, technology incubators and support structures. Greece has five science and technology Parks, three Business Incubators and supporting structures. UK has a special authority on the development and support of incubation environments – the UK Business Incubation [5] that was founded in 1998. In CEE Countries the Business Incubators industry is present in all countries but, except Poland and Slovenia where it is not so widely deployed. In Romania for example, there are nine Business Incubators and four technology incubators.

2.2 Types of business incubators

The initial model of a business incubator has been adapted to answer a variety of needs, from fostering commercialization of university technologies to increasing employment in economically distressed communities and serving as an investment vehicle.

Besides the classification based on location, in physical or virtual (hosted on the web) spaces, there are two wide categories of business incubators: *technology incubators* that promote new technology and act as facilitators for technology transfer, and *mixed use*, that are addressing a great variety of clients. Many authors are making the difference from the start, naming *business incubators* only the mixed use ones. In each category the incubator can be specialized for a specific industry or field of activity. This is feasible when there are sufficient resources for answering the needs of small group of clients. Some domain experts consider that “aggregation and convergence of different types of business incubation along with related services may be more applicable” than specialization [3]. There are countries that have combined classical incubation with virtual services.

In the UK, they have developed a three-stage (foundation, development and mature incubation - cutting edge) model of development as part of the National Business Incubation Framework...
The most widely used instrument for improving performances of a business incubator is benchmarking, as it was defined by the European Commission [6]. Indicators and measures that described the best practices are proposed by several associations and probably in the next future a standard set will be considered.

The main key success factors for a business incubator were defined by the Global Summit of Business Incubation Associations at the infoDev Asia Regional Workshop 2006 (fig.1).

3. The IT Virtual Business Incubator

3.1 Overview

Our IT Virtual Business Incubator (IT-BI) has as main objective to support students in Computer Science and Information Technology to develop entrepreneurial spirit, to start their own business in the field of IT. Of course, the virtual BI aims to act as a magnet for new ideas that will enhance the quality of IT products developed by students. Last but not least, it was our intention to use the incubator as an educational tool for helping students from a technical speciality to develop business capabilities.

The incubator was developed as an open source product, using PHP and MySQL and also Adobe Photoshop CS3, CSS, HTML. The main services offered by the incubator are: flexibility in consultancy and advice; unlimited free access to consultancy; free web hosting for two years; access to the software tools needed to build a professional web site; audit; decision support; a forum for discussions with the domain experts;

The Home page of the virtual business incubator is presented below and figure 3 represents in general the map of the site.
3.2 How it works

In the department of Computer Science and Automatic Control of the Faculty of Engineering of our university we have organized a Working Group on Business Informatics. The main objective of this working group is to introduce to our students, in a friendly and efficient way, business informatics concepts. The group consists of students in computer science and information technology and monitors (teachers). Some of the students are also enrolled at the Faculty of Economic Sciences. All students are attending special courses on business informatics and have practical works to apply.
what they are learning. Practical works are supported by the virtual business incubator. A student can choose between several roles (fig. 4). She/he can play the role of an entrepreneur and start a business together with other students. For that she/he will have to apply to the services of the IT-BI. The students that choose to start a business must register and develop a business plan. For developing the business plan they obtain information from the courses, but also from the IT-BI. They can find there examples of business plans; they can ask for counselling and examine different financial and legal documents. The counselling is offered by teachers but also by students in economic sciences. There is a commission that will analyse the business plan and will decide if the business is selected or not. The most important selection criteria are:

1) Innovation
2) How well it answers to the IT-BI field of interest (i.e. information technology);
3) How well it answers to the market needs;
4) What are the chances of success; how sustainable is the business;
5) Socio-economic impact;
6) Number of working places generated

All communications are online, via e-mails and announcements posted on the forum. So the first thing students are learning is to check professional messages and to answer in time. If the business plan is accepted, the students will be announced and a monitor will be assigned to the team that want to start the business. The students will receive free hosting for the web site of the business, they will get support to develop the business web site and they will get access to free counselling. After answering different tests they will have to enrol for specific training programs. After a period of two months the students must be ready to start the business. The business can be a “real” one, or a simulation. Initially we wanted to accept only real businesses but most of the students did not want to take the risk in the context of the financial and economic crisis, so we accepted as an exercise a simulation of a business.
Another role for a student is to be a member of the consultancy team on IT services management or to be a member of IT developers. This team is trained to use the Community Edition of ADOit – a toolkit developed by BOC GmbH. This is the most appealing role for our students. Learning to work with ADOit has the advantage of helping students in understanding software design aspects and this is important as every student of our department has to pass an exam on software engineering. Students interested in business can be trained to offer advice to their colleagues in this direction. Also some students will have to study Romanian legislation and regulations. The different consultants can be contacted via Yahoo Messenger, Webmessenger, Skype or e-mail.

The entire working group is meeting once a week face-to-face and the members have almost daily online discussions. There is a fix program for online consultancy. During the exam session the activity of the working group is suspended.

4. Conclusions

For the time being two conclusion are emerging. First, the virtual business incubator seems to be a good learning environment, acting as a catalizer. Maybe it is maybe too early for a sound verdict, but the first results are encouraging. Secondly, students are learning to work in an interdisciplinary team, to communicate and to share knowledge, and also they are acquiring a certain sense of responsibility. So, from the pedagogical point of view the virtual business incubator is quite valuable. But the socio-economic value of the virtual business incubator will be proved only if a certain percentage of the students involved in the pilot study will succeed in proposing, launching and maintaining a small business in the field of IT.

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AUTOMATION OF ENTERPRISES:
UKRAINIAN EXPERIENCE

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Abstract
The article considers the problems of implementation of automated informational systems at 
Ukrainian enterprises based on one of national AIS KASKAD and depicts the problems of teaching 
Business Information Science Master Studies (Joint Master Degrees).

1. The Peculiarities of Automation of Ukrainian Enterprises

Transformational conversion of Ukrainian enterprises caused by the market economy reforms and 
globalization processes is of paramount importance due to the joining of Ukraine in the World 
Trade Organization (WTO). A great number of Ukrainian enterprises are owned by transnational 
companies or have drawn actively foreign capital investments. It stipulates a certain change in 
enterprise management approaches which are alike those of Western managers'. It concerns, largely, 
the implementation and use of modern information systems and technologies.

The answer regarding expediency or non-expediency of enterprise automation has been known for a 
long time. However, the problems of choosing the kind of informational system, the way of its 
designing, programming and implementation, the degree of automation of economical processes 
and information system integration are still open for discussion.

Actually, all national enterprises have started automation with the implementation of accounting 
informational systems, using typical, so-called "box" solutions which were very useful at the initial 
stage, partially meeting the demands of management. Thus, the computerization of financial 
accounting has been successfully completed including the automated formation of bookkeeping and 
calculation of taxes. More perspective seems to be with managerial accounting which under the 
conditions of automated informational systems is based on practically unlimited analysis and the

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possibility of operative formation of accounting which, in its turn, is calculated on the basis of absolute and reliable bookkeeping information.

But the problems of automation of supplies, manufacture, distribution, logistics, personnel management which are basically the problems constituting the core of enterprise activities and profit are still remaining open. Sometimes certain spheres are automated. Such an approach allows some advantages for a certain employee which enable to reduce the number of mechanical errors, the number of routine operations and to accelerate their performance. If possible, the attempts are made to export/import the data among different informational systems which are to automate different tasks by different technologies. For example, there is often the case when the department of planning and financing imports bookkeeping of accounting systems in a tabular redactor Microsoft Excel and employs its standard potentialities, conducts a certain analysis and calculates the massif of these or those indices. The use of the local approach to the automation problem does not permit to consider comprehensively all the processes that take place at an enterprise and to analyse them from the point of view of systemic analysis.

The idea of applying computer technology for complex planning of enterprise activities, including manufacturing processes, goes back as far as the beginning of the 60s of the past century. For this purpose the concept MRP (Material Resource Planning) was elaborated. It was used in the so-called MRP-systems the main task of which is providing the necessary quantity of materials at the warehouses due to the production plans. Later the principle of the closed production cycle was realized in MRP-systems.

Since the MRP conception did not take into account the loading of production forces, the cost of workpower, the MRP II (Manufactory Resource Planning) standard was elaborated in the 80s which ensured the planning of production resources: sale and production, demand in material needs exercised the control at the level of a shop and so on.

In the 90s of the previous century a new ERP standard was suggested which meant the unity of MRP system with the module of financial planning. Thus, all business information is within a uniform system and there is no need to transfer the data from the production system to the financial one. ERP systems ensure the access of authorized managers to the information of the company activities. It enables them to exercise an operative analysis of the situation and manage the enterprise activities more effectively.

Classical ERP systems ensure the realization of a dozen of managerial tasks:

- finance management;
- planning and production management;
- formation and distribution of stock management;
- realization management and marketing;
- supplies management;
- project management;
- service management;
- production quality management.

ERP systems are implemented with the purpose of uniting all the sectors of the company and all necessary functions in one management system which is to meet the requirements of all these sectors. The development of such a system is not an easy task. ERP possesses the uniform data
base of all sectors and tasks which means that the access to the information is much simpler, the
basic advantage being the mutual information exchange among the sectors.

The implementation of the management system in many cases enables not so much to increase the
profitability as to decrease the expenses. The managers who take the decisions have
comprehensive information, may interpret it correctly and undertake the right actions. The financial
profit lies very often in the fact that the authorized persons can manage more effectively the
production stock, decrease its quantity to meet the demands and, thus, release the circulating assets.
The automation saves time for the decision-making employees for analytical work as many time-
consuming routine processes are cut down. Besides, the enterprise with the automated management
system meeting the requirements of the Western standards, has good chances for Western
investments.

For Ukraine nowadays, the tasks of the economic growth, increasing of production quality and
competitiveness, becoming a member of the world market are most topical. The solution of these
tasks without the increase of the quality management and automation of all spheres of economy
(state bodies of management, different enterprises and small businesses) is impossible.

The major problem is non-stability of running business in Ukraine which often results in the
absence of real long term strategic plans of enterprise development. This is a real problem for the
use of informational technologies. The fact is that while informational technology is in use only to
solve local tasks and improve some business processes, it does not require the strategic approaches
and fits completely the common pattern of national enterprise management when its activities are
planned maximum for a year period. When an enterprise wants to implement the ERP system in full
scale and not for solving local tasks, some problems may arise. And the implementation of such a
system is a constituent of the business development strategy. If this factor is not taken into
consideration by the company the negative consequences are evident. The only way out of this is, to
agree the strategic goal of the company with the purposes of implementation of the informational
system. In any other case the purposes ERP system implementation will have a declarative
character, thus the project is doomed to be a failure.

The high cost of ERP system implementation is the major barrier for small and middle enterprises
in Ukraine. The informational systems are often oriented on one or several branches of production:
serial assembling (electronics, engineering), small serial and research production (aviation, heavy
engineering), continuous (metallurgy, chemistry, oil and gas production). Such specialization is
reflected both in the set of the system functions and in the existence of business models of a given
type of production. The availability of the built-in models for certain types of production differs the
production system from one another, each system having profoundly elaborated trends and
functions. So it is very important not to make a mistake while choosing a specialization of the
informational system.

In accordance with the world practice when more subtle analysis of several or kin classes of systems is
necessary more attention is paid to the stage of choice. Each project in automation sphere which is to be
considered by an enterprise as a strategic investment of means must be paid back at the expense of
improvement of management processes, increase of production effectiveness, cutback of costs. The right
choice is of paramount importance first and foremost for top managers of the enterprise. Such a project
goes hand in hand with the acquisition, for example, of a new production line or construction of a new
shop. The enterprise, first of all, should estimate what to expect of such a system, what functional branch
and which types of production it should embrace, what technical platform it should use and what sort of accounting it should do.

Thus we can make the following conclusions:

1. For small enterprises, trading companies and firms which render the services of the price/quality ratio the financial and management systems would be most helpful as their major task is bookkeeping accounting, stock production management, personnel management. The financial and management systems may be also used at small production enterprises where the production process is simple.

2. For small and middle production enterprises with a small number of judicial persons and mutual ties, most effective seem to be middle integrated systems or simple configuration of integrated systems. For these enterprises the basic criterion is production management though accounting tasks still remain important.

3. For big holding structures, financial and industrial groups governing the companies for whom of primary importance is the management of complicated financial flows, transfer prices, information consolidation and so on, in many cases the big integrated systems would be the most effective. These systems enabling the solution of production management problems may meet the complex of requirements of a big corporation.

While choosing this or that system it is necessary to take into consideration that automation for automation’s sake has no sense. The main purpose should be the quality of management. Any of the system is only a mechanism of improving the effectiveness of management, making the right strategic and tactical decisions on the basis of opportune and reliable information which is retrieved to the company authorities by the informational system.

2. Automation of the Ukrainian enterprises with AIS KASKAD

Due to high cost of ERP systems Ukrainian enterprises use similar systems. The AIS KASKAD is the one, for automation of big and middle enterprises to increase the effectiveness of their work.

The following basic principles underlie the AIS KASKAD system:

- the use of means of effective processing and data protection;
- module principle of making the program complex to achieve the staging of implementation;
- decision scaling for further system development due to the increasing demands of the enterprise;
- flexible system of the data organization in combination with the own development system and business logic programming;
- possibility of integration with the systems and improvements of other manufacturers.

AIS KASKAD is realized on the basis of modern technologies with the use of RAD, WEB, OLAP, principles of ERP and CRM. The functional completeness of the system, flexibility of setting and adaptation permit to obtain a peculiar solution for each enterprise taking fully into account its peculiarities of organization and functioning. The core of AIS KASKAD is a centralized data base based on SUBD ORACLE which is built on a customer-service architecture with the usage of modern technologies of information processing and preparation of electronic documents. AIS KASKAD employs its own object model of storing data (IntelligentCore), which has a built-in system of fast making of business attachments (RAD), modern programming languages being in use (C, Java, Pascal + PL/SQL) as well as API KASKAD. The data base and the system of program modules which ensure the access to the data for the user together with the program interface constitute the core of AIS KASKAD. All the applied systems are on the basis of the core that ensures the information completeness and protection.
The application and implementation of the automated system of enterprise management is connected initially with large capital investments and constant expenses to maintain it. To radically decrease the expenses and get the maximum effect from its implementation it is necessary that project decisions are dictated not by technologies fashion or momentary understanding but by a real assessment of the requirements of the system and the cost of their implementation. Practically the same functions can be realized differently, the cost of their variants being different in ten times. Our goal is to ensure the minimal cost of the effective system of its class in the sphere of informational technology. All technical decisions are aimed at this goal.

As a result we have got the system in having some key advantages.

Fast adaptation of the system to the needs of the client: due to the own developed technologies “ObjectCore™” and “Kaskad API” we managed to remove the basic contradiction of modern automation systems: on the one hand, the usage of object-oriented approach while compiling the program, on the other hand, the usage of the relational data bases for information storage these programs work with. The AIS KASKAD™ system completely uses object approach both in the programs and the data these programs operate with. In other words “ObjectCore™” technology gives a possibility for the developers and the users to deal with completely objective data including the hierarchical data structures, imitation, etc. Such an approach enables the developers and the users to speed up two, three times the speed of the development of a new functional system and ten times more the speed of the modification of the system functionality (for example the change of the hierarchy of object structures with the preservation of their data and so on) in comparison with standard methods of development.

The simple and understandable interface ensures quick learning of the users. At the first stage it is not necessary for the user to possess the knowledge and skills in modern basic software to work with the system. In some days of work the user can easily cope with the system in his/her area. In some cases a complete simulation of an interface is done for a specific work place. These technologies enable a considerable acceleration of the system implementation, fast change and addition of other automated sectors for the user.

Reliability: Most enterprises are on 24 hours or two-three shift schedule of work which requires a reliable work of the system. The AIS «KASKAD™» is built with these requirements being taken into account, on the basis of the reliable centralized server architecture based on the industrial SUBD ORACLE 9i. To increase reliability, the system also maintains the automatic connection with the backup server. Besides, SUBD ORACLE permits to perform a complete backup copying and other administrative procedures without stopping the work of the server. This stop is not necessary while making changes in business processes, all the operations are performed in a centralized way, updating results are available for all the users. Promptly the structures of the documents may be modified, the modules, algorithms and information presentation can be changed. The usage of low-level protocols of the data exchange practically makes it impossible to cause system errors by incorrect functioning of software functioning in the network, which is always a problem in faultless system functioning. The reliability of the system is proved by the fact that there are no network and base administrators at some enterprises after the system has been installed.

Scaling: As a rule, at the majority of enterprises after the first stage of implementation of the system the number of working places is still growing. It is stipulated by the fact that the authorities of the enterprises having got a positive result from the implementation of the system continue to automate other sectors of the enterprise thus creating additional working places. Besides, as practice proves, the enterprises which implement informational systems of management belong, as a rule, to the
successful businesses which develop rapidly and can essentially expand the scope of operations, personnel and sphere of activity. Under such conditions one of the most important properties of the system is the possibility to enlarge the number of working places. The AIS «KASKAD™» system is easily scaled because it is a platform independent system, i.e. it works under the guidance of any modern operational system be it UNIX, WINDOWS, SOLARIS, employs one of the most productive industrial server of the data base - ORACLE 9i and is built with the usage of modern technologies.

Preservation of confidentiality: It is an important property of the system where the information of the enterprise is stored, which many users work with. The conception of distributing of powers of the users and roles underlie the basis of the AIS «KASKAD™»system. The system regulates the access to all the information and functionality. To be precise, the system enables also the possibility of blocking/unblocking of objects, besides the standard rights which give the complete control of the sector under activity. For example, after the document printing it is automatically blocked by changes, or the user has the access to the document instead of its deleting. The system also has a complete audit as by the system on the whole so by the users.

The possibility of the expansion of functionality is an imperative property of the system which is aimed at the effective durable usage. The AIS «KASKAD™» system is built on the basis of open standards, all business logic is provided by the complete output code. The employment of such high level programming languages as PL/SQL, Visual Basic for Applications, JavaScript, Kaskad, FastScript permits easy, quick, in short, and reliable realization of all the necessary functionalities of the system. With the help of the program utilities there is a possibility of automatically transfer of the functionality and the usage of its potentialities in the system compiled by other manufacturers. At the same time in contrast to other systems due to the available applied program interface access to the core (Kaskad API), the uniform data structure for all the clients is preserved which enables to update regularly and that constantly improves the functionality of the system. Due to the technique of updating the life cycle of the system is increased. One more advantage of the independent expansion of the system is the possibility of not giving the information to the outsiders, i.e. preserving confidential information.

The work with large size data bases: It is the requirement resulting from the aforementioned advantages. The ideal situation for this is when all the stored information is accessible with minimal expenses in a uniform data massif. It allows analyzing the information in a static diapason of the time period. The data development is of extreme use under the stabilizing of Ukraine’s economy. The AIS «KASKAD™» system incorporates the specialized software (OLAP), which enables the analysts and the leaders to analyze big amount of the data by means of the fast interaction, their presentation and different levels of their peculiarity.

The low cost of its acquisition: It is one of the most important properties of the AIS «KASKAD™», system which is connected with a program and technical architecture and the chosen platform. The total cost of the acquisition of the system is formed from buying expenses, implementation and application of software, equipment and the system of the data transfer. The decrease of the system acquisition cost is made of buying, implementation and exploitation of the software, equipment and the data system transfer. The decreasing of the cost of the AIS “KASKAD” system is made out of the following:
• the rate of adaptation and the formation of new functionality – the creation of new and modification of the existing functionality occurs much quicker that allows to diminish the expenses, while exploiting the system due to the new conditions legislature changes, switching the new functionality associated with the automated sectors earlier;
• The centralized system: When the changes have taken place, no expenses are needed to distribute the updating for new work places;
• The decrease of costs for teaching of beginners and their prompt switching into the work;
• The reliability of the performance excludes stoppages, the reason of the system’s failure and the expenses as a result of this;
• The scaling permits to enlarge the number of the users and the equipment productivity easily and practically as it is required instead of large scale investments;
• The openness of the system to be improved gives the enterprise which has its own specialists an opportunity to use its own resources, decreasing the expenses of the outside developers;
• Maintenance of the performance with big data base and the built-in means of (OLAP) technologies. It saves time when accessing to any information, including the expenses associated with it particularly when it is an urgent information.

1) The object model of the data preservation on the basis of IntelligentCore gives the possibility to the developers and the users to deal with the object data using the hierarchical structures and imitation.
2) The usage of the hierarchical model of the data presentation
3) The possibility of arbitrary expansion of the data structures in the process of implementation and exploitation of the system.
4) The built-in system of the development with wide possibilities of programming permits in accordance with the needs to manipulate the data structures on the spot as well as their processing (business logic). The AIS KASKAD system employs in full degree the object approach both in subprograms and in the data these programs operate with;
5) The built-in system of the accounting formation which is successfully implemented at many enterprises. The AIS KASKAD system gives a possibility to automate complex business processes quickly and qualitatively.

3. The Problems of Teaching Business Information Science: Master Studies (Joint Master Degrees)

The world nowadays has become extremely dynamic and full in information. The reliable and opportune information has become a powerful factor of the world progress in all spheres of human activity, including economics, business, politics, science, etc. However, the possibility to collect, process, keep and transfer the information to the consumers like economists, scientists, people who make decisions, may be secured only by informational technologies, the development that is based on the combination of the technological potentialities and high-level experts.

The optimal information management as a production resource is impossible without the usage of modern computer systems and technologies. Proceeding from this, the curricula of all economic trends of training include the computer-oriented subject cycle.

The implementation of informational subjects offer many advantages to economists in their educational process such as:
- Practical skills of exploitation, administration and programming of modern informational systems;
- Improvement and development of powerful analytical skills and systemic thinking;
- Compliance and readiness of graduates for the national and overseas market workplace;
- Compliance with Western standards in the sphere of informational systems;
- Rapid development of Informational Technologies in Ukraine;
- Use of modern management methodology of Business Processes.

We must admit that implementation and use of Informational Technologies in higher education is linked with some risks and shortcomings, namely:

- High cost and inaccessibility of the licensed software;
- Necessity of certification and refreshing of the teachers;
- High apparatus requirements for modern ERP-systems;
- Quick tempo of development and updating of software.

Thus, the experience of teaching the informational systems and technologies in the educational process emphasizes the necessity of constant implementation and expansion of software in economics and business. The cooperation between higher education establishments and developers of the appropriate software to conclude agreements on rendering new informational systems and methodological which lies on a non-commercial basis is very important.

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SCALING MANAGEMENT OF IT PROJECTS DEPENDING ON THEIR SIZE AND COMPLEXITY

Jan Werewka

Abstract

In the work scaling management of IT processes from the enterprise perspective is considered. Project management must fit and be synchronized with IT governance and different software production activities. It is assumed that the projects executed by the organization can be of different size and complexity. This situation causes that project management is performed in some heterogeneous environment.

It is assumed that scaling is based on lean manufacturing principles. These projects are divided into four categories: small, medium, large, and extra large projects. The project management is based on PMBOK which builds a framework, but the software development can base on traditional (disciplined) or agile methods. There are presented solution proposals for IT projects.

1. Governance structure in a project based organization

In a project-based company a well defined and established governance should be an important concern for business organization. Generally, the corporate governance is the system by which companies are directed and controlled. The main parts of the organizational governance are management by operations and management by projects. Activities in both parts depend on strategic planning. Corporate governance is supported by IT governance, which deals in first instance with the connection of business focus and IT management of an organization. Simplifying, the IT governance can be treated as management system used by senior level managers and directors. The companies with well performed IT governance had 20% higher profits compared to companies with poor governance for the same strategic objectives. For IT governance different solutions are proposed. An example is given in [P1], in which a framework is described, enabling tailoring the approach to different environment, strategies, priorities, capabilities and available resources.

One of the best known frameworks of governance for project based organizations is developed by Project Management Institute (PMI) and consists of project [1], program [16] and portfolio [15] management. Among them the project management framework described as PMBOK (Project Management Body of Knowledge) is very popular and its growing popularity is measured by a number of PMP (Project Management Professionals) around the world. The governance structure of the organization based on vision, mission and organizational strategy and objectives is presented in fig. 2.

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The project focused companies recognize the need to align to strategy and use both portfolio and program management. Examples of introducing these solutions are presented in [2, 5]. Of course not only large companies are interested in such development but also other, smaller companies. The need of using different software development and management methods may cause some problems while applying portfolio and program management.

![Figure 1: Organizational governance elements](image)

The processes involved in projects can run according to different software development methodologies:

- Systematic software production like CMMI, RUP, …
- Agile software development like SCRUM, XP, DSDM, LEAN, …

For companies which have successfully applied agile methods on project level, it may be difficult to integrate IT company governance with the agile project management. In that case some rework on a different organization management level is needed.

![Figure 2: Governance structure of an organization](image)

The goal of the paper is to define a general frame of project management scaled appropriately for different projects. It is assumed that some elements of governance and IT governance exist in the
company. In the paper it is assumed that the projects are run following a solution similar to PMI proposals for portfolio, program and project management.

Furthermore, it is assumed that the IT project management and environment undergo the following assumptions:

- The IT company is a project based company. It means that the main business goal of the company is to run projects.
- The IT company works in multiproject environment. At one time there are many projects running.
- The IT company is of small or medium size.
- At a lower level different projects may be managed differently, using various management styles and development technologies.
- The project can be performed by virtual teams (teams dispersed in place and time).

The agile methods of software management and development like SCRUM, DSDM, XP and FDD are growing in popularity. IT companies have reported increased productivity and business satisfaction, using the methods which are focused on value. The popularity of the traditional plan based management methods is also increasing. Some IT projects for different reasons must be plan oriented. Therefore, an additional assumption is made that the organization should perform projects more plan- or value-oriented.

2. Project management using a plan parallel to value-driven methods

The traditional management methods are plan oriented. It means that for the project deliverables (products) some requirements (features) are defined, and the project costs and schedule are estimated in order to obtain a product with the given requirements (Fig. 3). Conversely, in agile methods, which are value-based, the cost and time frames are given in advance. After the time frame has expired, the obtained deliverables should have features that give the largest business value. It means that value or vision creates estimates for the features (Fig. 3).

In [4] there are some reasons given why it is difficult to use plan-based (traditional) methods in software development projects:

- software is intangible and difficult to explain well
- rarely the same software system is built twice (analogy to an existing system does not exist)
- executing a software project is a complex and risky activity (changing technology)
- extreme modifiability coupled with problems with defining requirements accurately.

A simple comparison of PMBOK plan based project management and general agile project management methods are presented in Fig. 4. At first glance both methods look similar. Both methods have similar activities at the project start: initiating processes in PMBOK and envision on
agile part. The same case is with project closing. The other processes seem to be a direct mapping; planning – speculating, executing - exploring, controlling – adapting. The agile methods are using different project planning, executing and controlling.

In the PMBOK planning plays a central role, the task to be executed passes from the plan to the execution processes (management-as-planning). The control of project execution is based on “thermostat model” in which project progress is checked against project plan. In case of discrepancies the corrective actions are planned and executed.

In the agile methods there are used prioritized-feature lists, which encourage changes against an existing software prototype. Project manager maximizes this value of delivery by selecting features for the current iteration and removing obstacles from the development team. Such way of proceeding enables early requirement validation.

![Figure 4: Comparison of main PMBOK and agile project management processes](image)

The intention of the simplified comparisons was to show essential differences between plan and value driven methods. Also the role of a project manager differs significantly [Q2] in both methods.

3. **General principles of scaling**

The main principle of scaling is to minimize the activities in project management performing. Almost all activities concerning project management may be scaled or can be withdrawn. The problem was which principles should be used for scaling. The base principle chosen here is to eliminate waste, which is based on the ideas of Taiichi Ohno, the originator of the Toyota Production System known as Lean Manufacturing.

Mary and Tom Poppendieck [7, 8] adapted principles and practices of Lean Manufacturing to Lean Software Development (LSD). The 7 lean software development process principles supported by 22 tools are presented in Table 1. Eliminating wastes is a fundamental lean principle from which all other principles have originated. Waste is anything that is of no value for the customer. In lean manufacturing and in LSD there are seven types of waste defined, shortly described in Tab. 2. The content of the tables was prepared basing on papers and presentations [6, 14].
<table>
<thead>
<tr>
<th>LSD Principle</th>
<th>Description</th>
<th>Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Eliminate waste</td>
<td>Activity that doesn’t pay for itself should be removed; Learning to see waste, uncover the biggest sources of waste and eliminate them</td>
<td>Eliminate waste by 1. seeing waste 2. value stream mapping</td>
</tr>
<tr>
<td>2. Amplify Learning</td>
<td>Increase feedback, learn new methods to produce robust system.</td>
<td>Amplify learning with 3. feedback 4. iteration 5. synchronization 6. set-based development</td>
</tr>
<tr>
<td>3. Decide as late as possible</td>
<td>Learn as much as possible before making irreversible decision; Options thinking, last responsible moment, make fact-based decision.</td>
<td>Decide as late as possible with 7. option thinking 8. last responsible moment 9. making decision</td>
</tr>
<tr>
<td>4. Deliver as fast as possible</td>
<td>Deliver quickly, it reduces the chance of requirement changing.</td>
<td>Deliver as fast as possible with 10. pull system 11. queuing theory 12. cost of delay</td>
</tr>
<tr>
<td>5. Empower the team</td>
<td>Respect people. Engaged people provide the best advantage. Let the people who add the value use their full potential</td>
<td>Empower the team by/with 13. self-determination 14. motivation 15. leadership 16. expertise</td>
</tr>
<tr>
<td>6. Build integrity in</td>
<td>Build quality in. Perceived integrity product achieves a balance of function, reliability and economy that delights the customer. Conceptual integrity is concerns how well the product is designed and developed.</td>
<td>Build integrity by/with 17. perceived integrity 18. conceptual integrity 19. refactoring 20. testing</td>
</tr>
<tr>
<td>7. See the whole</td>
<td>See the system as a whole. Balance technology and opportunity. Beware of the temptation to optimize parts at the expense of the whole.</td>
<td>See the whole by 21. measurements 22. contracts</td>
</tr>
</tbody>
</table>

Table 1: Lean Software Development Principles and tools

Wastes in manufacturing | Wastes in software development
--- | ---
1.Excess inventory | Partially completed work, which may be never used, excessive documentation. It is not clear if executed source code (partially completed) runs according requirements. Don’t accumulate code. |
2.Extra processing steps | Code directly from user statements, get clarification directly from client |
3.Overproduction | Extra features, unnecessary code and functionality (gold plating). Extra features increase complexity and possibility of failure. |
4.Unnecessary transportation | Task switching, assigning people to multiple projects are a source of waste. |
5.Waiting (for other parts to be produced) | Waiting for decision, delay in review, testing, deployment. Slow internal communication. Reduce decision-making time, communicate face-to-face for immediate understanding. |
6.Motion (unnecessary movement) | Finding information. Great amounts of knowledge remain with the creator and never passed. |
7.Defects (lower quality) | Bugs not caught by tests. Release nothing before it was thoroughly tested. |

Table 2: Description of wastes in lean manufacturing and in lean software development

Concluding, lean software development is based on well trained team members, reduced management overhead. Therefore, project management scaling from lean principles and tools seems an appropriate decision.
4. Scaling factors

Different project activities concerning project management may be scaled. Scaling possibilities depend on: project strategies, product type delivered by the project, project size, project complexity. Project strategies for product development can and should influence the project activities. The following project strategies are defined for product based projects [11]:

- **Product Advantage (Superiority)** – team puts emphasis on the superior product characteristics. The developed product should not only meet, but also exceed the expectations of the customer. The team focuses on research and development. Additional time is needed to obtain desired features and functionalities. The product quality and performance should be reviewed often.

- **Time advantage (Product time to-market)** - First product on the market. The project is managed on project schedule. The team efforts are going to finish the project within a given delivery time. Short overlapping phases should be planned.

- **Customer focus (intimacy)** – addressing a specific customer’s need. Team maintains a close relationship with the customer, which has major influence on company’s financial benefits. The customer needs should be often reviewed.

- **Product cost advantage** – Lowest cost product. Creating “more for less”. Team develops products which are cost competitive. The team has to develop low-cost product that can generate revenue in a competitive environment. The product cost should be frequently reviewed.

The product is here the main deliverable of the project passed to the customer, as a result of the project. Its type depends on IT company activities, e.g. software development – software, consulting – consulted company or people in the company. The project management activities depend heavily on the produced deliverables.

The project size is mostly described by parameters:

- Total financial resources available
- Number of team members involved
- Number and size of deliverables to be produced
- Complexity of deliverables to be produced
- Timeframes of the delivery

The project complexity can originate from two basic categories: technical complexity and management complexity. Technical complexity consists of:

- **Low Technical Complexity**: Simple process automation tasks, or single thread; Interactive performance limited to a single platform; Based on many similar systems; may include re-engineering of legacy application.

- **High Technical complexity**: Embedded, real time, distributed, and/or fault-tolerant systems; High performance and/or portable systems; Redefine architecture of legacy system; New or novel systems.

Management complexity consists of:

- **Low management complexity**: Small scale; Informal processes; Few stakeholders; Focus on product development.

- **High management complexity**: Large scale project; Need for contractual compliance; Many stakeholders; Focus on project instead of products.

The project activities depend on many factors, but project size and project complexity seem to be basic parameters used in project scaling. Other factors will influence both mentioned parameters.
5. Scaling proposals

It is proposed here that the scaling project management processes will be made on staged basis. For the following types of projects separate processes can be scaled (Fig.5): small projects, medium projects, large projects, extra large projects.

There are some reasons for choosing that type of scaling:
- It is easier to prepare templates, procedures and other documents for a few project categories.
- Company senior management needs the same or similar view of the projects.
- On different levels of management a comparison of projects should be made. It is easier to obtain for a few project categories.

![Figure 5: Project categories](image)

For IT projects concerned with software development, the project size can be derived from numbers of source lines of code (SLOC) or function points. Depending on the number of these parameters the project size categories are defined in [13]. In the tab. 3 some selected data are presented.

<table>
<thead>
<tr>
<th>Project size</th>
<th>Function Point Size</th>
<th>SLOC (C++, Java)</th>
<th>Costs, New development, GBP</th>
<th>FTE days</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>≤100</td>
<td>≤5000</td>
<td>≤70,000</td>
<td>≤234</td>
<td>70%</td>
</tr>
<tr>
<td>Medium</td>
<td>≤1000</td>
<td>≤50,000</td>
<td>≤700,000</td>
<td>≤2,344</td>
<td></td>
</tr>
<tr>
<td>Large</td>
<td>≤3000</td>
<td>≤150,000</td>
<td>≤2,000,000</td>
<td>≤7,031</td>
<td>19%</td>
</tr>
<tr>
<td>Extra-Large</td>
<td>3000&gt;</td>
<td>150,000&gt;</td>
<td>2,000,000&gt;</td>
<td>7,031&gt;</td>
<td>11%</td>
</tr>
</tbody>
</table>

From the number of function points some other parameters may be derived:
- SLOC (source lines of code), based on relative size scale which is 53 SLOC/FP for popular languages like C++, Java.
- Cost figures quoted in a currency (here in GBP valued on 1st January 2004[13]).
- FTE (Full Time Equivalent) which is the effort of one staff member working full time.

The project categorization may be based to some extent on the following simple parameters:
- Project duration. IT project duration cannot be long, 6 months, 1 year, 2 years. Due to technology change.
• Team size: There is a simple rule; for every five people a new level of organization structure is needed. In that case team sizes of 5, 25, 125, 626 tend to need an additional management level.
• Costs: Project costs.

An interesting question is when some work should be defined as a task (simple project) and when as a small project. In [9] project management for small projects is described basing on PMBOK framework. In this work the small project features are (here in short form):
  ▪ Short duration, typical lasting less than 6 months, part-time effort hours.
  ▪ Usually a team of 10 or less members
  ▪ Involves a small numbers of skill areas
  ▪ Has single objective and solution which can be readily achieved
  ▪ Project manager is the primary source of leadership
  ▪ Produces straightforward deliverables
  ▪ Cost is below $75,000 and the fundings are available.

The usage of project management on small projects has a value, because small projects are often challenged by the following factors:
  ▪ Planning gives the project well defined project scope, and project creep may become a scope creep. Small projects have usually short duration and are considered as easy to deliver, and the team immediately begins working on producing the deliverables.
  ▪ Low project priority at the organization. It is difficult to involve the people and show the importance and urgency of the project. The risk of distraction by other project is high, then we loose the focus on the project and returning back again takes time to get on track.
  ▪ Inexperienced project team. It is very often difficult to get key team resources for small projects.
  ▪ Processes and tools. Trying to use processes and tools designated for large projects will not work; it is time-consuming and frustrating.

The parameters as project duration, team size and project cost are starting points for project categories definition. But practical division into project categories should depend on the essential differences in project management activities.

6. Scaling areas

Different activities concerning project management may be scaled. In the course of the work, only activities connected directly to project management are considered. At the first stage, the following components are considered for scaling: project management, project and IT company organization, project management environment (assets), tools and techniques.

The frame of project management chosen here will be based on scalable processes and simplified tools based on PMBOK framework. A proposal of PMBOK – based project management scaling is presented in [3] and bases on the following project categories:

• Minor investment, informal schedule goals, low organizational priority and visibility.
• Moderate investment, definite schedule target, some organizational priority and visibility.
• Significant investment, important schedule goals, medium organizational priority and visibility.
• Major investment, critical schedule goals, substantial organizational priority and visibility, significant technical and cost risks.

All groups of processes known in PMBOK as Project Management Knowledge areas can be scaled: Integration Management, Scope Management, Time Management, Cost Management, Quality Management, Human Resource Management, Communications Management, Risk Management, Procurement Management.
When selecting among PMBOK processes which play the most important role in synchronization of project governance and management processes, there is a project integration group of processes, which includes the following processes [1]:

- **Develop Project Charter.** Project charter formally authorizes a project or a project phase. The project charter in the simplest form can be a one-page project agreement document between project sponsors, which contains information on project scope, commitments, constraints and resources.
- **Develop Preliminary Project Scope Statement.** Preliminary project scope statement can be omitted for small projects.
- **Develop Project Management Plan.** The plan for a small project can describe basic phases, milestones, project deliverables.
- **Direct and Manage Project Execution.** The process depends on the chosen methodology.
- **Monitor and Control Project Work.** The monitoring can be performed differently depending on the chosen methodology, but the project state should be reported weekly or at least monthly for the goal of project governance.
- **Integrated Change Control.** The project depends on the chosen methodology, but for small projects at least major changes should be reviewed and approved by senior management.
- **Close Project.** Formally closes the project or a project phase.

In the PMBOK standard it is stated that the project manager, in collaboration with the project team, is always responsible for determining what processes are appropriate, and what is the appropriate degree of rigor for each process of a given project.

Project organization scaling is related to project organization structure, and responsibilities are assigned to project managers and other team members.

Organization performing projects have procedures, guidelines, templates which are standardized and help in project performing known as organizational process assets. Generally there are two categories of assets:

- Organization’s processes and procedures for conducting work.
- Organizational corporate knowledge base for storing and retrieving information:

The organization should have assets that can be configured to different project categories or assets tailored to the used project categories.

Tools and techniques for running each process are proposed in PMBOK. For example, according to PMBOK, the following tools and techniques may be used for developing a project charter:

- Project selection methods
- Project Management Methodology
- Project Management Information System
- Expert Judgment

One of the mentioned tools – the Project Management Information System is a software tool. Generally it is difficult to scale software tools. The scaling may be based on a tool selection method.

7. **Conclusions**

The paper presented the importance of scaling in project management and their environment. The improvement of project management processes in a heterogeneous environment is not an easy task. Low level tactics is to find and remove obstacles in software production. But at some level of process improvement, the lack of some synchronization activities on different management level
begins to be the main obstacle. Vision of management structure, which was partially realised in an IT company, was described as well.

The presented vision integrates portfolio and program management on one side to project management on the other, while performing scaling appropriate to project size and complexity, enabling the usage of different software production methods. For the proposed solutions an integrated information management system was constructed. It integrates project and enterprise project management.

8. References


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