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ONE POSSIBLE WAY OF APPLYING INFORMATION SYSTEMS IN AGRICULTURE

Az információs rendszerek mezőgazdaságI alkalmazásának egyfajta lehetősége

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Abstract
In recent decades a number of revolutionary change has taken place in the international and domestic IT market substantially affecting almost all areas of information technology. One of the most significant changes is the widespread use, the rapid development and the domestic and international spread of integrated management information systems which feature a wide range of functions and are highly integrated, standard, ready to buy but can be "customize" easily. The IT technology has a very important role in the development of enterprises. This is indicated by the fact that most companies now spend as much on the information technology and information systems as on research. Information technology can contribute to the development of a company at least as much as research activities which, on the other hand, can prove useful only by relying on efficient and global ERP systems. A successful company can retain its competitiveness and profitability only if it is able to renew itself, adapt its organizational structure, and replace its less efficient technological processes, technology, and IT tools with new ones that meet current requirements and expectations. We believe that the application of modern management information systems is a strategic element for businesses to create and retain competitiveness. Unless this system works well, it is utterly difficult to monitor the costs and responses to the customer needs and development expectations are delayed. These statements also hold true for agricultural enterprises on the understanding that owing to the special characteristics of production and environmental factors and the excessive caution of the software developers the introduction of information systems in the sector is in early stages. The earliest implementation and adoption of information systems in the sector is important because a modern, science-based information system can facilitate operational decisions and strategic planning thus boosting competitiveness.

Keywords: competitiveness, information technology, agricultural enterprises, efficiency of data

Jel Code: L86; Q19

Összefoglalás
Az elmúlt évtizedekben több forradalmi változásra került sor a nemzetközi és a hazai informatikai piacon, amelyek az információ-technológia szinte valamennyi területét lényegileg érintették. Az egyik legjelentősebb változást az integrált vállalatirányítási információs rendszerek széles körű alkalmazása, a funkciók skáláját felölelő, magas fokon integrált, standard, készen megvásárolható, majd

„testre szabható" információs rendszerek rohamos fejlődése és elterjedése jelentette, szerte a világon és Magyarországon is.A számítástechnika alkalmazásának kiemelten fontos szerepe van a vállalatok fejlődésében. Ezt jelzi az is, hogy a cégek jelentős része ma már ugyanannyit költ az informatikára, az információs rendszerekre, mint kutatásra. Az informatika ugyanis legalább ugyanannyira képes hozzájárulni a vállalat fejlődéséhez, mint a kutatás, amely viszont általában csak a hatékony és globális vállalatirányítási információs rendszerre támaszkodva viszi előre a céget Egy sikeres vállalkozás csak akkor őrizheti meg versenyképességét és jövedelmezőségét, ha képes megújulni, szervezeti struktúráját átalakítani és a kevésbé hatékony technológiai folyamatait, technikai-, informatikai eszközeit lecserélni olyanokra, amelyek a mai kor követelményeinek, elvárásainak megfelelnek. A korszerű vállalatirányítási információs rendszerek alkalmazása véleményünk szerint a vállalkozások számára ma már egyértelműen a versenyképesség megteremtésének, megőrzésének stratégiai eleme. Amennyiben ez a rendszer nem működik jól, nem lehet figyelemmel kísérni a költségek alakulását, késik a reagálás a vevők igényeire és a fejlesztési elvárásokra. Ezek a megállapítások igazak a mezőgazdasági vállalkozásokra is azzal a kitétellel, hogy a termelés, a környezeti tényezők specialitása és a szoftverfejlesztők túlzott óvatossága miatt az információs rendszerek ágazatban történő bevezetése kezdetleges. Az információs rendszerek mielőbbi teljes körű bevezetése és adoptálása az ágazatra azért is fontos feladat, mivel egy korszerű, tudományosan megalapozott információs rendszer megkönnyítheti az operatív döntéseket, illetve a stratégiai tervezést, ezáltal segíti a versenyképességet.

Kulcsszavak: információs technológia, mezőgazdasági vállalkozások, adatok hatékonyság

Introduction

Information expresses value and power in today's world. In every organisation the fast and precise management of information is a priority. The huge amount of frequently and quickly changing databases must be managed nowadays so that their internal value could be transformed into an asset. These days with the spread of electronic data processing it is not obtaining information that means a serious problem for enterprises as they can be found in different databases and storages in the form of internal and external information. Rather, it is the processing of such pieces of information that are necessary for making a decision in a given situation. During the past decades data management and in-company communication have significantly been transformed. At first only a few computers were purchased so organisations installed applications covering different aspects of business organisations separately. In this way a so-called isolated, island-like solutions were created. As they did not form a unified system altogether, synchronising their databases proved to be rather difficult. Due to the mistakes of recording the same business event several times reports containing false data were published from the directors' desks and running the current applications in the long term proved to be very expensive if we take the costs of useless resources of repeated data recording into consideration.

What could help us in solving problems better than Information Technology, or, to be more exact, the information systems that replaced the island-like software solutions used for decades. During their application a systematic way of thinking plays a great role. Moreover,

of the millions of data to be recorded at a suitable time only the ones necessary to base a managerial decision must be obtained. In order to offset the island-like solutions mentioned above several companies have opted for introducing an integrated enterprise resource planning system. The fact that more and more multinational companies have relocated their headquarters, warehouses and plants to Hungary and brought the well-established information technology solutions has also played a great role in spreading the systems. The systems introduced consisted of clearly integrated subsystems whose modularity made not only the gradual introduction possible, which in itself is not a disadvantage knowing the price of the systems and the costs of running, but also the entire corporate structure could be covered by applying one single software.

Material and method

Information, similarly to capital and labour force, has grown to be a resource nowadays. Information management is not only the science of management information systems, the technique of creating end users' software, computer technology and system organisation, rather it means all of them or even a bit more: an approach, a management technique for the economists, system organisers and engineers whose objective is the cheaper management of information resources and the better management of corporate information assets (Dobay, 2003).

Material

According to Kapronczai (2007) information means functional knowledge for a specific purpose which helps base and execute decision making. Ficzeréné et al (2009) concluded that information must refer to opportunities and must protect the company from risk taking to serve planning, controlling and last but not least, internal controlling through creating an internal control system. If we go further, Atkinson (2007) stated that information provided by managerial accounting plays an important role in forecasting and planning processes. In addition to providing factual information about the current situation of the company, it is in tight connection with meeting future objectives and plans. Michelberger (2002) did not only approach the definition of information system from the aspect of information technology. According to him 'the main parts of the information system are humans responsible for basing and making decisions, internal and external information as well as internal and external hardware, software parts and organisational solutions.' Zárda (2009) stresses the systematic application of management accounting for agricultural enterprises, too. In his study he concludes that the parallel applicaton of managerial accounting and the test system Farm Accountancy Data Network (FADN) farms can be more effective and efficient than their competitors. In addition, the information provided plays a role in making decisions and supporting the management.
As a result of his research, Hágen (2009) draws attention to the fact that it is necessary to adapt new procedures, methods, to be open to new innovative systems and these must be incorporated into the mechanism of decision making to run the enterprises efficiently. To this end, integrated enterprise resource planning can help a lot as Herdon - Rózsa (2011) put it. They emphasize that these systems serve as a framework for collecting, processing and forwarding information while meeting production, service providing and controlling tasks. The efficiency of this process can be kept if users are properly trained even before starting to use the system (Katonáné - Csomós, 2010).

In our opinion the data created during the running of a company have been playing a greater and greater role, which can be turned into information and then knowledge after being processes. As more and more electronic data and others in various forms are created it is inevitable to use technological inventions such as computers and enterprise resource planning.

Kapronczai made the following statement in several of his lectures and studies: ’It is not true that the Hungarian agriinformation system is in ruins and the news about total anarchy is simply not true although it is certain that the gap between information needs and information base has become wider, which calls for rethinking the information systems of agriculture’. (Kapronczai 1999) The common impacts of several factors have played a role in the emergence of this issue:

The hasty deregulation of the late 1980s’ when several of the existing data collections and databases were heedlessly abolished, which proved to be a mistake later on.

The faulty conclusion that information requirements will decrease under the circumstances of a market based economy.

The late execution of tasks concerning our harmonisation with the European Union.

Last, but not least, agriculture has been made ’more complicated’ which must be displayed by the information systems. On the one hand, it means that previously the thorough examination of 3-4 thousand farms was enough to have a picture of the total agricultural system, today at least ten times more are necessary. On the other hand, product path connections were better regulated and easier to understand, which also made the display of real processes easier.

Due to all these reasons agriinformation system developments have especially been stressed these days with an objective that they must comply with EU expectations and standards in addition to complying with the Hungarian traditions and expectations.

To this end, the main stages and objectives of this work are summarised by Harnos - Szenteleki (1999) as follows:

working out the methodology of data collection
carrying out data collection
working out the methodology of statistical evaluation
working out the methodology necessary for evaluating industrial data
applying the results of methodolgical research in the case of a concrete database
working out the methodology of providing primary and secondary data and
testing data.

In addition to paying a special attention to the stages and objectives above it is also important to consider that parts of the system must be managed as one and accordingly, the system must be designed in a thorough systematic plan when adapting a modern agriinformation structure in Hungary. It means that ranging from enterprises through regions to the government and supranational organisations possibly consistent (sub-) systems based on one another and able to communicate in all directions must be established. At this stage, however, an emphasis is placed on creating the structure of the information system and ensuring connection between its subsystems.

Concerning the research, 2000 questionnaires were sent out in the Northern Hungarian Region, 500 of which have been assessible and evaluated.

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 responsed 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.

Method

Our research results are based on a questionnaire conducted in the North Hungarian region. Personal contact as a method could only partly be carried out due to both the deadlines and regional separation. To keep the personal touch and the power of acquaintances as well

enough questionnaires should be filled in, the involvement of county farm counsellors proved to be inevitable.

The questions of the questionnaire were separately analysed by using grouping variables and separated on the basis of the hypotheses. These are the following hypotheses:

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: 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.

H3: 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.

The questions of the questionnaire were:

- General information
    - Who and in what form does farming in the region?
    - What personal competencies do farmers have?
    - Is there a correlation between establishing an enterprise and personal competencies?
    - How do farmers see the future of their enterprises, do they have a vision or a strategy for the future?
- Information requirements, infrastructural background
    - What do they think about the infrastructural situation of their environment?
    - What are the opportunities of gaining information like in the region?
    - What are the training and technological opportunities like?
    - Are properly trained specialists available?
- Alternative solutions
    - Are suitable IT instruments available and do farmers have an internet connection?
    - What is the decision making process like and where is the necessary information available from?
    - What are information requirements like and how frequently is this type of information used?
    - What alternative solutions and opportunities exist? How do farmers see the future of their enterprises, do they have a vision or a strategy for the future?

Results

To meet the information requirements it is necessary to examine what information is required by the producers and if there is a concrete, well established need or objective in connection with obtaining information.

Table 1 illustrates the results of the factor analysis carried out to survey the requirements.

Of the sample included in the survey the own value decreased below 1 in the case of the fourth factor so it is practical to distinguish three factors where fraction of variance is 63.93 per cent (properly discernible from Table 1).

Table 1: **Total explained variance II.**

Com-ponent	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumu-lative %	Total	% of Variance	Cumu-lative %	Total	% of Variance	Cumu-lative %
1	5.007	41.723	41.72	5.007	41.72	41.72	2.99	24.99	24.99
2	1.407	11.727	53.45	1.407	11.72	53.45	2.53	21.09	46.09
3	1.258	10.482	63.93	1.258	10.48	63.93	2.14	17.84	63.93
4	.982	8.186	72.11						
5	.863	7.188	79.30						
6	.700	5.834	85.13						
7	.494	4.114	89.25						
8	.360	3.001	92.25						
9	.287	2.391	94.64						
10	.232	1.929	96.57						
11	.223	1.861	98.43						
12	.188	1.565	100.0						

Source: own compilation based on SPSS analysis

The factor analysis presented by Table 2 explains what information was required by the respondents. It can be seen at what parts of factors correlation is high so these linear connections define the possible correlations.

Table 2: **Rotated factor weight matrix II.**

To what extent is the information below required?	Component		
	1	2	3
Technology		.198	**.894**
Technical	.124	.140	**.853**
Legal	**.836**	.176	.155
Financial, taxation	**.837**	.149	.229
Project opportunities	.163		.295
Sales opportunities	.208		.530
Marketing	.493	.574	.183
Human resource development	.231	**.837**	.118
Corporate management	.231	**.839**	.106
Opportunities for alliances		.700	.166
EU regulation	.691	.383	.203
Decrees, laws	**.820**	.198	.204

Source: own compilation based on SPSS analysis

According to the responding entrepreneurs primarily technological, technical, legal, financial, human resource development and management information is necessary for the smooth running of the enterprise and its management. In addition to these requirements, some weak correlation could be detected in the case of cooperation and alliance opportunities and information requirements on European Union regulations.

By synthetizing our surveys and other researches we have come to the conclusions below:

- There is a need for such an integrated enterprise resource planning with a suitable online database connection even in agriculture that can assist in management and support functions in addition to production.

- The database requires such a central information storage that can advise on concrete areas by making use of modern geoinformation systems either on technology (optimising crop rotation, nutrient supply, agritechnical processes) or sales (stock exchange data connection, market information supply system).

- Of course, legal and financial advising is also possible this way and also integrated enterprise resource planning can be used in taxation and accountancy as well as logistics, warehousing, purchasing and also this system can also help in billing.

An important point in the successful running of an information technology based system is that the targeted users must be capable of operating it.

The existence of these abilities is presented by Figure 1.

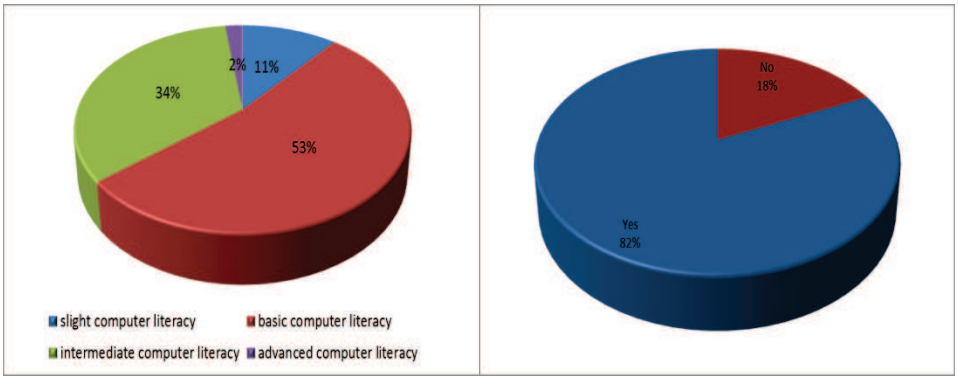

Figure 1 Meeting IT competency needs and the ratio of information system users (information surfaces, portals, programmes etc.)
Source: own compilation

It can be seen that those involved in the sample have at least intermediate level IT skills as 87% of the respondents have basic or intermediate computer literacy. Based on their competencies, a great part of those involved are suitable for making their work more effective and meeting their information requirements by using IT instruments. Moreover, it is also concluded that 82% of the respondents use a kid of information system, surface or portal at work.

The purpose of use is illustrated by Figure 2.

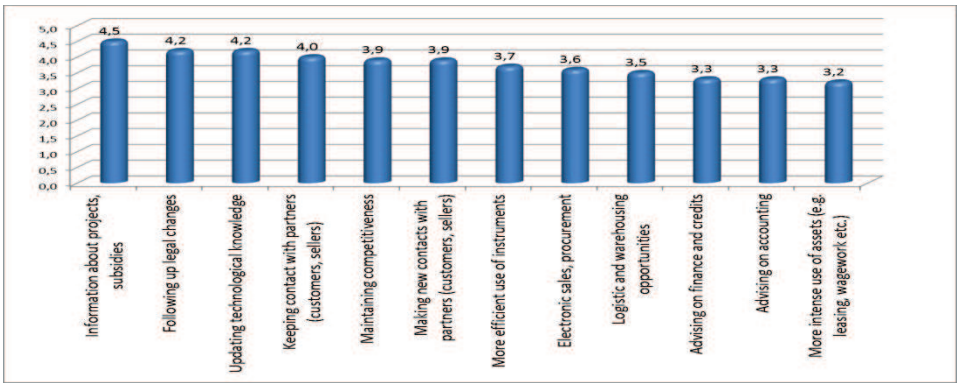

Figure 2 The purpose of using information systems
Source: own compilation
The figure clearly presents that the respondents evaluated the most important activities on a 5-degree Likert scale.

Conclusions

It can be concluded from the results of the study that a significant proportion of producers in the sample have specifically formulated information requirements whose acquisition, process and interpretation is almost impossible without an adequate IT background. It has also become obvious that the respondents mostly use the information systems to gather information on subsidies and applications, to upgrade technological skills and knowledge, and also to follow legal changes. However, they prefer personal contacts in connection with information about available economic services.
From the point of view of this research it is an important achievement that 96% of the respondents stated that the application and use of an integrated information system could increase the competitiveness both of their own businesses and that of agriculture.
With the consideration of the results of the research we have developed a model which, we believe, would be suitable for solving the problems we raised and significantly speed up the flow of information. The system is named 'ATIR' or Agricultural Advisory and Information Service System

The model would contain the following parts and modules:
The **first module** would contain technological information. The module would enable users to obtain concrete, economical technological alternatives after uploading proper input data by being connected to different sensors (e.g. Cubilog, geoinformatics) and databases.

The **second module** contains business calculations and return on interest (ROI) indicators in connection with production and infrastructure development. When creating or transforming the system of production as well as when planning investments the knowledge of possible ROI indices is essential. This module produces this type of information. A database could be connected to this module where a list of instruments to be leased and uploaded by the producers with the maximum period of lease would be displayed. This connection with the business calculations mentioned above would make the creation of a network system possible and would also make the use of assets more efficient.

The **third module** can be used for mapping commercial channels and meeting supply and demand. This module would also be suitable for establishing an online market in addition to stock exchange information and trade. On the basis of the requirements of producers, buyers, merchants and distributors the system could select needs that can go together based on a certain criterion and sends a report to users about it.
On the basis of stock exchange forecast and possible trends alternatives on futures can also be offered.

The **fourth module** would include financing alternatives. In this module a guide can be found about crediting, projects and subsidies. In terms of crediting preliminary qualification and ranking as well as selecting suitable alternatives could be included. A project monitoring system would supplement the module to map projects and subsidies, which would make farmers find their way in this system that seems to be difficult and too complex sometimes. After uploading the requirements the system selects the most suitable opportunity (opportunities) and provides information to assist decision making mechanism.

The **fifth module** would update and make legal background easier to follow by liaising with different databases. The module must be suitable for monitoring and by sending a message or a notification it informs about legal changes and gives a short report on the operative tasks following these changes.

The **sixth module** would perform accounting, billing, warehousing and logistic tasks. Its operation is similar to that of enterprise resource planning as these activities are not significantly different in agriculture, either.

The structure of Agricultural Counselling and Information Providing System is illustrated by Figure 3.

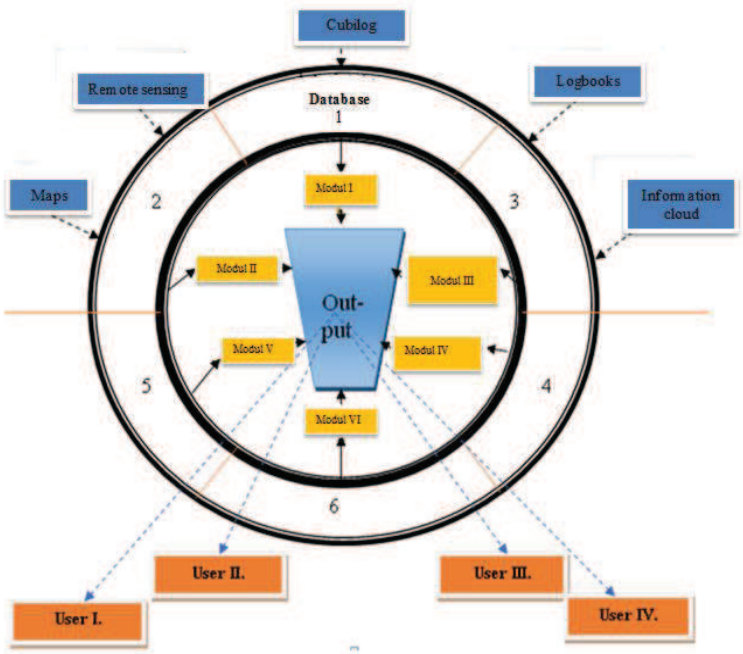

Figure 3 The logical structure of 'ATIR model'
Source: own compilation

By using the sensors and databases of the model above with the help of the six modules almost the entire process can be modelled. By means of a transformer or a system that transforms input data into output data meeting the needs of the users it makes a report and this way it promotes efficient and proper decision making.

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