University doctoral (PhD) dissertation abstract

OPPORTUNITIES TO DEVELOP DIGITAL BUSINESS NETWORKS FOR SMALL AND MEDIUM SIZED ENTERPRISES

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1. AIMS OF THE RESEARCH

The ICT technologies are present in every area of life its role is indisputable, that is why they have become important production resource for the enterprises. In this aspect, the situation of the SMEs (small- and medium sized enterprises) is difficult, as the utilisation of these technologies does not reach the desired level neither in Hungary, nor in the European Union. The SMEs have a difficult time adjusting to the integrated corporate information systems developed for the use large enterprises. Moreover, the systems developed for the SMEs market (especially systems produced by developers) do not make possible the accomplishment of inexpensive and flexible inter operational business relationships between the small enterprises. As SMEs are decisive factors for the economy of every country, many enterprises spotted the potential market in this segment. Unfortunately, these systems cover primarily the internal processes within the enterprise, so they do not provide enough support for the relationships and processes between the enterprises. As a result, the EU affirmed that new technologies need to be developed and implemented that can successfully used by the SMEs in their daily electronic business activities. In order to carry out a successful research on this topic, I wish to study the „Open Source" ICT solutions and tools that can be applied by the SMEs. Furthermore, based on the researched technologies and systems, I would like to assess the electronic business activities of the Northern Great Plain Region of Hungary.

My research focuses on

- The analysis of the data gathered through my research, based on which I would like to assess the attitude of the SMEs of the Northern Great Plain Region of Hungary in relations to ICT solutions
- The development of a prototype, based on the existing technologies, methods and results of the analysis carried out at the enterprises of the region; a prototype that uses accessible free solutions through which the digital market space of the SMEs can be extended.

In more details, the tasks and activities to be carried out as part of my research were:

The theme of the research is in part defined by the Internet standards, e-commerce regulations and developed practices and regulations. Therefore one of my main objectives is to process, systemize and analyse from our theme's point of view the technological regulations and practical solutions pertaining to our theme.

The small and medium enterprises are able to invest very little energy into studying the ever-growing Internet technologies and selecting the ones that could be useful for their business activities. At the same time implementing and using the newest technologies is key to maintaining and improving one's competitiveness. Therefore my objective is also to present the technologies that are to be used when implementing the suggested prototype. To evaluate the conditions (e-preparedness) under which the new technologies can be applied I carry out a survey, in order to analyse the digital business communication of the small and medium enterprises of the Northern Great Plain Region of Hungary in 2010. In relation to this I set a number of hypotheses. The three most important ones are:

H1: Websites and web shops are of utmost importance for the enterprises.

H2: The greatest factors hindering the spreading of electronic business communication are lack of knowledge and expertise in information technology, and inadequate leadership vision.

H3: The best way to find new customers is still the personal referral system.

Based on the results of the survey I propose an adequate solution system that uses open source solutions for the SMEs through the development of a prototype based on a „Digital Business Ecosystem" (DBE) concept. In relation to the above I have set as objective the development of a „hub – share centre" prototype portal aimed at gathering information and publishing it to the respective enterprises and experts (Figure 1.). My hypotheses pertaining to the objective are:

H4: Connecting the combination of the actual information storing technologies with services has a value adding effect.

H5: The produced portal system can turn services into value chain-elements, thereby making a new type of offer to the requester.

2. PRELIMINARIES, METHODOLOGY APPLIED

2.1.   PRELIMINARIES

The methods and tools of the electronic business technologies (e-business) and the Information and Communication Technologies (ICTs) pertaining to business applications. The activities accomplished through e-business mean both the e-commerce transactions (procurement, acquisition, sales) performed in the B2B (Business to Business) relations, as well as implementing ICT technology for the internal and external business processes with the proper IT support. The business opportunities offered by the e-commerce and the Internet reach beyond the earlier solutions. They contain new and constantly changing possibilities with their direction changing dynamically, but their impact being sensed in our everyday life. The technological pressure generated by the Internet presents the enterprises with new challenges day by day. It is not easy for the company leaders to adapt the ever changing Internet to their existing systems in order to achieve the strategic goals of the company.

A few years back the main goal was to understand, rationalise and divide the internal business processes into elements that could be covered by computer transactions. The next expectation against these systems, once these applications were interconnected and used for the internal business processes, was to provide permanent interchange communication channels for external business transactions. On the electronic market appeared not only businesses but the private as well as state sectors with the aim to carry out their internal and external business transactions in electronic form, through the Internet. Multinational companies – as they were the first ones to step into the network – forced and are still forcing all other participants of the business sector to perform their business transactions in this way. Connecting to these systems that have great resource requirements is a great burden for the small- and medium enterprises (SMEs).

2.2.   The applied methodology

I began the analysis of the actual state of the small and medium enterprises and the screening of the available Internet technologies through professional bibliography research. This implies that the analysis of the given topic is primarily done through secondary type research. In the course of the „desk" research and secondary type research I have considered the publications and studies that were issued until this point. From these I have selected and processed the information and results relating to the topic of my research.

In spite of the fact that the starting point of the analysis is a secondary type research, in-depth professional interviews and consultations were pivotal to preparing the case studies. I have visited several companies to assess firsthand the solutions they were using. The professional interviews provided vital and direct background information that helps understand the examined topic. Thus the validity of the gathered information is not only supported by the quantity research but also by primary type quality research as well.

As the result of the professional interviews and primary research I have prepared the appropriate questionnaire with the aim of analysing the digital business communication of the small and medium size enterprises of the Northern Great Plain Region of Hungary. The professionalism of the questionnaire was checked by professional-, and it's interpretability by 20 randomly selected control groups. I have amended the questionnaire based on the feedback of the control groups. As target group for the research I have considered all existing small and medium size enterprises that are based in the Northern Great Plain Region of Hungary.

In order to support **the survey,** an on-line version of the questionnaire was prepared with the help of the Lime Survey software system. The survey needed for the research was set up in a way so that the audience could answer the essential questions regardless of their professional background. As there aren't holistic and accessible statistics about this period on this topic, I wanted to scan the actual status of the region through the help of the survey. Purpose of the research was to have the following questions answered:

- What type of IT infrastructure do the SMEs of the Northern Great Plain Region of Hungary have?
- To what extent do they take advantage of the new software technologies that appear on the market?
- What is the degree of importance of the different info-communication tools at the given „connection points" during day to day operation?
- What is the mental attitude of the given SMEs towards the ICT tools?
- What is the level of ICT preparedness of the SMEs of the Northern Great Plain Region of Hungary?
- What percentage of the yearly revenue is designated to maintain their IT systems?

The companies that were part of my target group were of various business activities. The contact list was offered by 4 multinational companies. I have compared the different databases and eliminated all redundancy. I have determined the adequate ratio for the

representational state based on the publication of the Ministry of Economy and National Development's analysis of the SMEs. After this the on-line questionnaire was sent out to 4320 businesses in the form of a newsletter. The result was: one response that was returned on-line. I have tested the efficiency of this solution through the so called jump page method. Next I selected 750 companies that I approached in person and/or per telephone. Of these, 250 were willing to fill out the questionnaire. I have mailed the questionnaire to them and 210 were returned by deadline. Some of the questionnaires that were sent out were filled out on-line through the research server of our faculty (http://nodes.agr.unideb.hu/limesurvey/). Based on this, the 210 responses meant that the willingness to respond was over 25%. Although whilst filling out the questionnaire the identification of the responders was not documented, yet almost half of the companies did take advantage of the opportunity to have the result of the survey sent to them in an email form.

The questionnaire and data were stored in MySQL database; the answers were converted into a form where they could be processed with the help of the data export module of the Lime Survey, through the SPSS software package. I have conducted my analysis with the help of the software package. Besides the simple statistical analysis I made sure to use methods that reveal the most amount of details. As the survey encompasses 15 questions and 17 question blocks (224 questions altogether), I have reduced the questions – with the help of the main component analysis – into 22 components. As aim of the **main component analysis** is to expose the background variables (dimensions) that control the variables in a way that the variables that are connected with each other are gathered into a main component, I have gained data that was easier to handle without substantial loss of information. Moreover 2 quantitative and 4 qualitative characteristics were preserved. On the resulting **main components I applied the Variance Analysis and built 2 LISREL (Linear Structural Equation System Involving Multiple Indicators of Unmeasured Variables) models. Beside this I tried to point out other key information with the help of cluster analysis.** I have used Microsoft Office Excel 2007 to present the results and make figures.

My method of approach was to draw general conclusions about e-business and observe trends based on considering and systemizing both the theories revealed in the first part of this work as well as the knowledge gained from the interviews and survey (inductive approach).

In light of the conclusions **I have developed a prototype portal software product that is able to connect the companies and expand their market. While creating the system, I used different modelling and developing methods**. The preparation of the prototype was preceded by a research, during which I examined the available technologies. My purpose was

to use technologies that are valid and could be upgraded in the future. Another criterion was that they should be free. I have made my selection of programming and server software based on the above mentioned criteria. During development I used the PHP (Hypertext Pre-processor) open source computing script language, as it is primarily used for designing dynamic WebPages and its popularity is constantly growing through the release of newer versions. While designing and developing the application my goal was to create it in a way that it is appropriate for the object oriented programming approach and encompasses all of its features. Prior to the preparation of the prototype I have considered the available DBE (Digital Business Ecosystem) applications as well, from purpose and utility point of view.

While designing, I have chosen to accomplish the portal system in a modular form, so that I could later integrate the planned modules into the system. The development of the portal can be divided into 3 main parts.

The first module is the user interface, the webpage itself. This interface provides an easy search mechanism for the inquirer.

The second module is the manager interface. It is meant to facilitate the work of the peers. For this I have developed a JavaScript based interface that supports the easy administration through web 2.0 solutions.

The third module ensures the user- and data protection. Each peer that is connected stores their data in their own database on their own servers. This can only be accessed through a secured object-access protocol that has become de facto standard. The data is validated through the MD5 fingerprint.

The developed product is an application that uses the existing ideas and technologies, expands them, and offers- by implementing further innovative solutions- a highly usable software package. I have tested the developed prototype in various environments, and then uploaded it with experimental data. In the last phase I processed and examined the observations and critique that has been gathered through the course of the research.

3. THE MAIN OBSERVATIONS OF THE THESIS

3.1.   Variance Analysis

With the help of variance analysis I was looking to find the differences in the attitude of the SMEs based on their answers, while grouping them based on specific criteria. I have illustrated the results of the analysis graphically. After performing the analysis I have made the following observations:
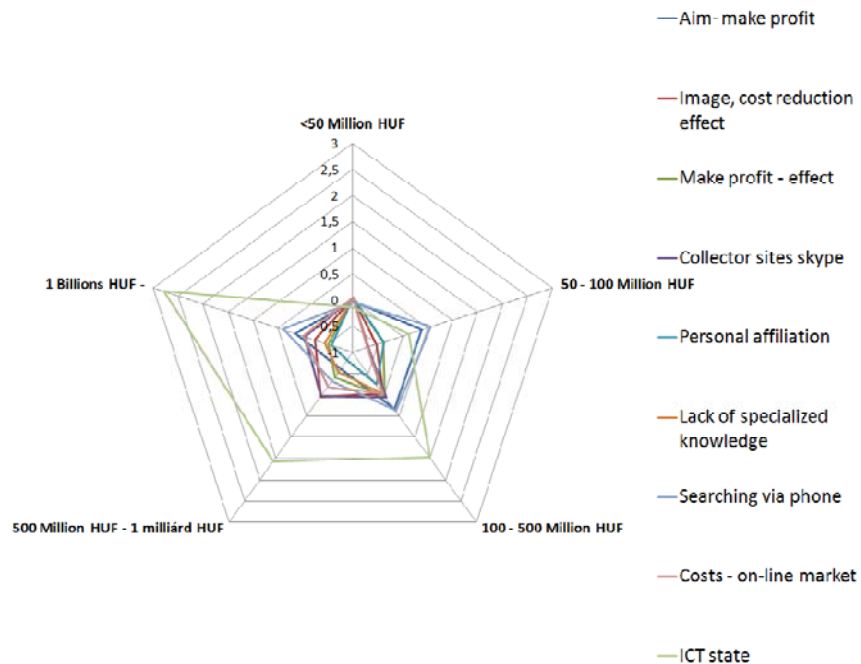

Figure 1. Changes in goals and effects based on revenue

Source: own compilation

- No company, regardless of category, makes use of the advantages offered by the gathering page s and free on-line voice transmission solutions.
- In companies with revenues between 50-100 M Ft or over 500 M Ft the spread of the ICT products is hindered to a greater extent, when compared to others, by
  - o   lack of sufficient IT expertise of the employees,
  - o   the fact that they do not know the services provided,
  - o   the employees handle the tools with difficulty.
- Telemarketing has a greater emphasis at companies with revenues between 50-500 M Ft and over 1 Billion Ft. Companies with revenues between 0,5-1 Billion Ft interestingly enough put less emphasis on this method of gaining new customers.
- Personal referral is an important factor in every category, but it is relatively of most importance in services, constructions and commerce.

- Short and long term profit, as a goal is important in every sector, with the relatively highest role in the group of commerce and other industrial enterprises.
- There was a sensible difference in how companies viewed the potential business impact of the gathering page s and free on-line voice transmission solutions. In case of the industrial sector these applications have a relatively lesser role compared to the agricultural sector where their role is relatively great.
- The role of company website and web shop is significant in the commerce and in the other industrial enterprises sector.
- The spread of the ICT products is hindered to a greater extent by the lack of sufficient IT expertise of the employees, their lack of knowledge about the services provided, and the fact that they handle the tools with difficulty in agriculture, commerce and industry and seems to be less of a problem in the area of services.
- The IT development increases in direct proportion to the increase in the number of personnel. Searching and browsing is relatively high in companies with 11-250 employees.
- The spread of the ICT products is hindered to a greater extent by the lack of sufficient IT expertise of the employees, their lack of knowledge about the services provided, and the fact that they handle the tools with difficulty in companies with less than 50 employees.
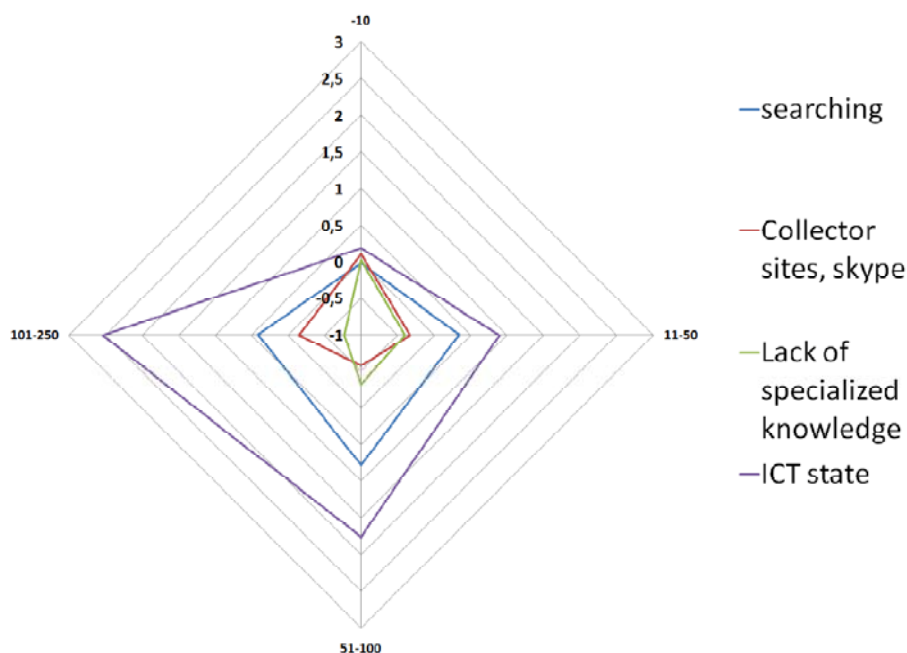

Figure 2. Changes in goals and effects based on the number of employees
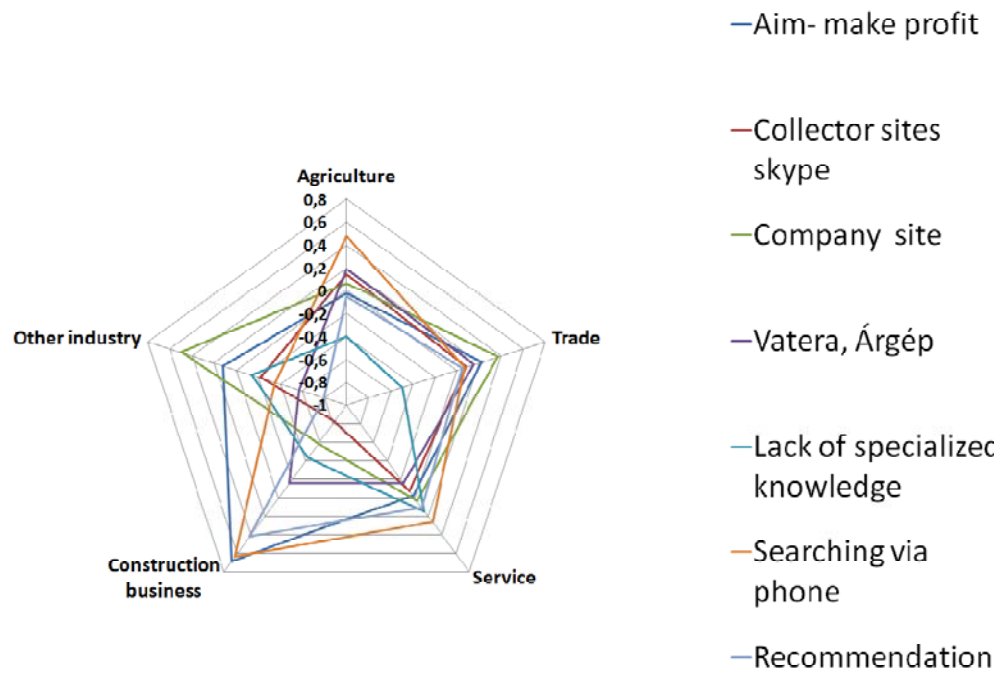
Source: own compilation

Figure 3. Changes in goals and effects based on sector of activity

3.2. Cluster analysis for the three sectors

Using cluster analysis I have examined the areas of connective operation that companies should concentrate more on. To determine this I have inserted questions into the survey to reveal who is the communication partner for the given company. I have made a distinction between internal-, customer-, and vendor communication. Once providing these three forms, I have defined the form and purpose of communication. I then created the three tables that provided an easy possibility for the experts of the different companies to give an answer. The answers ranged on a scale from one to seven, where „1" meant „not important" at all, and „7" being „very important". After the survey was completed and the answers systemised through cluster analysis, I was able to determine the communication areas that the enterprises should also consider based on their existing preferences. I have conducted the analysis for each sector separately and illustrated the results on the below figures

Below is the description of the three part connotation for the proper interpretation of the figure: **XYZ**

X: Communication Channel: SZ: personal, T: telephone, E: e-mail, H: Internet voice solutions, F: forum, K: Community platforms, I: Information system based

Y: Other party (With whom I am in contact): B internal, Ü: customer, S: Vendor

Z: Name of business process: G: gathering information, É: inquiry, A: requesting an offer, M: ordering, F: payment, S: services

The following conclusions can be drawn through cluster analysis. Any enterprise, once the sector of activity is defined, has to find the communication channels listed on the figures that are considered to be important (For example the information gathering done via E-mail (EBG)). Once the appropriate clusters are defined, they can then find within the clusters further methods that could be important for their business. From these, only the existing ones are worth improving.

Figure 4. Cluster analysis for the agricultural sector

Source: own compilation

Figure 5. Cluster analysis for the commercial sector
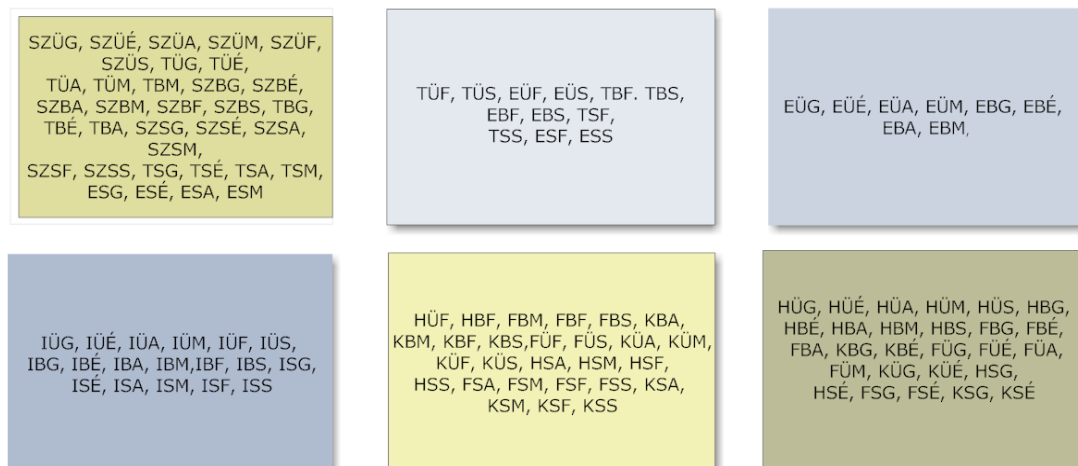
Source: own compilation

Figure 6. Cluster analysis for the services sector

Source: own compilation

3.3. Analysis done with the LISREL model

In my theses I have developed two LISREL models aiming to examine the factors that impact the use of the community applications and how they impact them, as well as the factors that impact the increase of the on-line sales.(figure 7, 8)
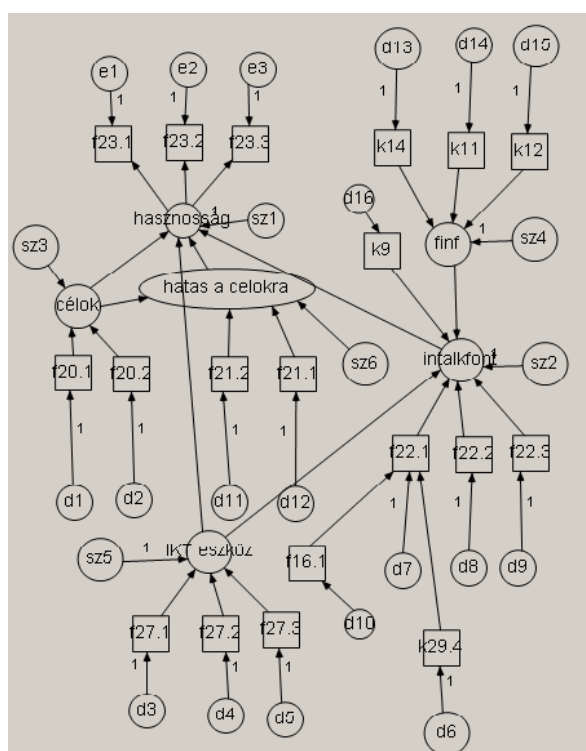

Figure 7. The factors that impact the use of the community applications and the way they impact them
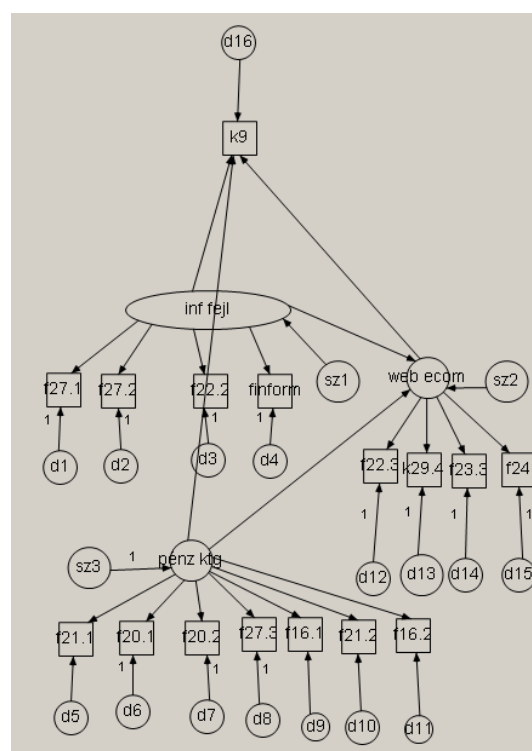
Source: own compilation

Figure 8. LISREL model for the impact upon the increase of the on-line sales

Source: own compilation

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In the case of both models the GFI value shows an over 0, 8 value that proves the validity of the model from a statistical perspective. After analysing the completed models I was able to draw the following conclusions:

The meaning of the results can be summarised as follows:

There is an increase in importance from the business perspective of the internet community market spheres, the B2C and C2C market spheres and of the community platforms
- Inasmuch as the goal of the enterprise is to avoid leeway and reduction of expenses.
- They are furthermore important in case these spheres of operation are considered to be both short term-, as well as long term profit gaining opportunities.
- Inasmuch as the enterprises realise that ICT tools are indispensable for such activities, where not only the procurement of such tools but the proper training of the management is emphatic, so that the executives would get acquainted with the advantages inherent in these systems.

There is a decrease in importance from the business perspective of the internet community market spheres, the B2C and C2C market spheres and of the community platforms, if the main goal is cost reduction, because the introduction of a new technology at corporate level definitely implies an increase of expenses in the first stage of the rollout.

From business perspective the personal community spheres are important in case the goal is to increase the on-line income. Not overly surprising is their expectation that these spheres will help improve their image and lead to cost reductions. Of course maintaining and updating such sites demands time and energy, therefore the businesses need to invest money in it.

The information sharing community portals are advantageous for those businesses that consider searching and browsing to be important by default. They are considered to be important by the businesses that believe that more on-line presence will lead to an increase in both short term and long term profit. Furthermore they are considered to be important by those businesses that believe that such spheres will help improve their image and lead to cost reductions.

The growth of the income resulting from e-commerce is facilitated
- Inasmuch as this has an effect on cost reduction and image improvement.
- When there is a fear that leeway in the implementation of new technologies will disadvantage them against their competitors.

- This is considered to be important by those SMEs that expect an increase in profit through the implementation of this technology.

These companies consider it to be important, and most of them will probably have a website or web shop and they also use on-line advertising opportunities. Increase in income resulting from e-commerce is hindered when there is no adequate management and employee IT expertise, and when the costs of the ICT tools are considered to be high.

3.4.   Digital business ecosystem prototype

The results of the survey show that the SMEs perceive the financial benefit that is to be found in the utilisation of the on-line applications. The answers given in the questionnaire also show that some SMEs lack the intellectual potential that is needed to ensure and maintain the given business' continuous on-line presence. The continuous change in the popularity of the on-line applications also demands that their users also continuously train themselves. This cannot be accomplished by most employees, as self training is not their main job. Nevertheless there are an ever growing number of applications, thus businesses need to be present in more and more places, updating and maintaining their data, which demand more and more energy from their part. Typically this type of investment will only return long term, either financially or by not losing the existing customers.

Purpose of the prototype is to create and operate value chains that help enterprises to extend their markets. Through their help the inquirers and buyers get to know the elements of the value chain, and can therefore make decisions much easier. The way the services offered in the value chain are stored makes it possible for the businesses to store their services and offers on their own, in a predefined structure, and forward the requested data on-line through the portal service upon demand. The portal also makes it possible for a company that already owns a functioning system that stores their data in any form to adjust the interface to their own system, thus avoiding the problem of multiple data storing. Moreover, the goal of my prototype is expand the operation of the portal with applications that are able to collect information and expertise and provide connecting possibilities among groups of similar interests. I have summarised these applications in the generic term „information desk". I have connected the information desk to the value chains. The connection is provided through Meta data, thus one element of the value chain can be connected to more elements of the information desk and one element of the information desk can be connected to more elements of the value chain.

In my opinion, it is the businesses participating in the processes themselves that know the processes best. Therefore, if it is the businesses themselves that create, modify and maintain the value chains, they can expand their possibilities, and the inquirers are exposed to a wider market. What is more, they can receive a great amount of relevant information through the help of the „Information desk". The lowest elements of the value chains are the elementary processes. The businesses can connect to the elementary processes with their services. It is important to mention that purpose of the prototype is to build the chain of services, then offer it to the inquirer and to show the companies that offer such services and the way to find them. Purpose of the prototype is not to display specific offers. For example if a given elementary process is „ploughing", then upon clicking on the elementary process „ploughing" one finds the service provider – with the preferred description -, that offer ploughing, but specific prices and properties are not displayed. Details are revealed once we follow the link to the site of the service provider.

The set up of the Digital business Ecosystem prototype

When designing the prototype, my goal was to accomplish it through open source software elements and applications. I opted for the modular system structure, as this makes the attachment of further modules possible. I have divided the development of the application in three parts.

The first module is the web page, the so-called „front office" interface. I have devised a page that makes searching and selecting very easy.

The second module is the so-called management page. To make the work of the peers easier, I have created a JavaScript based interface that is based on simple, so-called „drag and drop" technology.

The third module ensures the data security. Each peer has their own database, stored on their own servers. Only they can make changes in their own database. The communication between the main server and the peer's server is performed through the so-called XML SOAP technology. I have, of course, ensured data encryption for the sending and receiving of information. The data authentication is guaranteed through the MD5 fingerprint algorithm.

General introduction – operating principle

The developed prototype consists of two intertwining parts. One part is a value chain publishing portal, the so-called share centre, the other one being a community application

compilation that provides tangible advantages to the connecting SMEs. Although the two parts can operate independently from one another, they are of greatest use when working together.

The foundational concept of the share centre is based on my observation that in fact almost any kind of activity can be covered through a pattern defined through certain parameters. By this I mean that if for example one goes abroad for a vacation, they need to travel there, stay there, visit certain programs and buildings, they will eat, be entertained, travel and spend on certain programs – and who knows what other activities they will perform – then travel back home. The sum total of the activities listed in the example I would call „value-chain". Although this is not the traditional value-chain concept, yet I believe this is the most appropriate expression for it. Different value-chains can be allocated to the different activities that will relate to each other on different points (for example logistics or services). I believe that the value-chains, with their inherent elements and connections can be stored. The storage of data, I believe, is to be done through the traditional relational data model. The structure of the value-chains is as follows. The value-chains are the sum total of sub-processes, that are to be labelled based on properties. The sub-processes can be either containers or elementary process type. If it is a container element, further elements are to be found in it. If it is an elementary process, then it will not contain further elements, but the businesses are connected to it. The search results will be determined by the main processes, the descriptions of the sub-processes and property labels. A property can be for example the position of a service in time and space, so if one owns a restaurant in Budapest, they will not be able to provide their services to those that would like to go out for dinner in Debrecen. As mentioned earlier, the main processes can be divided into sub-processes, the sub-processes into further sub-processes and so on, to the needed depth, based on the given value-chain. One cannot predict what will make a main-, or sub-process, or if an event will constitute a main process within a value chain or a sub-process. That is always dependent on the nature of the value-chain itself. Just like when producing a pen, the pen itself is the end product, but the spring within – that is a part of the pencil- is from another process' perspective the end product of that particular process. The creation and management of the value chains as well as the provision of useful information through them constitutes one of the main purposes of the prototype.

There are many applications to be found on-line that could be useful for the SMEs, but it is their integration into their own system and their combined use that will create new opportunities and market presence for them. This is why I examined several applications of this type. I have designed, programmed and integrated the selected ones into the prototype.

Web 2.0 type developments make the use of the applications even more comfortable and simple.

I have integrated the applications and the process controlling module – the share centre – into one unit. As mentioned earlier, its primary purpose is to provide presence for the SME through these processes. Once a process is selected, one can search among the services related to it; receive offers and direct access to applications related, as well as connecting in a standard way to external applications.

Main advantage of the portal can be the fact that the community that will run the given value-chain, will know it at a professional level, thus being able to assemble the most appropriate value-chain they need. This will reflect – because of the community principle – not just one person's knowledge but that of a community. This can be of great help to the inquirer, as he/she can receive information or services they have not even thought to consider. For the service providers this implies a greater market. Main attributes of the portal are data security and equal market presence opportunity for the businesses. These I have accomplished through cryptographic and P2P solutions. The operation of the portal is performed on community principles. When designing the portal I have set goals that are achievable with today's technology, yet at the same time it is easily expandable because of its modular structure, thus it can continuously represent the newest trends. The goals were as follows:

- Usable for various industry types
- Built primarily for the small and medium enterprise community
- Fit for information distribution
- It should provide the possibility to send private messages
- Businesses should be able to offer their products/ and services
- Fit for storing sensitive data
- It should make the creation of service-chains possible
- The number of the service-chain levels should not be limited
- Recording / managing should be simple
- Searching for service-chains should be possible
- It should automatically allocate properties to the search process based and predefined rules, thus narrowing the search results
- It should have standard in-, and output, in order to be compatible with systems that are of different type or operated somewhere else
- It should be upgradable/expandable
- Made with open source development tools

The hub- sharing center:

The operation of this part of the portal is presented on figure 9. It functions as follows. In the databases found on the left side of the figure we store the base-, connector-, connecting and knowledge base data needed for the central operation. When a request comes in, the appropriate business process will analyse the request and if possible decide about the value-chain or access to the information desk, or about any needed steps to which it will later be enabled due to the modular system. After this, if data is needed that is not stored on the central database but on one of the SMEs' computers (for example a brief description of an activity, or the contact information of the SMEs), then after performing the security procedures it will select the appropriate object access protocol, through which it can communicate with the computer on the SMEs premises. This way it acquires the information from the local database and forwards it to the server, so that the search result page can be compiled based on the received information. At the end of the process, the created page will be displayed. This part is seen on the bottom of the figure.
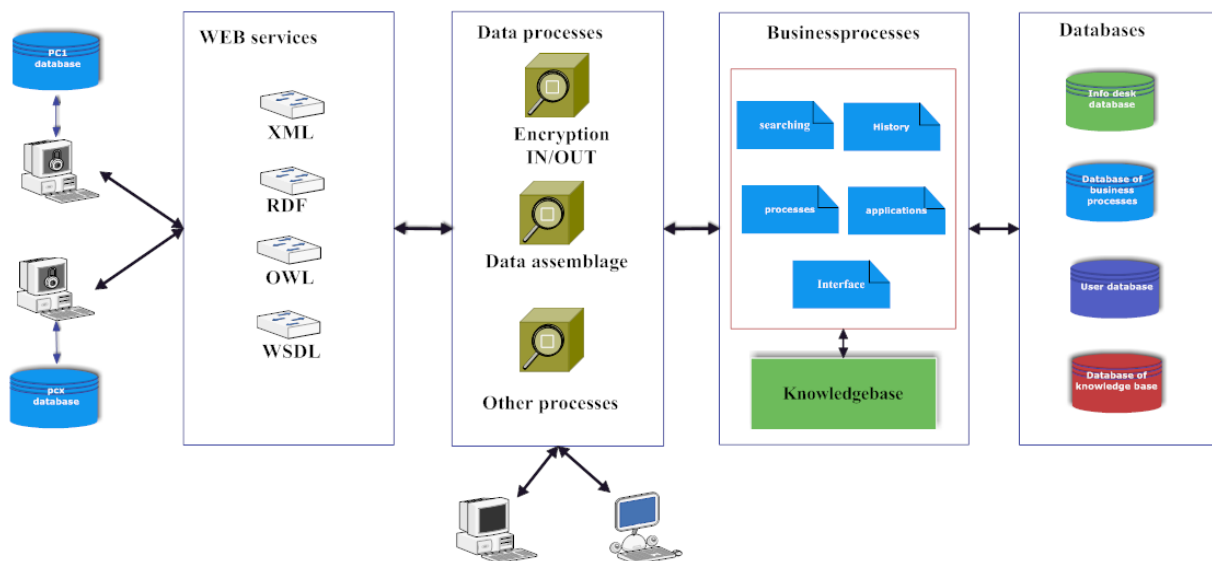

Figure 9. The share centre's operating principle

Source: own compilation

The user page

After the search words are typed in and analysed, the relevant processes-, and on further clicks the sub-processes (container elements) and elementary processes are loaded. The container elements can be clicked on, so one can go to a lower level within the structure. When an elementary process is clicked on, the service offers are loaded on-line.
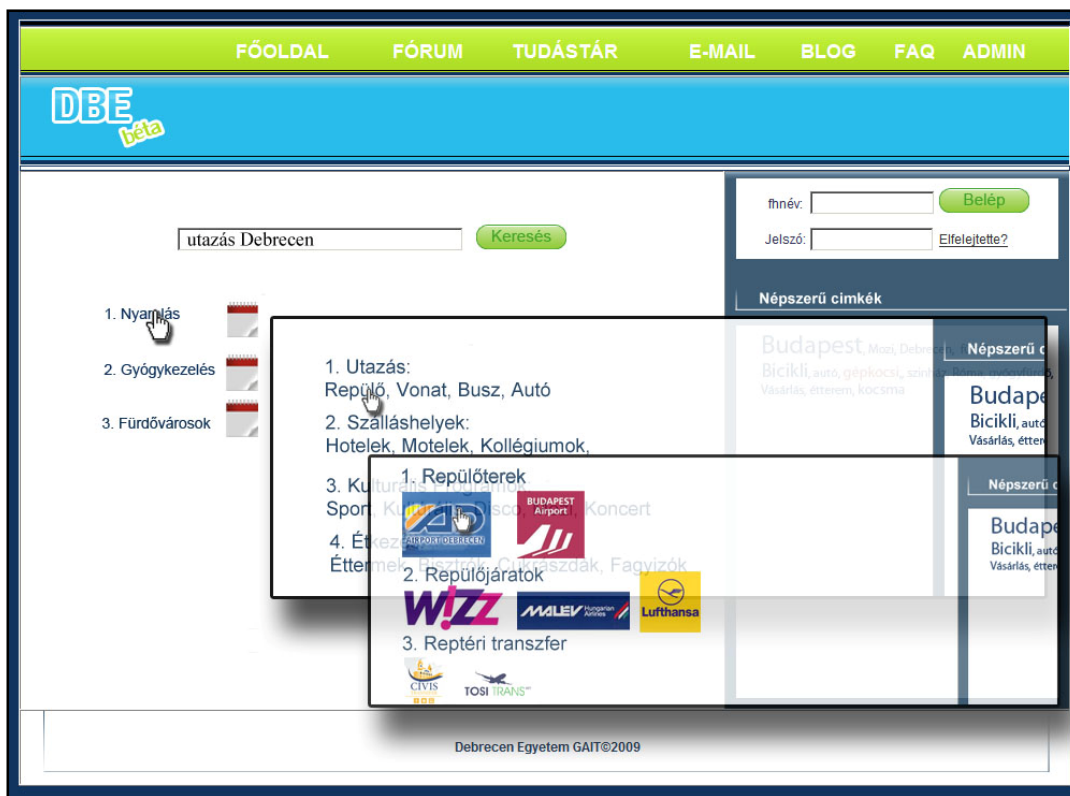
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Figure 10. The user page

Source: own compilation

„Information desk"

As previously described, I have connected to the HUB function the applications that are useful accessories of the portal. These applications I called info desk. The info desk consists of:

- Blog
- Forum
- Knowledge base
- E-mail

I have developed all modules myself. Of course, I could have used open source program modules, but I considered it important, that the program codes that are part of my theses should all be my own intellectual products. In the next paragraph I will explain in detail why the given applications were chosen to be part of the portal, but I would first like to introduce their common properties. The first three applications can be read by all and can be edited by the registered people. Another important common property is that they are connected to one another and to the elements of the value-chains through the labels and descriptions. Therefore,

if we load a process, on the right side of the page the links to the relevant blog, forum and knowledge base logs are loaded as well. The fourth application is the e-mail, where the connecting parties can send one another internal e-mails with our without attachments.

Back office – administration pages

System rights

In order for the portal to function properly, a secured area needs to be designated, accessed by the appropriate persons. Therefore I have created the system rights accordingly. The different levels of rights are as follows:

- User
- Service provider
- Manager
- Administrator.

Value-chain manager page

Main purpose of the value-chain manager page is to create and modify value-chains. It is found on a protected area of the portal, being used basically by two roles, the registered businesses with service provider roles and the value-chain manager with manager role. The first role can make suggestions for the modifications and extensions of the value-chain, whereas the latter will maintain the structure of the process.

Info desk management pages

Registration is needed for the use of the forum, knowledge base, blog and e-mail. It functions similarly to the traditional like pages.

Nodes page

It belongs to the secured area of the portal and consists of the following parts. The peer can create different services on the central portal, with specific properties. There are predefined property labels that characterise the service generically. Their circle is continuously expanding, along the principles of community. There are also new properties that were not

previously in the database. In the second part, the created services can be connected to the process structure.

Database structure

When creating the structure, I have followed the principles of the relational database modelling, and I converted the data I wished to store into third normal form. The criteria for the set-up of the database are: I wish to store the data of the connected SMEs, the structure of the value-chains and their details, the building blocks of the value-chains and their properties. Moreover, the data of the inquirers and their searches, the tables needed to run other applications, as in the knowledge base, thesaurus, etc.

4. THE NEW RESULTS OF THE THESIS

Primary goal of my research work was to explore the accomplishment possibilities of digital business networks for the small and medium enterprises. I have analysed the present state of the SMEs and the available ICT solution principles. Enterprises are faced with new challenges as they try to keep up with the continuous technological changes. The decision makers of the enterprises are in a more and more difficult situation trying to figure out which systems they should integrate into their existing systems, and which ones they should introduce in order to support their business processes. I have carried out my research along these questions. The results of my research have proven that the introduction of modern IT solutions could significantly enhance the business opportunities of the SMEs, and they could thereby ensure for themselves a sustainable presence in the on-line segment. Of all the results of my research, I would like to highlight the following:

Relying primarily on questionnaire survey empirical analysis, I have examined the ICT implementation practices and the e-business preparedness of the small and medium enterprises of the Northern Great Plain Region of Hungary. Utilising the most modern information and communication technology tools, methods and models, and taking into consideration the results of the survey, I have developed the system model that supports the accomplishment of the Digital Business Networks, more specifically it's prototype. Based on the statistical analysis of the questionnaires filled out by over 200 businesses, the prototype development and the validation results I have concluded the following:

1. Utilising the main component and variance analysis methods, I have grouped – based on the answers to the survey - the communication directions and types according to importance. **The survey makes it possible for the SME to identify the useful, yet unused communication forms, and develop their communications portfolio along these forms.**

2. Using the method of variance analysis I have observed that although considered as very important by the private sector, **the advantages of the free on-line voice transmitting solutions and of the gathering pages is not being exploited by the SME.**

    a. **The importance of the business web page and web shop in commerce is high compared to other sectors.** With this I have validated my H1 hypothesis.

b. The variance analysis has proven **that the spread of the ICT tools is hindered by the inadequate IT experience of the employees and their lack of knowledge in regards to the services available and that of the customer-winning techniques personal referral is an important factor in every area and is relatively the highest in services, constructions and commerce**. Therefore I consider my H2 and H3 hypotheses as proven.

3. I have prepared 2 LISREL models, through which I have concluded, that the **on-line market spheres, the B2C, C2C community spheres are important for the businesses that would like to avoid leeway, are interested in long-, and short term profit increase and those that recognise that training of the employees and getting them familiarised with new technologies, methods and procedures is very important.**

4. I have designed and created a prototype system that can be used for the set-up of digital business networks, with its most important partial results being:

   a. **I have created a share-centre based portal database-, structure-, operational-, and access rights system model**, that is able to dynamically convey the services of the SMEs to the inquirers.

   b. **I have created a knowledge base application compilation called "Information desk"**, that consists of applications created and selected by myself and is fit for the storage and successful conveyance of the accumulated knowledge both privately as well as publicly

   c. **I have designed and developed the system model share-centre based portal** that can be utilised in several areas of application for the accomplishment of "business clusters" or a type of DBE concept.

   d. The developed system takes fully into consideration the requirement of the SMEs that its use should not require a considerable amount of financial investment, anybody should be able to use it legally and at the same time the tasks should be resolved at a high level.

5. PRACTICAL USABILITY OF THE RESULTS

In my research I have set several practical objectives, and I have presented their accomplishment in my work.

The practical usability of the statistical analysis

The results of survey give an overview of the attitude of the SMEs of the Northern Great Plain Region of Hungary towards e-business and the level of ICT saturation as of august 2010.

The thesis contains several observations that can be implemented, which I have presented in detail in the respective chapters of the work.

Follow up on the changes in status can be performed through periodic repetitions of the survey.

Practical usability of the prototype system

Primary purpose of the program developed through the research was to create such a DBE based-, web2.0 solutions utilising model, by which I can show that through the utilisation of simple "open source" applications, the cooperation opportunities of the SMEs can be increased. The operational processes defined along the community principles can become useful elements of the communication between businesses. With further modules added to the system, such e-services become available for many small and medium enterprises that prior to this, would have required very expensive systems. In the following I will summarize the practical usability of the system I have created:

- The prototype I have created is fit for the market extension of the connecting businesses – primarily SMEs - by connecting to the value-chains they have built.

- The value-chains are not limited horizontally or vertically through the program, thus they can basically handle any type of value-chain

- As any given service is connected to more elementary processes that could be found on even different share-portals, the management of the services is simple.

- The businesses taking advantage of the service can connect to the share-centres through standard interfaces

- The value-chains provide complex services, therefore the inquirers can receive much relevant information in "one stop" regarding the value-chain opportunities

- The "info desk" conveys the assembled knowledge base through well controlled and overviewed interfaces.

6. LIST OF PUBLICATIONS IN RELATED FIELDS

The most important publications:

Herdon, M. – Raffai, M. – **Péntek, Á.** – Rózsa, T. (2010): Digital Business Ecosystem Tools as Interoperability Drivers. In: Springer, LNCS 2098 ISBN:3-642-15518-1, DOI: 10.1007/978-3-642-15509-3_11 pp. 116-127

Füzesi, I. – Herdon, M. – **Péntek, Á.** (2010): Food Tracing and Interoperability of Information Systems in the Hungarian Meat Industry. In: Agris on-line Papers in Economics and Informatics Volume II /2010 ISSN 1804-1930 pp. 39-49

Péntek, Á. (2011): Digitális Üzleti Ökorendszer koncepció és gyakorlati megvalósítás lehetőségei. In: Acta Agraria Kaposvariensis (ISSN 1418-1789) Volume 14 No 3 (megjelenés alatt) 17 p.

Péntek, Á. (2009): Elektronikus aláírás alkalmazása az elektronikus kereskedelemben. In: Agrártudományi közlemények, 2009/34 pp.153-159

List of all publications:

Papers published in refereed international scientific periodicals:

Herdon, M. – Raffai, M. – **Péntek, Á.** – Rózsa, T. (2010): Digital Business Ecosystem Tools as Interoperability Drivers. In: Springer, LNCS 2098 ISBN:3-642-15518-1, DOI: 10.1007/978-3-642-15509-3_11 pp.116-127

Füzesi, I. – Herdon, M. – **Péntek, Á.** (2010): Food Tracing and Interoperability of Information Systems in the Hungarian Meat Industry. In: Agris on-line Papers in Economics and Informatics Volume II /2010 ISSN 1804-1930 pp.39-49

Papers published in refereed Hungarian scientific periodicals with a foreign language summary:

Péntek, Á. (2011): Digitális Üzleti Ökorendszer koncepció és gyakorlati megvalósítás lehetőségei. In: Acta Agraria Kaposvariensis (ISSN 1418-1789) Volume 14 No 3 (megjelenés alatt) 17 p.

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Papers published in refereed international scientific conference proceedings:

Péntek, Á. – Rózsa, T. (2006): Dynamic e-market portal solution for farmers. In: XV. Agrarian Perspectives Prague, ISBN: 80-213-1531-8 6 p.

Herdon, M. – Zimányi, K. – **Péntek, Á.** (2006): e-Factors in e-Agribusiness. In: XII. European Conference Information Systems in Agriculture and Forestry on Through scientific development to prosperity Prague, ISBN 80-213-1494-X 10 p.

Péntek, Á. – Herdon, M. (2007): New technologies for e-commerce. In: XIII. european conference Information systems in agriculture and forestry Prague, CD-ROM Kiadvány 9 p.

Várallyai, L. - **Péntek, Á.** (2008): Web-based Programme in Education. In: AWICTSAE Greece 11 p.

Herdon, M. – Raffai, M. – **Péntek, Á.** – Rózsa, T. (2010): Digital Business Ecosystem Tools as Interoperability Drivers. In: IFIP TC 5 International Conference, EAI2N 2010 Brisbane, Ausztrália, 2010.09.20-2010.09.23. 11 p.

Herdon, M. - Péntek, A. - Várallyai, L.(2010):Digital Business Ecosystem Technologies for Small and Medium Sized Enterprises. In: The Economies of Balkan and Eastern Europe Countries in the changed world: 2nd International Conference. Görögország, 2010.05.07-2010.05.09. (ISBN:978-960-363-033-3) pp.158-167

Papers written in English, published in refereed Hungarian scientific conference proceedings:

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Other publications:

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Várallyai, L. – **Péntek, Á.** (2007): Portálüzemeltetés. In: (egyetemi jegyzet, Informatikus Agrármérnök és Informatikus Szakigazgatási Agrármérnök BSc hallgatók számára) 292 p.