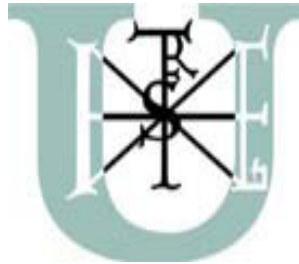# SZENT ISTVÁN UNIVERSITY
Gödöllő

PHD SCHOOL OF MANAGEMENT AND BUSINESS ADMINISTRATION

THE LIMITATIONS AND OPPORTUNITIES OF THE APPLICATIONS OF INFORMATION SYSTEMS AMONG AGRICULTURAL PRODUCERS IN NORTH HUNGARY

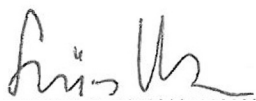## THESES OF THE DOCTORAL (PhD) DISSERTATION

Csomós Tamás

Gödöllő
2014

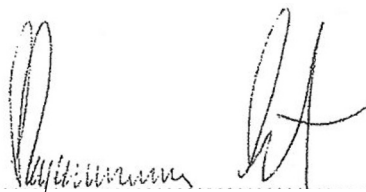**Name of the PhD school:**   **PhD School of Management and Business Administration**

scientific branch: **Management and Business Administration**

Head: **Dr. István Szűcs**
Head of institute, professor
Doctor of economics
Faculty of Economics and Social Sciences,
Institute of Business Analysis and Methodology

Consultant: **Dr. István Kapronczai**
Director-general, honorary professor
PhD.

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Signature of head of doctoral school   Signature of consultant

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1. INTRODUCTION

When choosing the research topic my teaching experience at Károly Róbert College was a decisive factor on the basis of which I consider the adjustation and development of the human resources of the region and agricultural production to market challenges of primary importance. The domestic and European economic crisis has again created challenging times for agricultural production and meeting these challenges will be the key task of the coming years. One possible breakout opportunity may be the human resource development of the sector, in which there are great potentials in my opinion. The ability to make rational and goal-oriented decisions must given significant weight based on rational and objective information which requires the extended use of information systems. The use of such systems may provide not only rationality but also transparency, which is – according to the classics of economics – the prerequisite for the functioning of the market economy. Innovations in production, management and consulting methods as well as the determination of appropriate strategies may have a prominent role in this process.

I have been dealing with IT developments for nearly a decade and the development, operation, and teaching of integrated management systems that satisfy the demands of the modern age thus my choice necessarily oriented in this direction.

During my research I tried to find out how to apply information systems which have been successfully introduced in other areas of the economy in the development of agiculture and in the boosting of the competitiveness of agriculture.

1.1. The topicality of the question

A number of epoc-making developments have been realised in the past years both in the international and domestic IT markets, which have affected basiclaay all the segments of information technology.
All around the world and in Hungary one of the most importan changes is represented by the development, rapid spread and application of integrated corporate systems, which are highly integrated, standard, ready-to-buy systems which can be adjusted to individual needs and complete with a wide range of functions.
IT plays a vital role in the development of companies. This statement is supported by the fact that most companies spend as much on IT systems as on research. This is because IT may contribute as much to the development of a company as research which on the other hand relies on effective and global management information system.

A successful enterprise may remain competitive and profitable only if it is ready to change and improve its organisation structure, and replace its less efficient technological processes, technology and IT tools with ones that meet today's requirements and expectations. Thus the use of modern enterprise management information systems is a strategic element for enterprises to retain their competitiveness. When these systems malfunction, the development of costs can not be monitored, response to customers' needs and development expectations is delayed. However, some business features, options may vary significantly. It must be the aim of management to continuously provide information technology solutions that best serve the interest of a given company.

These observations hold true for agricultural enterprises with the caveat that due to the special environmental factors and the excessive caution of production and software developers the penetration of information systems in the sector is primitive.

The freedom in decision-making and the market and social environment have changed for companies and they require quick and well-established responses, which can be made on condition that all the relevant information is available.

It can be stated that among market environment relations it is of utmost importance to provide the necessary macro-economic, legal, infrastructural and market information so that the economy could function properly. These tasks, however, require knowledge that differ from previous ones in content, level of detail and frequency, which, at the moment, is available in a limited way.

The full and earliest introduction and adaptation of information systems to the segment is important because they render it possible for the Hungarian agriculture to enforce its interests in the EU. It has to be remembered that a modern, science-based information system can facilitate operational decision making and strategic planning.

1.2. Research objectives, hypotheses

The objective of my paper is to present the state, management, and the structure of the supporting information systems, the required data, and possibilities of the agricultural enterprises in North Hungary, and ont he basis of all this I draw the general consequences.

I deem it especpecially important to present suggestions that increase the competitiveness of the agricultural sector thus a consultation system could be created which is supported by a well-developed methodological background and able to meet challenges adaptably.

As an individual objective I have been ably to prove by means of outlining a model that there is a need in the agricultural economy for integrated systems and integrated databases. They use make legal, financial, tax, warehousing, logistics, technology, and market processes more transparent and harmonized, besides the transfer and provision of advice as well as the consultancy system become more efficient. Therefore there is a need for a central database that provides up to date information to agricultural enterprises. This is a real demand for it in the agricultural sector.

The basic assumptions related to these objectives are as follows:

H1: I confirm through my research that the use of modern information technology and technical options, to improve the sector's competitiveness, tofind ways out of the economic crisis and to strengthen the sector's place in the hierarchy of agriculture are of primary importance for the agricultural economy.

H2: Most agricultural enterprises in the region are forced enterprises and there is a strong correlation between the reason of their commencement, the lack of opportunities and the availability of personal competences.

H3: They consider the increase of their competitiveness as an important objective, but do little to achieve it, they mostly rely on external assistance. The tradition of agricultural production is significant in North Hungary but despite this fact business in the region do not have long-term strategies.

H4: The primary precondition of high quality and effective agricultural production in today's accelerated world is the ready availability and adequalte processing of information, which is impossible without proper computer support. In the region the infrastructure, education and information gathering options are appropriate. The agricultural professionals are well-trained but the use and involvement of the Internet and computer systems in agricultural production is still rudimentary.

H5: Agricultural enterpreneurs have recognized the importance of fast and adequate information gathering and there is a demand for it, however it is not unproblematic. Relations between the agrarian background institutions, advisory bodies and the farmers are ad hoc and superficial, there is no permanent liaison and feedback between the parties, thus the information requirements of entrepreneurs is not met. This reduces the efficiency of data use and has a negative impact on the competitiveness of the agricultural sector.

2. MATERIAL AND METHODOLOGY

During my research I collected data on agricultural enterprises, their information requirements and their correlations in Northern Hungary (Heves, Nógrád and Borsod-Abaúj-Zemplén counties) by means of a questionnaire survey.

Of the Two-thousand five hundred questionnaires seven hundred evaluable ones were returned, which were processed using statistical software packages. I was looking for possible solutions using different methods in the evaluation process to verify the hypotheses raised by me.

The success of research fundamentally depends on the chosen method. Therefore besides carrying out the primary and secondary research accoding to recommendations laid down in the literature I paid special attention to selecting the most appropriate statistical method for analysis. I also utilised the theoretical elements that seemed to be appropriate for my reaserch activity.

These methods were a univariate and multivariate statistical methods, a short description of which is essential before thr presentation of the results.

Two basic forms of research must be separated when selecting methods i.e. primary and secondary research. Primary research can be further divided into two groups, namely qualitative and quantitative research.

Secondary research
During my research I carried out analyses and comparisions based on a variety of available research databases - EUROSTAT, KSH and other databases.

During the analytical processing of the domestic and foreign literature special emphasis was laid on studies on information systems and the agricultural economy. During the literature review in addition to the above mentioned facts I studied and analysed international journal articles, conference papers and other publications.

Primary Research

The data necessary for the anylisys was collected by means of questionnaires and personal interviews. Data was collected from agricultural enterprises operating in North Hungary, as well as from Agricultural Offices and Chambers.

I carried out two separate research questionnaire research both of which focus on North Hungary.

In the case of the **first study** (Use, knowledge and the operation of information systems) the primary target group consisted of registered agricultural enterprises to whom the questionnaires were forwarded through the database of the Agriculture Office

The so-called **snowball sampling** was used during which I contacted an initial group of respondents and asked them to forward the questionnaire to other entrepreneurs. The process can be continued in successive waves, which leads to a snowball effect. With this method, the employees of the Agricultural and Rural Development Agency received the questionnaire and sent them to their acquaintances and customers on condition that after filling the questionnaires in they also use their network of acquaintances.

With the help of the **second survey** - which is well separated in time from the first one, and a targeted sampling method was applied, I primarily tried to find out whether there is a rationale for my a model and if so what kind of information needs must it fulfil. I had the questionnaires filled in with village administrators, Chamber staff and with the producers who responded in the first survey. Sampling was carried out using on-line and traditional (paper-based) questionnaire. During the on-line survey the open source Lime Survey was used since it possesses greatest functionality and can handle all the question types I intended to use. The questionnaire editor was installed on the server of Károly Róbert College.

Data analysis was performed using Microsoft Excel spreadsheet and the SPSS 17.0 statistical software package. The former was primarily used to display various statistical data lines and cross tables in graphic form while the latter was used to recode data, to calculate variables and for a multivariate analysis. Thus during my research both secondary and primary research was carried. During the secondary research I used sources available without restriction (HCSO, Eurostat). Of the possible methods during my research I used univariate analysis, cross-table analysis, variant analysis, aswellas factor and cluster analysis.

3. PRESENTATION OF THE RESULTS OF THE RESEARCH

On the basis of the questions and responses three groups were distinguished which, in my opinion, were adequate formy purposes. These groups can provide answers for general information, the information and communication systems and the existence of the necessary infrastructure.

3.1 The state of the agricultural enterprises in Northern Hungary

I first examined the types of agricultural activities by counties, the results of this are shown in figure 1.

It is clear that the majority of the respondents in Heves County were primary producers and the number of small-scale producers and family farmers was negligible while in Nógrád and Borsod Abaúj Zemplén counties the vast majority of respondents were entrepreneurs.
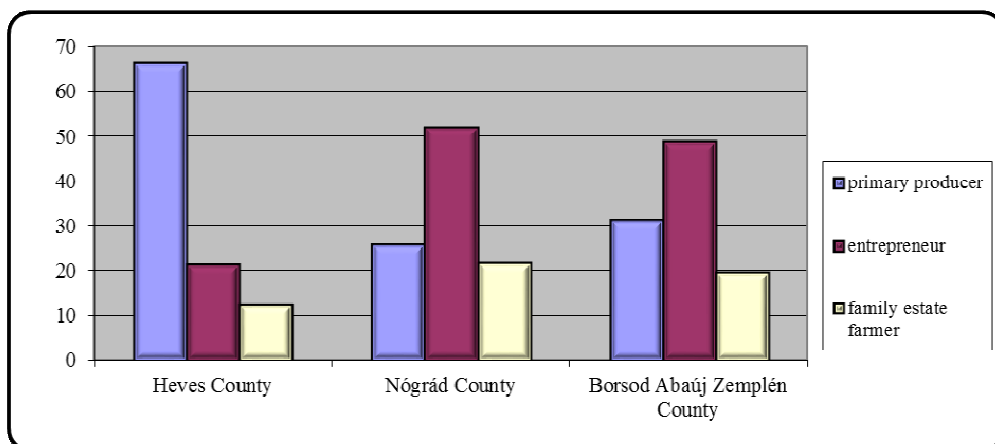

Figure 1**: What is the legal form of your business?(%)**
Source: own edition

Nearly a quarter of the primary producers work in full-time. The explanation for this may be that agricultural production is a specific activity, in some cases it is seasonal, on the other hand, there are very few other business opportunities in North Hungary.

Figure 2 clearly depicts the relationship between the legal form and status.

The entrepreneurs and family farmers work in full time, while primary producers do their agricultural production in part-time employment. The reasons for this can be explained with the differences between the activities, furthermore, even if there is intrinsic motivation and personal competence the lack of adequate size and infrastructure for production will prevent a career and livelihood based on agricultural activities
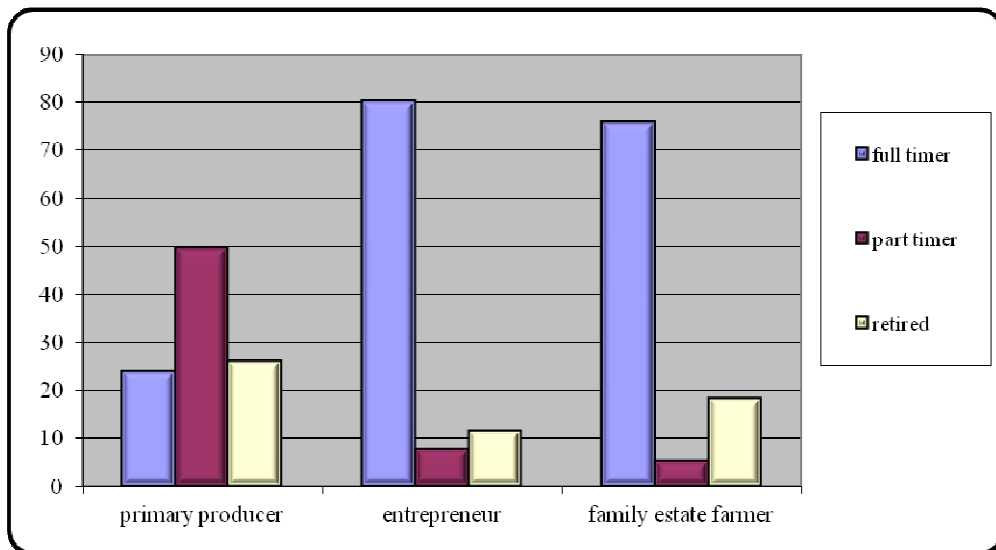
Figure 2: **What is the status of your activities? (%)**
Source: own edition

The personal traits of the respondent is mainly determined by their leevel of education, and on the basis of the results (figure 3) it can be stated that of the professional competences of the farmers the agricultural and technological competences can be traced at primary-, secondary-, and tertiary educational levels.
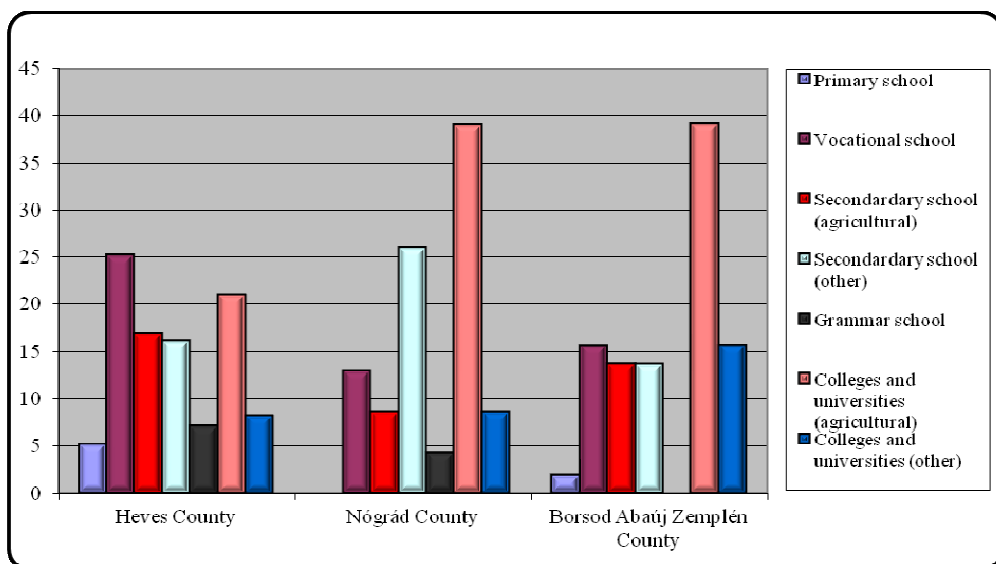

Figure 3**: Level of education by counties (%)**
Source: own edition

The majority of the examined farmers (30% in Heves county, almost 50% in Nógrád county, 55% in BAZ county) have relevant college or university education (probably people with higher levels of education were more willing to return the questionnaire), which presupposes that beside the relevant professional knowledge they are also familiar with entrepreneurial skills, economics, commerce, finance, and accountancy. People with a vocational and secondary education represent a similarly significant portion in the sample. The rate of people with non-secondary education and those who quit their former profession is relatively low (under 10% in all three counties).

In connection with personal competences I considerent the language skills of the decision makers as of great importance since a fair level of language skills is inevitable in creating network capital, in opening to new markets, and in boosting competitiveness.
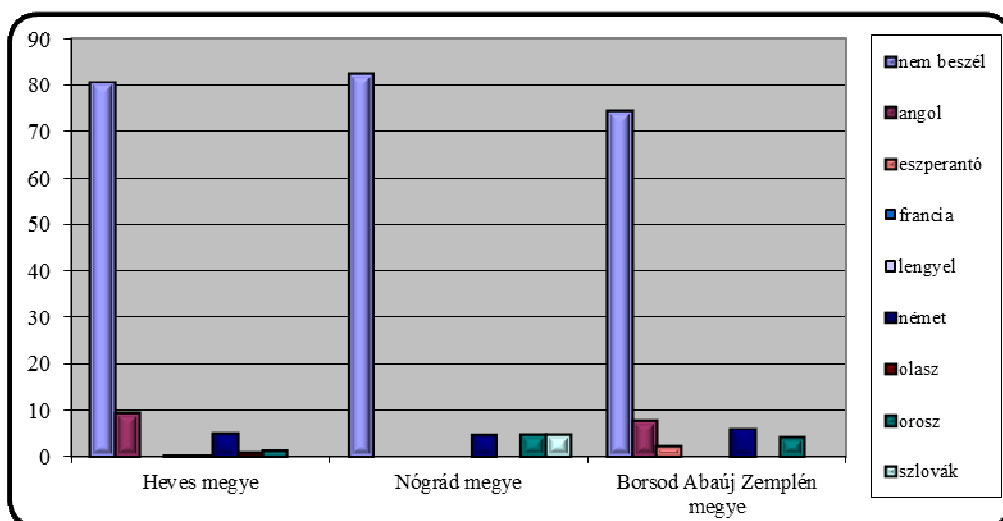

Figure 4: **What language do you speak? (%)**
Source: own edition

Naturally, language skills are also necessary to create and operate the IT background. In this respect the whole country lags behind, which is also proven by my research as well. It holds true in general that 80% of the agricultural entrepreneurs speak no foreign language at all (figure 4). The reasons can be traced back to a number of reasons such as the education system or the specific traits of agricultural enterprises.

In this sector production takes place in rural areas and the age of the decision makers, who insist that the most important factors in their profession are tradition, technology, and expertise, is fairly high.

It may be interesting to consider the way these enterprises look into the future and whether they have alternative solutions and strategies in order to boost their competitibóveness.
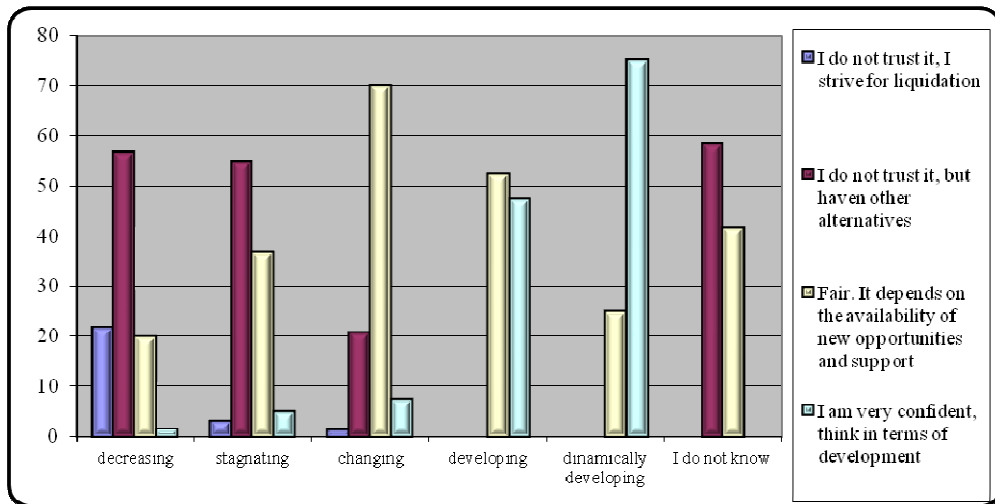
Figure 5 depicts the results of the examination.

Figure 5: **Future expectation of enterprises (%)**
Source: own edition

I do not trust it, I strive for liquidation, I do not trust it but have no other alternatives, So-so. It depends on the availability of new opportunities and support, I do trust it, I plan developments

The examination reveals that respondents describe the present state of their own enterprises either as stagnating or changing. Decreasing and developing descriptions are used equally. Future expectsations are more precisely described when the state of the enterprises are evaluated together with the extent of future trust of the enterpreneurs.

The resulting picture looks very pessimistic, which is understandable given that the already precarious agriculture is brought into an almost hopeless position by the economic crisis, the changing social background, and the not yet fully crystallized agricultural policy.

This situation is duly reflected by the fact that stagnant firms lack confidence in the future, but have no other choice. The changing businesses are more optimistic, but mostly about changes in the external circumstances,they hope to receive government assistance such as grants, purchase orders, tender growth opportunities.
It is surprising that more than half of the developing companies share this view and only a minority of respondents are confident about the future and think about development.
The action is not as pessimistic as the opinion. The possibilities of businesses

for survival are determined by strategies and the actions for their realization, the examination results of which can be seen in figures 6-8.

The results of my research clearly show that the classification of the business is directly proportional to the existence of the medium to long term strategy.
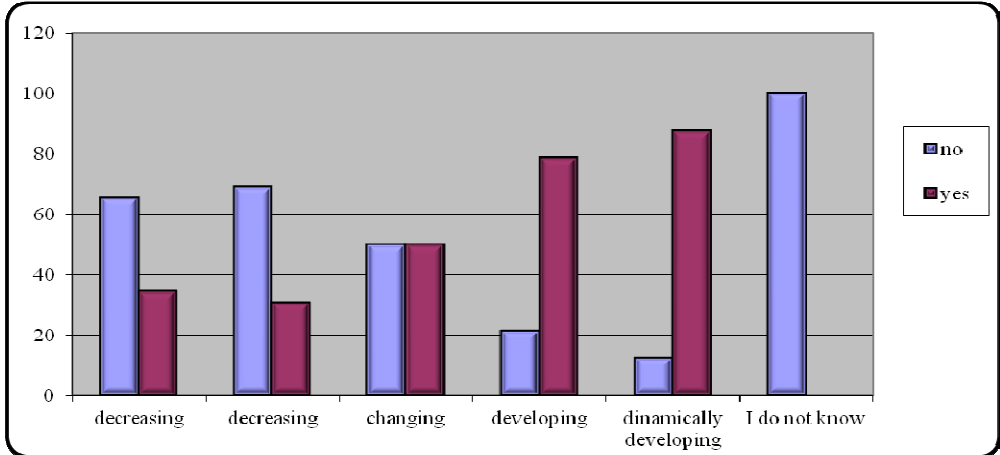
Figure 6**: Does your enterprise have a medium-term strategy? (%)**
Source: own edition

The changing businesses that trust the success of the developments have a medium-term strategy, but not a long-term one.

The developing companies have long term plans due to the existence of appropriate alternative developments. Half of the dynamic businesses have medium-term plans only because of the uncertain and rapidly changing economic environment and the acceleration of change.
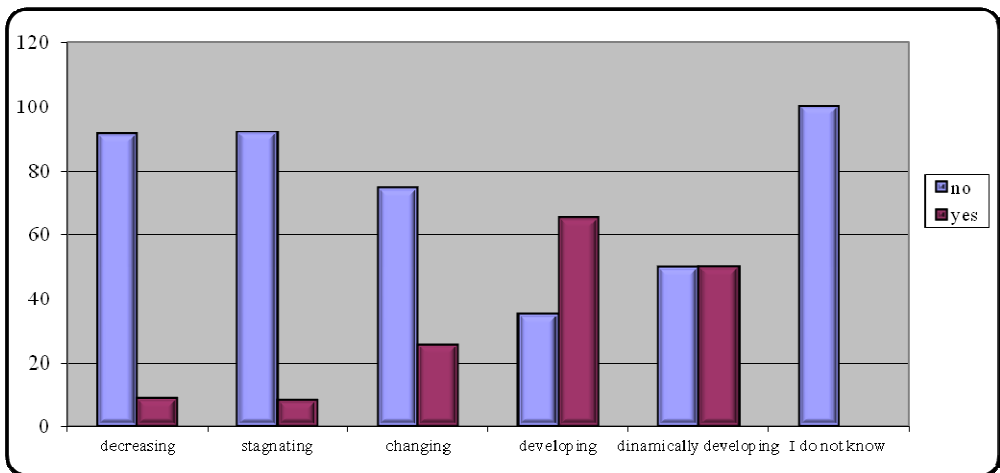

Figure 7: **Does your enterprise have a long-term strategy? (%)**
Source: own edition

It is an important question to consider whether these strategies exist only on paper or whether the entrepreneurs realy attach adequate, factual, professional, and planned activities to them.

Almost all of the respondents believe that they take steps to realise their plans. Most of the decreasing and stagnating entrepreneurs have by now realised that these steps are not adequate and it is high time to change only the best direction will have to be found and they expect outside help for it. The developing and dynamic enterprises are convinced that they have taken the right direction and the do everything to succeed.
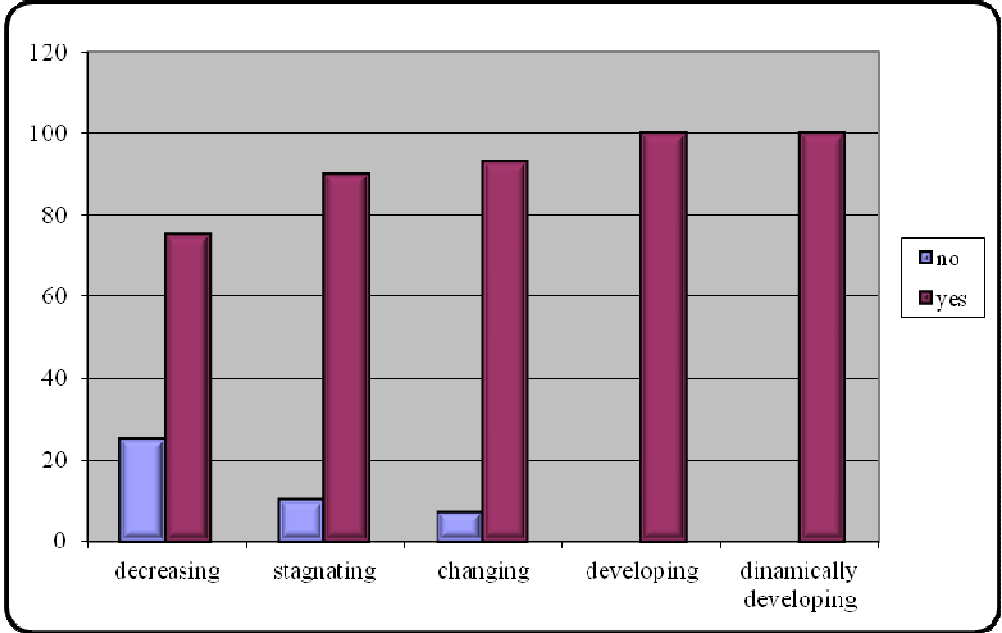
Figure 8**: Have you taken steps to realise the strategies? (%)**
Source: own edition

On the basis of the experience gained so far I became exceedingly curious about the emotional reasons of commencing a business, the conclusions that can be drawn from the changes in the society, family, or economic situation and whether there are anyrelationships between these componets and entrepreneurship.

In order to define relationships factor analysis was carried out (Table 1). During the analysis possible answers were condensed into factors, which allows recording of the visible contacts. Factor analysis reflects the very reasons for starting the enterprise. The data in table clearly shows high correlation between elements within the factors and they determine the possible relationships.

Table 1.

Rotated factor matrix I.

Reasons for starting the business	Components				
	1	2	3	4	5
1. Level of education		**,801**		,275	,112
2. Work experience		**,855**	,198		
3. Family requirement	,186	,113	**,881**	-,151	
4. Unsatisfied with previous workplace		,146			**,906**
5. Loss of previous job	,574			,196	**,503**
6. State support			**,687**	**,567**	,211
7. Privatisation	,248	,172		**,841**	
8. No other skills	**,855**	,164			
9. No chance for a job elsewhere	**,880**		,219		,107

Source: own edition based on SPSS analysis

It can be stated that most of the businesses I surveyed are forced enterprise - for reasons of formation – they have no adequate long-term staretigies thus two of my hypotheses (H2, H3) can be considered proven.

3.2 Information requirements, infrastructural background

In the first phase I examined to what extent enterprises are satisfied with the available factors of production in their environment (9. ábra).
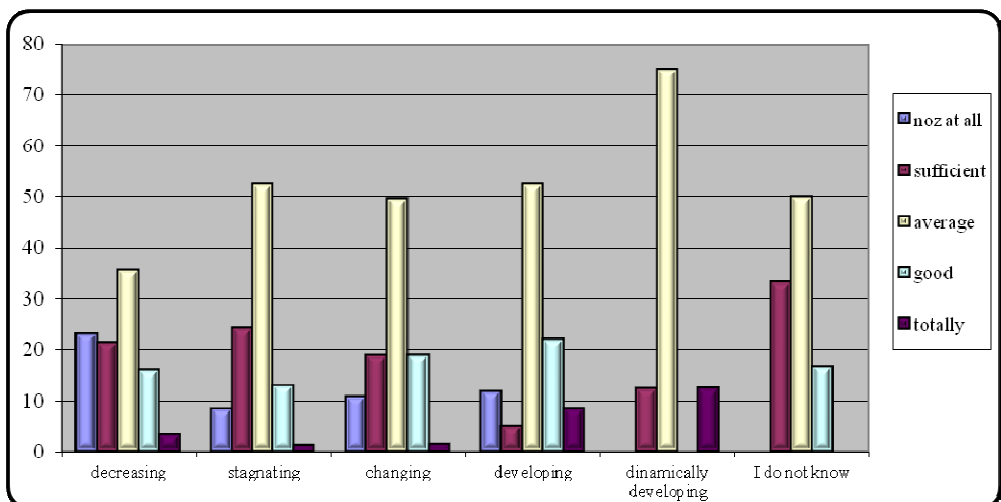

Figure 9**: To what extent are you satisfied with the infrastructure in the vicinity of the business (%)?**
Source: own calculation

During the examination of the factors of production I paid special attention to the availability and accessibility of information in addition to the availability of infrastructure since these days information cannot be ignored as a factor of production. Of course, not only the fast data flow, but also its proper use is important, therefore Iexamined the educational, training and consultancy opportunities.

Agricultural professionals are uniformly dissatisfied with the infrastructure in Northern Hungary. Equipment required for production in this region can be acquired, but the road network and other conditions needed for competitive operation are mostly incomplete.

Another important factor of competitiveness is information, the lack of which significantly affects it (Figure 10).
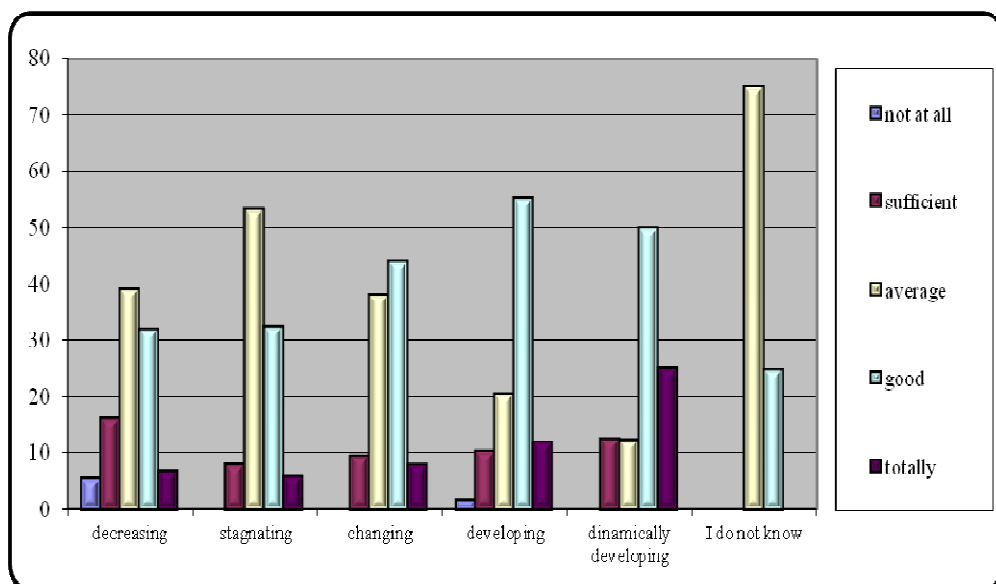
Figure 10: **How satitsfied are you with information sources in the vicinity of the business? (%)**
Source: own calculation

Considering the respondents there is linear relationship between information sources and the judgment of businesses i.e. the more developed a business was judged, the more satisfied they were with the information flow.
This fact also proves that the rapid flow of information affects the market position and competitiveness of enterprises.
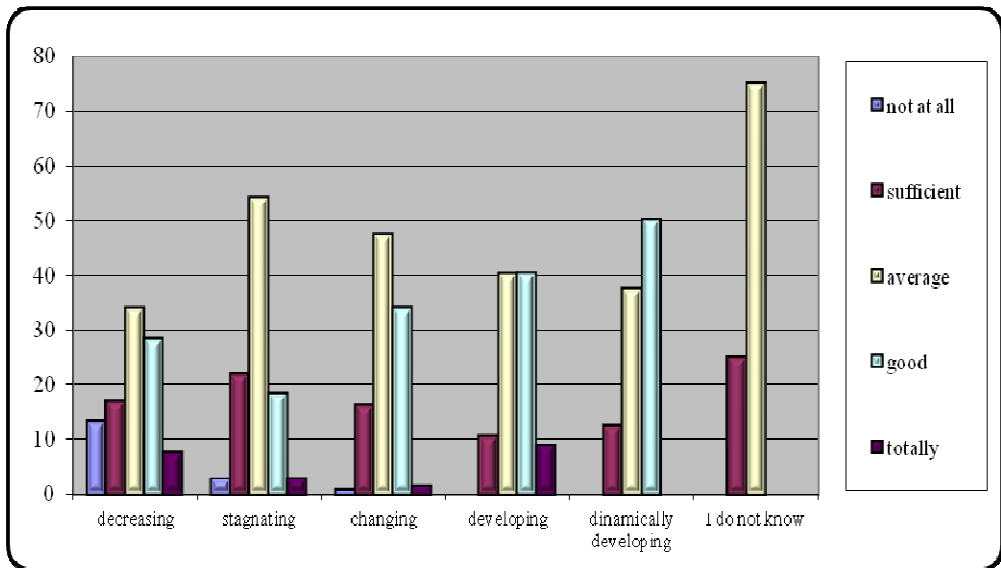
Figure 11: **How satitsfied are you with training possibilities in the vicinity of the business? (%)**
Source: own calculation:

From the point of view of the competitiveness of the enterprises what matters is not only the availability of raw materials, marketing, accessible resources, and information but also the well trained experts that can utilise production conditions and resources and are capable of processing available information properly.

The respondents did not think there were great problems in this respect. Almost half of the changing and the developing enterprises were satisfied with the training opportunities (figure 11), and even the declining enterprises name other factors as the source of their operational problems.

It can be stated that the majority of the respondent enterprises is satisfied with the infrastructure in the region and the educational and information possibilities. (H4 can be considered proven).

3.3 E- Readiness and development possibilities, requirements

Figure 12. clearly shows that only a minor part of the respondents, mainly the primary producers, are the ones that do not possess computers.
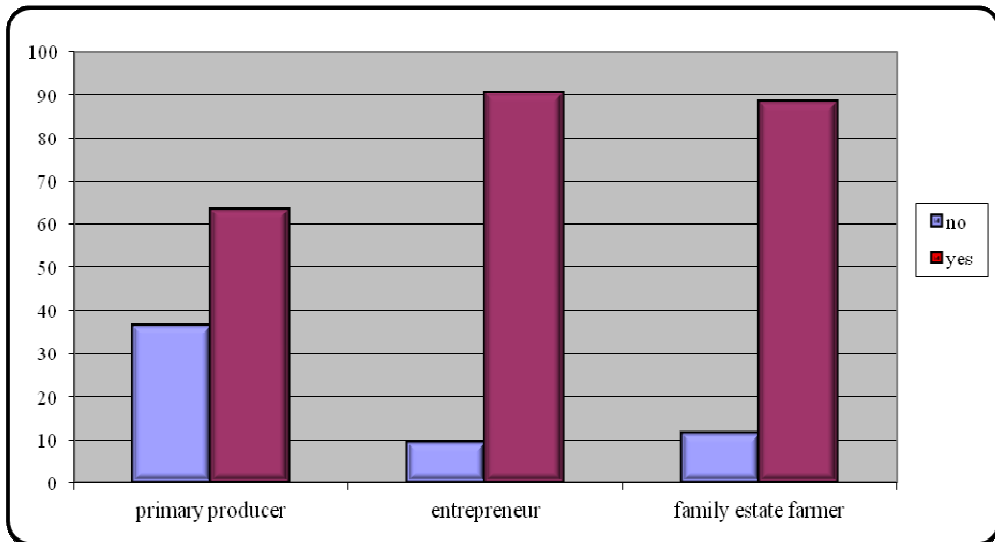
Figure 12: **Do you possess a computer? (%)**
Source: own edition

From the point of view of the ready availability, storing, and use of data it is not only the computers themselves but the softwares, and web access are also important, the examination of the availability of these is presented in figure 13. The rate did change but to a small extent as these days it is not the possession of a computer influence the choice of having an internet access, rather web options are the motivating factors for peurchasing computers.
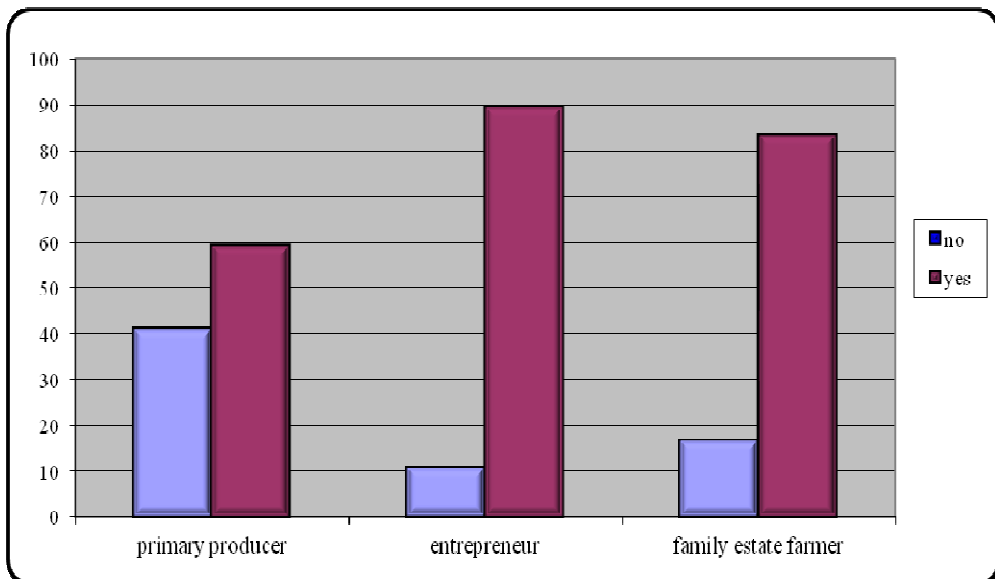
Figure 13: **Do you have Internet access? (%)**
Source: own calculation

Competitiveness, effectiveness of operation is not influenced by the possession of a computer since if they are used solely to visit social networks, or news sites, or used to view films or play internet games, then applications useful from the point of view of operation cannot be taken advantage of.

Table 2: **Working relationships of respondents with different organisations, institutions**

| Organisation, institutions	Link		
	Yes	No	total
Agriculture and Rural Development Office	**58,5%**	41,5%	100,0%
Hungarian Farmers' Association	1,1%	**98,9%**	100,0%
Agricultural advisers	**92,1%**	7,9%	100,0%
Chamber of agriculture	30,6%	**69,4%**	100,0%
Local government	32,9%	**67,1%**	100,0%
Micro-Regional Associations	7,3%	**92,7%**	100,0%
MAGOSZ	9,1%	**90,9%**	100,0%
Farmers' advocacy organizations	3,9%	**96,1%**	100,0%
NGO Consultancy	7,3%	**92,7%**	100,0%
Educational, research institutions	6,6%	**93,4%**	100,0%
MOSZ	5,0%	**95,0%**	100,0%
Financial institutions	34,2%	**65,8%**	100,0%

Source: own edition on the basis of SPSS analysis

Table 2 contains some shocking data since it excellently presents that the agricultural entrepreneurs do not have regular contact with organisations other than the Agriculture and Rural Development Office and the agricultural advisers, that is they do not have any other sources of information and consultancy.

After the analysis of the results on the availability of counselling opportunities I focused on methods of information gathering. I came to the conclusion that although the acquisition of information has become more widespread by means of computers and the Internet, farmers in the region will continue to require interactivity, namely the maintenance of personal relationships.

Having examined the use of the Internet for gathering and spreading information I found that there is a relatively high standard deviation among the classifications. Concerning its efficiency the minority of the respondents ranked the use of the Internet in the first four places, while the other half considered its efficiency negligible.

The age and IT experience of decisionmakers greatly affect the use of these instruments as among the older age group – who are maximally aware of the technological processes in agricultural production – there is a common fear

against the impersonal systems that they caanot comprehend. The antipathy primarily concerns data protection and abuses of the system.

In the currewnt economic situation the support of the IT background is indispensable from the point of view of competitiveness.

Whatever business strategy is followed the effects resulting from the development and applications of IT systems must be taken into consideration. The profitability of the business activity is increasingly determined by knowledge, which means that more and more knowledge and skills are required by the processes. The validation and support of these competencies require the use of IT systems.

The analysis clearly allows us to draw the conclusion that personal contact and trust are especially important for the agricultural entrepreneurs but at the same time they consider the availability of the IT background for information gathering and couselling as important. (H1)

The number of Internet-based content and application services is growing rapidly in the agricultural economy of the European Union and together with it continuous quality improvement can be observed.

The analysis of international trends show that in the agricultural sector the systems supporting decision making are becoming increasingly widespread the common characteristic of which are that they use the Internet as an integrating system and also that they increasingly rely on these systems for documentation and recording.

Against this background, in particular, it was important for me to examine whether the region's agricultural experts know and use ERP systems.
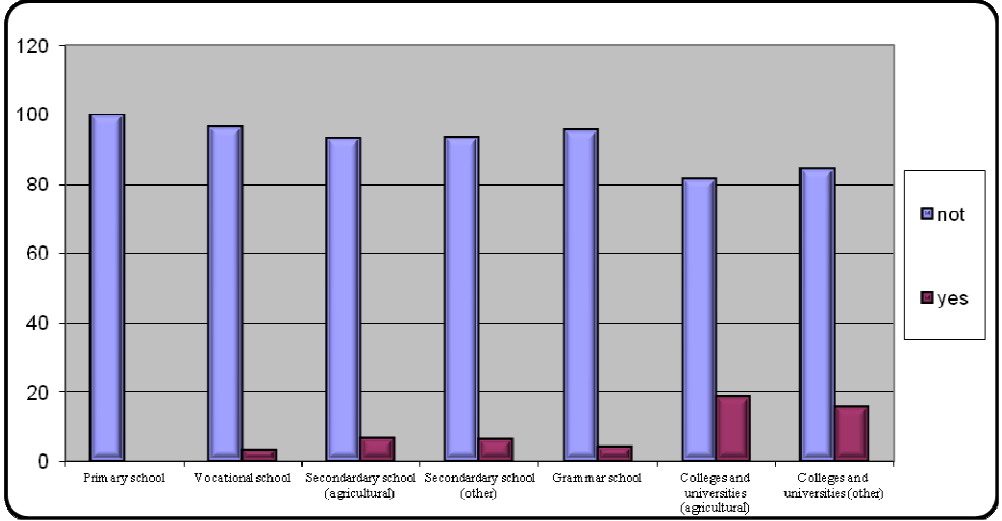

Figure 14**: Are you familiar with the following databases, integrated systems? SAP (%)**
Source: own edition

Figure 14 clearly depicts that even the SAP system which is widespread and popular with large enterprises in the economic life is not properly known but the other systems – not used in agriculture – are not known at all by agricultural entrepreneurs.
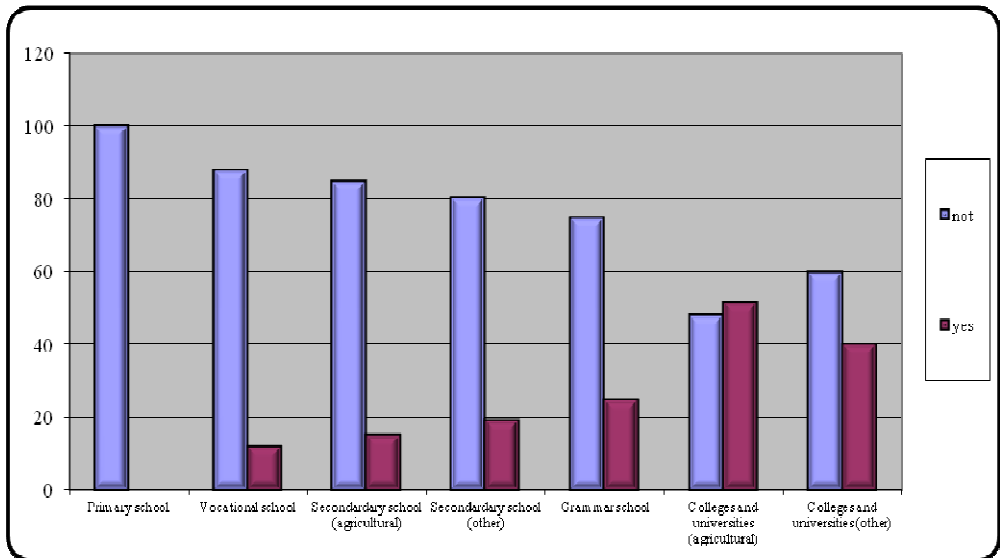

Figure 15**: Are you familiar with the following databases, integrated systems? Agraroldal.hu (%)**
Source: own edition

The respondents are mostly familiar with www.agraroldal. hu (Figure 15) and the EU information system, which cannot be considered decision support systems but the fact that they are well known can be explained with their content.

In order to be able to satisfy information needs I decided to examine the type of information agricultural producers require and whether there there are any concrete, well-defined requirements or goals concerning the acquisition of information.

In order to analyse the requirements I carried out factor analysis (table 3).

Factor analysis adequately reflects what information the respondents require. It can be seen which elements show high correlation within the factors, these linear relationships define the possible links. To the question of what information agricultural professionals mostly require I received the following responses: according to the respondents in the examined region the smooth operation of an enterprise mostly require technological, engineering, legal, financial, human resources development and management information. In addition to these demands, a less tight but valid correlation can be found with the cooperative and association opportunities, as well as with the demand relating to EU legislation.

Table 3: **Rotated factor matrix II.**

How much do you need the following information?	Component		
	1	**2**	**3**
Technical apparatus		,198	**,894**
Technology	,124	,140	**,853**
Legal	**,836**	,176	,155
Finance, tax	**,837**	,149	,229
Application possibilities	,163		,295
Sales possibilities	,208		,530
Marketing	,493	,574	,183
Human resource development	,231	**,837**	,118
Management	,231	**,839**	,106
Cooperation possibilities		,700	,166
EU regulations	,691	,383	,203
Regulations, laws	**,820**	,198	,204

Source: own edition based on SPSS analysis

Thus it can be declared that the vast majority of the respondents have concrete requirements concerning information, the gathering, processing, and analysis of which cannot be achieved without a modern IT background, therefore H5 can be considered proven
It can also be observed that the integrated information systems that are widespread in other sectors of the conomy have not been introduced to agriculture or only to a limited extent.

3.4. "AAIS model", the structure of the Agricultural Advisory and Information System

The questionnaires were sent out by means of targeted sampling method to the target groups that consisted of agricultural advisors, employees of chamber of agriculture, and producers who provided evaluable responses during the first survey.

The result revealed that therespondents had at least average computer knowledge as 87% of the respondents – by their own admission – had at least basic and secondary-level user skills.
Thus on the basis of their competencies the majority of the respondents are capable of useing computing devices in order to support their work and make it more efficient and also to meet their own information needs.

82 % of the respondents use some kind of information systems, interface, or a portal in their work. Of course, it is also true that the sample determined this finding since some of them are working in the public administration and basic computer knowledge is a prerequisite in their jobs.

The really interesting question is, however, for what purposes these systems are used.

The respondents believed that the use of information systems is important in gathering information on application and government support possibilities, to follow changes in legal regulations, maintaining contact with partners (customers, salespersons), establishing connections, maintaining competitiveness, or improving the efficiency of the utilisation of resources.

However, personal contacts are preferred in matters such as the acquisition of business information (update on technology skills , electronic sales, purchasing , finance, lending advice , accounting advice, logistics , warehousing facilities).

I also found it important to consider whether there is any sort of connection among the information requirements of the respondents. Can they be divided into groups and homogeneous units depending on how important they are thought to be by the repondents?

To determine the relationship I carried out two cluster analyses concerning information needed to maintain competitiveness in relation to the operation of the business and to the economic environment.
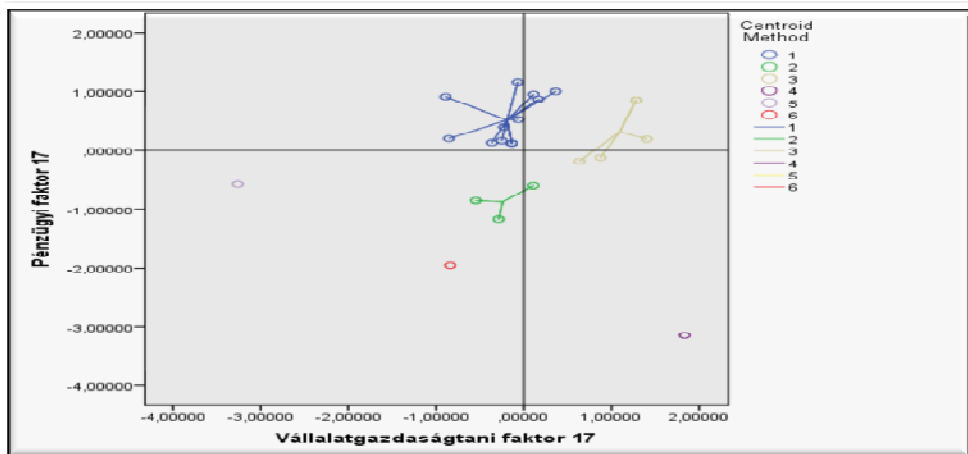
Figure 16: **The purpose of the use of information systems.**
Source: own edition

In the first test the KMO value was 0.642, Bartlett's test is significant, that is, the factor model is reliable. During the test by reducing the number of the observed units and with the least possible loss of information I managed to distinguish two factors, namely the company's financial and economic information, from the seven starting variables. By means of centroid method

I created homogeneous groups. The results are presented in dendrograms (figure 16).

The figure clearly shows that although six groups can be distinguished only three have a significant number of elements. Based on their weight center of these three groups, they are located in the positive part of axis 0, therefore either the financial or the business economics factor or both pieces of information are equally important for the functioning of the operation.

The KMO value of the second cluster analysis was 0.641, Bartlett's test is significant. During the test I managed to distinguish two factors, namely the sales and financing information, from the starting six variables.

Figure 17 shows that seven groups can be distinguished but only three have a significant number of elements. On the basis of their weight center two of the three groups are located in the positive part of axis 0, therefore either the sales or the financing information or both are equally important.
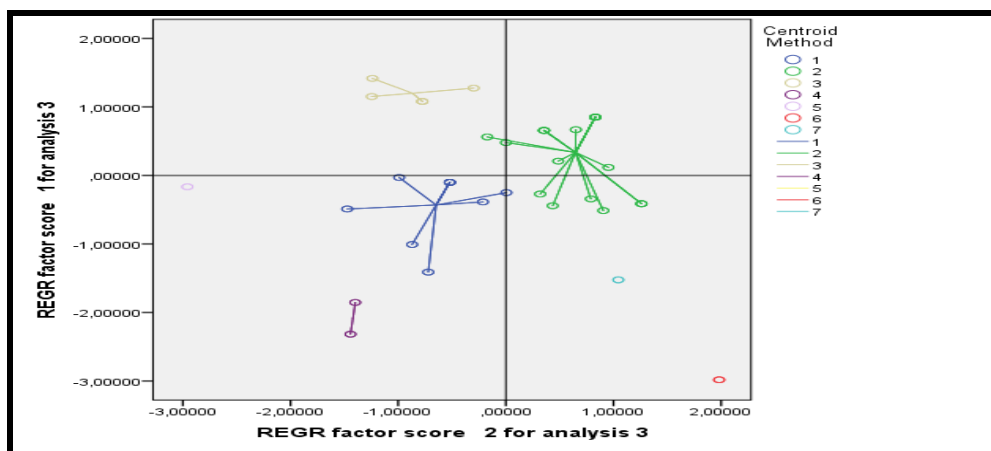

Figure 17: **The purpose of the use of information systems.**
Source: own edition

I also wanted to find out whether the farmers use a web interface in order to increase their competitiveness. 96% of the respondents believe that the use and operation of such a system would increase the competitiveness of their businesses and also that of the agricultural sector.

Based on the results it can be declared that the respondents in the sample have adequate computer skills which they employ in their work. They have well-defined information needs and the information can be divided into homogeneous groups or modules. According to their opinion the competitiveness of the sector would be significantly improved if the required information could be retained any time quickly and in an adequate format from an easily accessible system.

The next question is about what this system should be like, how it should be

created, what information it should contain, and what areas it should include. I intend to answer this question by presenting a possible alternative of a concrete model which is based on the findings of my primary and secondary research activities.

The Agricultural Advisory and Information System (AAIS) that I designed is a special hybrid self-learning expert system which consists of six moduls.

The **first module** (**Technology Module**) contains technological information. The module, connected to various sensors (eg Cubilog, GIS) and databases, allows the user to receive, after uploading adequate input data, concrete technological alternatives formed on the basis of economic considerations. Based on the GPS data of the area and using a relational database the system selects three cultures that according to the specific site conditions can achieve the highest yield and after the selection it designs the complete technological process (from soil preparation to nutrition replacement and harvest).

The **second module** (**Investment and Asset Management Module**) enables calculations related to production, economic infrastructure development, indicators of return. The expected return and efficiency are important aspects when we design or redesign production structures or plan investments, this module performs the generation of this information. The module could connect to a database containing a list of rental equipment and timeframe uploaded by the producers. This connection and the above mentioned profitability calculations would allow the development of a system operating as a network and could increase the asset utilization of the industry. The producers would receive decision alternatives on the basis of economic considerations before the start of the investment or during the planning of production process.

The **third module (Commercial Module)** will be ideal to to map the commercial channels and to coordinate the demand and supply sides. Beside the stock exchange trades this module would be capable of creating an online market. On the basis of requirements uploaded by producers, buyers, traders, and distributors the system selects the consistent, interoperable elements according to certain parameters and sends a report to the users. On the basis of stock market forecasts and expected trends it may provide solutions for futures optionally.

The **fourth module (Finance Module)** would include the financing alternatives. In this module, information on loans, grants and support options could be received. In connection with borrowing pre-assessment of eligibility and the selection and ranking of the correct of alternatives could be carried out. In order to find out about opportunities for applications and grants an application monitoring system is connected to the module, which would allow farmers to more easily understand the seemingly complex system. After uploading the needs the target system selects the most appropriate option(s) and provides information about them thus supporting the decision-

making mechanism.

The **fifth module (Regulatory Module)** allows the updating of the legal background since it is connected to various databases, thus users could easily become familiar with the actual legal background. The module must be suitable for monitoring and notify about changes in legislation and provide a brief summary of operational obligations induced by changes.

The **sixth module (Service Module)** performs the accounting, billing, warehousing, and logistics tasks. Its operation corresponds to that of the ERP systems, as these activities do not significantly differ from agricultural activities.

Thus, in summary, by using data from sensors and databases six modules enable us to model almost the entire process. By beans of a transformer or inference system which converts the input data into output data corresponding to the users' needs the system generates reports and text documents from these thus promoting effective and appropriate decision-making.

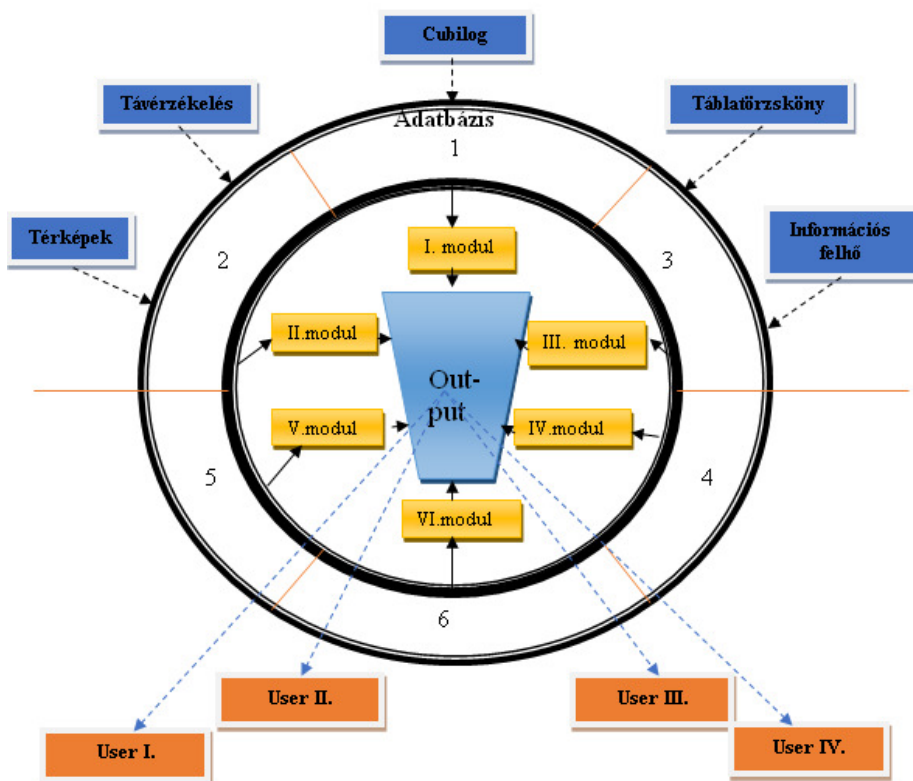Figure 18 shows the structure of the Agricultural Advisory and Information System.

Figure 18: **The structure of the "AAIS model"**
Source: own edition

The problem of the introduction and spread of the system may result on the one hand from the fear and revulsion of an impersonal and unknown device and system, which can be found naturally in professionals working in agriculture. In my opinion, this can only be solved through personal liaison and interactive presentations, i.e. only on a confidential basis. The results of my research clearly imply that this trust is evident mostly towards agricultural advisors, a system which has been operating well for a long time – according to the respondents – therefore during the implementation of the system presentations, training sessions, and follow-up research activities should be based on the well-established network of agricultural advisors.

The key question, which concerns finance and fund-raising, has already been anwered by figure 26, according to its result if this is a shared system created with an appropriate content, users would pay for it.

Obviously this opportunity could solve problems in some measure concerning operations but cannot generate reserves for the creation of the system. In order to provide the necessary funds for development financial resources from applications, expert developers and wealthy investors as well as government support are all inevitable.

Governmental support and the availability of new EU funds, which emphasises the importance of agricultural innovations and considers the the deployment of digital networks as a tool of regional realignment, in my opinion will not present an obstackle, thus financial problems can be tackled.

6. NEW AND INNOVATIVE SCIENTIFIC RESULTS

1. 1 During my research I proved by using factor analysis that a significant part of the agricultural enterprises located in Northern Hungary are forced business, and their foundation and development can be explained with aspects such as the production traditions of the region and the lack of other livelihood options.

2. The farmers examined have suitable technical and technological competencies in theory, but those who barely have medium-and long-term strategy and virtually no vision for the future cannot be considered as adequately trained entrepreneurs.

3. I have been able to establish that in the North-Hungarian region the infrastructural background required for production can be considered satisfactory, although further improvements are necessary to increase competitiveness. The factors of production are available. Of the different possibilities to raise funds the availability of applications is favourable but the lack of potential investors is clearly visible. The lack of resources may lead to the deterioration of competitiveness and the stagnation of sustainable development and ultimately result in the decline of the region's primary revenue generating sector and the loss of agricultural production.

4. During my research I have proved that although appropriate computing devices and internet connections are available for agricultural enterprises the use of information systems has not spread widely.

5. It can also be stated that according to the respondents in the studied region the smooth functioning of enterprises and agricultural production primarily require technological, technical, legal, financial, and human resources development and management information systems. Thus it is obvious that the majority of agricultural entrepreneurs have specifically formulated information needs. To meet these demands a database should be created that is constantly updated and contains the necessary information and to which users can connect either online or directly.

7. CONCLUSIONS, SUGGESTIONS

On the basis of domestic, own, and international publications and research results it can be established that digitization and the use and development of IT systems are crucial factors to improve the competitiveness of the agricultural sector.

There is a particularly strong need for the development of agriculture in North Hungary because due to its characteristics, disadvantageous position, and traditions farming is the almost only source of job creation in the region and a steep decline in agricultural activities could result in a significant increase of commuters, and unemployment. Development requires an agricultural strategy on which guaranteed livelihood can be based in the long run.

I have found that the smooth functioning of enterprises and agricultural production primarily require technological, technical, legal, financial, and human resources development and management information systems. Thus it is obvious that the majority of agricultural entrepreneurs have specifically formulated information needs. Therefore I suggested that in order to meet these demands a database should be created that is constantly updated and contains the necessary information and to which users can connect either online or directly.

During the examination of the feasibility of my proposal I found that the vast majority of the companies operating in the region are forced enterprises that lack even basic visions or strategies and consider themshelves to be in a stagnant or declining condition.

A significant part of agricultural enterprises examined in the Northern Hungarian region are mostly primary producers or private proprietors working mostly in part-time as they believe that in today's unfavourable economic climate it is utterly difficult to base livelihood on agriculture.

The respondent agricultural entrepreneurs have acquired adequate professional and technical competencies as well as other abilities (but not language skills) necessary for managing an enterprise. Nevertheless, they hardly have any medium and long term strategies, and virtually have no vision for the future.

As for the factors of production the infrastructure is acceptable in the region because the supply of raw materials and the conditions of sale are available at an acceptable, but not perfect, level in the region.

Regarding the obtainability of information the basic requirements such as an adequate IT background and internet access are also available.

The biggest deficiency is found in the processing and utilisation of the obtained information.

The village administration network enjoys full confidence regarding counselling, information transfer, and professional assistance, which can be explained apart from the regular personal interaction by the fact that they are

well-known and highly appreciated.

I examined both the external and internal possibilities of resource raising. The involvement of external sources is favourable because of the application possibilities, but by contrast, the lack of potential investors is duly reflected by my findings which reveal that the primary reason of the weak interests is the large distance between the examined region and Budapest, the center of economic life. The lack of internal financial reserves can be explained by the narrowing of the distribution channels as well as by the fear to expand into eastern markets. The lack of resources may lead to the deterioration of competitiveness and the stagnation of sustainable development and ultimately result in the loss of the region's primary revenue generating sector.

Spatial informatics, remote sensing, sensing and wireless technologies, and the agricultural applications of E-business systems spread very fast. Internet applications are present in a number of areas of agri-business. The only drawback of these systems is that they are not integrated which means that they are capable of modelling individual sectoral processes but not the whole one because of the complexity of the developments. The agricultural experts of the region are not familiar with the ERP systems used in other sectors and as a result they do not take advantage of them.

In my opinion a database should be created that is constantly updated and contains the necessary information and to which users can connect either online or directly.

In my opinion the database should be a central information storage space which relying on the modern spatial informatics systems can provide advice concerning concrete areas in questions of technology and sales.

Naturally, legal and financial counselling can be realised this way, what is more, ERP systems enable the realisation of taxationand accountancy tasks. These systems can provide help in logistical, warehousing, and purchasing tasks as well as in invoicing. As long as these systems are created with mutual efforts and adequate cotent the users would have to pay for them. Obviously this opportunity could solve problems concerning operations but not the expenses of the creation. In order to provide necessary funds for development financial resources from applications, expert developers and wealthy investors as well as government support are all inevitable.

In my opinion governmental support and the availability of new EU funds, which considers the the deployment of digital networks as a tool of regional realignment, will not present an obstackle.

LIST OF PUBLICATIONS

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1. **Csomós Tamás –Helgertné Dr Szabó Ilona -Vanó Gábor - Kurcsinka Tamásné –Katonáné Dr Erdélyi Edit:** Pénzügyi számvitel példatár (Saldo pénzügyi tanácsadó és informatikai Zrt. 2010. ISBN:978-963-638-356-5

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