

UNIVERSITY OF DEBRECEN
CENTRE FOR AGRICULTURAL SCIENCES
FACULTY OF AGRICULTURAL ECONOMICS AND RURAL DEVELOPMENT
DEPARTMENT OF BUSINESS AND AGRICULTURAL INFORMATICS

DOCTORAL SCHOOL OF INTERDISCIPLINARY SOCIAL AND AGRICULTURAL
SCIENCES

Director: **Prof. Gábor Szabó, DSc**

PhD Thesis

**POSSIBILITIES AND DEMANDS OF MOBILE INTERNET BASED
APPLICATIONS IN AGRICULTURE**

Submitted by:

Róbert Szilágyi

Supervisor:

Miklós Herdon PhD
Associate Professor

DEBRECEN
2006

1. RESEARCH OBJECTIVES

The development of information technology has had a considerable influence on the agriculture of the highly industrialised nations as well. There have emerged a number of new industry-specific technologies and new applications over the past few years, including the ever widening agricultural application of mobile communications devices and technologies. Further considerable improvement is expected in the use of the PDA, the personal digital assistant, and mobile computers (Handheld Computers) as well as other mobile devices in both foreign and Hungarian businesses. This is also strengthened and justified by the high number of projects aiming at the development of mobile communications devices, systems and applications supported by Framework Programme No. 5 of the EU and the priorities included in Framework Programmes No. 6 and 7. The Czech Wirelessinfo and the Ami@NetFood projects, (the latter on with Hungarian participation) are good examples for the agricultural exploitation of the opportunities offered by the technology and for presenting these opportunities. Securing high broadband and mobile Internet access for everybody, especially for those living in rural areas (e-Rural) is among the first priorities of the research and development programme of the Information Society Technologies (IST) of the EU. According to research-developmental and application trends as well as forecasts and expectations these technologies and services are to become widely applied tools in enhancing business innovations and supporting business management.

As regards the target area the following research objectives have been drawn up:

- **Investigating and analysing the developmental trends of the means of mobile communication technology and the development of services.** On the basis of international and domestic trends I wish to investigate and justify the hypothesis that technology is gaining a more and more important role in the lives of both organisation and private individuals. Gaining international outlook and transplanting its results into our domestic environment may become useful in forecasting changes at home.
- **Investigating the innovation factors of the means of mobile communication technology and applications.** The evaluation of the impact of technology can only be done when the innovation factors inherent in the technology have already been made clear. After drafting the factors it is vital to investigate the more important domestic issues. In order to carry out this task of assessment and analysis a questionnaire survey has been prepared.

- **Analysing agricultural applications and application opportunities built on Internet technology.** Due the specific requirements of the agricultural industry the existing general applications, opportunities for their agricultural application and the different already operational agricultural application systems solutions and experiences have to be analysed. By outlining the opportunities for application and presenting concrete applications it is my objective to provide opportunities for domestic applications after the technology has been made more widely available.
- **Development of mobile Internet applications for mobile tools supporting economic activities of agricultural businesses.** After reviewing the technical literature the preparation of prototype applications was made a target as an important partial task. This objective was motivated by the requirement of getting to know developmental tools and systems and developing a prototype system, which was meant to demonstrate opportunities for the development of mobile applications and the use of developmental tools. In the course of developing the applications great emphasis is laid on the characteristics of technologies and mobile services available in Hungary.
- **Practical testing and application of the developed and recommended applications.** Testing the practical applicability of the completed applications, repairing the occasional defects and needs for modification occurring during testing are basic preconditions and parts of the development in information technology. The experience acquired during testing may reveal further needs for the application of the device and therefore this area has also been a vital area of my research.
- **Analysis of the practical applicability of the developments and recommendations for their dissemination.** It is the practical applicability of the developments prepared that will decide on their future application. The fact that an application is worth nothing unless it is made use of must not be overlooked.

2. HISTORY AND THE RESEARCH METHODS APPLIED

My choice of research area was motivated by several considerations. Having graduated as an agricultural economist and my interest in informatics led to to choose a research area that embraces both of them. While studying the relevant technical literature I realised the wide spectre of potential opportunities inherent in the technology. More and more foreign and domestic research started in mobile communication in the past few years and the dynamism of the research results and the development of mobile network services justified my assumptions. At the “Systems” 2003 exhibition in Munich, Germany I had the opportunity to see several progressive developments that showed me the direction of oncoming development. I was also greatly influenced by conferences EFITA 2003 and EFITA 2005 where demand for mobile informatics in agriculture appeared markedly. Last but not least I chose this research area because of the more and more frequent agricultural applications.

Technical literature as such is treated in this dissertation as parts of the individual chapters and is dealt with there. The inclusion of the relevant technical literature in the individual chapters is justified by the fact that this treatment gives better grounds for the theoretical foundation of the topic as well as enhances the understanding and evaluation of the given part.

The different segments of my research required the application of different approaches.

In the course of investigating domestic and international mobile communication it was my aim to assess and process the sources found in the technical literature. In analysing the practical applications I made use of my own already published results in addition to the ones found in the technical literature. The applications were evaluated on the basis of user assessments and through consultations at conferences.

The international situation regarding the mobile Internet and mobile communication was studied on the basis of the statistical data published in OECD Communication Outlook 2005. To get an overview of the data for Hungary I used the statistics of the Nemzeti Hírközlési Hatóság (National Information Authority) and the publications of Információs Társadalom és Trendkutató Központ (Information Society and Trend Research Centre). In my data collection I was restricted by the fact that my attempts at obtaining Hungarian and foreign data relevant to my research area (utilisation of mobile Internet in agricultural management) failed since they were not available either from the Nemzeti Hírközlési Hivatal or other sources. At the

same time in order to justify my research I thought it worthwhile conducting a (although not representative) survey which may lead to a more thorough study later on.

In the course of developing the applications I had the opportunity to get acquainted with several development environments. In developing WAP (Wireless Application Protocol) applications the consultations with the Budapesti Műszaki Főiskola, Neumann János Informatikai Kar, Mobil Informatika és Mesterséges Intelligencia Szakcsoport (Mobile Intelligence group of János Neumann Faculty of informatics of the College of Technology of Budapest) proved very useful. In Java development activities it was the consultations with the Java developers of Debreceni Egyetem, Informatikai Kar (Faculty of Informatics of the University of Debrecen) that provided useful initial bases. In the course of developmental work I had to resort to unique solutions in a number of cases, which also gave me opportunities to go deeper into the particular development environment. In system design and programming tasks exchanges of ideas with other developers proved very useful. The experiences gained in the course of testing the prototype applications can be made good use of in further developmental work.

3. MAJOR CONCLUSIONS OF THE THESIS

The focus of my research was the Internet applications based on mobile devices and the assessment of their effects on agriculture. Due to the fact that the development of applications and user applications require wide-ranging condition and effect systems the investigation of several condition and effect mechanisms and research tasks were carried out.

International and domestic trends and expected improvement of the utilisation of mobile communication tools were studied. Also, innovation factors of mobile communication technological devices and applications were analysed. Following the assessment of agricultural applications and opportunities of applications based on mobile Internet technology Internet prototype systems, supporting the economic activities of agricultural business were developed for mobile devices. The systems developed were tested in practice as recommended applications and recommendations were made for the propagation of mobile applications.

3.1. Analytical results of the studies on the improvement of modern communication devices and applications

In the course of my studies of the application of mobile communication technological devices it was concluded that there were several types of wireless communication systems and that they provided different services. The comprehension of the mobile Internet is not totally unequivocal and may give rise to misunderstandings, despite the fact that it can be considered a well-defined area. The improvement of mobile systems can well be demonstrated both as regards the speed of data transfer and services. 3G (third generation mobile telephone system) and wireless networks (Wi-Fi) have several similarities and differences too. The access to wireless Internet services can be realised by using a number of technical solutions. The assessment of the mobile Internet from the point of view of business, however, must not be conducted outside their own particular contexts as this area is rather complex. After studying the applicable devices and the services built on them it became evident both the characteristics of the devices applied and the economic factors of their operation showed a heterogeneous picture. As a result of technological development devices with more and more novel functions and degrees of integration as well as services to accompany them will emerge.

The improvement of services will largely be influenced by the fact that with the long-term increases in transportation costs communication is to gain more and more importance. Figure 1 illustrates the evolution of the telephone, the GSM (Global System for Mobile Communication) and the wireless Internet in Japan. The table clearly demonstrates that the number of subscribers to the wireless Internet rose sharply after the technology appeared in the country. Due to the characteristics that are inherent in Japan a breakthrough of this magnitude is not expected in Hungary but the spread of the wireless technology is worth paying attention to anyway.

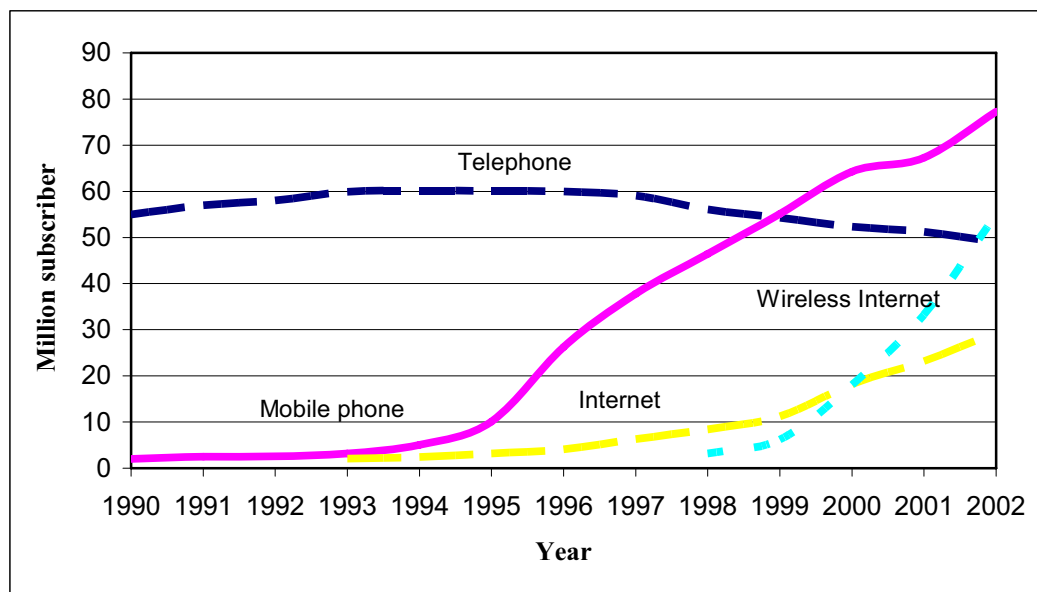


Figure 1: The development of the telephone, the GSM, Internet and wireless Internet in Japan (TAKAHASHI, 2002)

International trends reveal that the prices for IT (Information Technology) devices and services are decreasing, which is bringing about decreases in the communications costs of enterprises (Figure 2). It is surprising that the price indexes for communications devices and services in the EU 15 countries decreased by almost 16 % in 2003 compared with the same data for 1996.

Distance employment made possible by the Internet and mobile employment opportunities open up totally new dimensions in taking up jobs. Managing personal information has a positive effect on the successfulness of businesses. In compliance with the international trends above there are similar changes, although with a certain phase of delay (Figure 3) going on in Hungary as well. By the third quarter of 2001 the number of mobile subscriptions exceeded the number of live main lines. The dynamics of the increase is well illustrated by the fact that

while the number of wired main lines remains nearly constant the number of mobile subscriptions increases continuously.

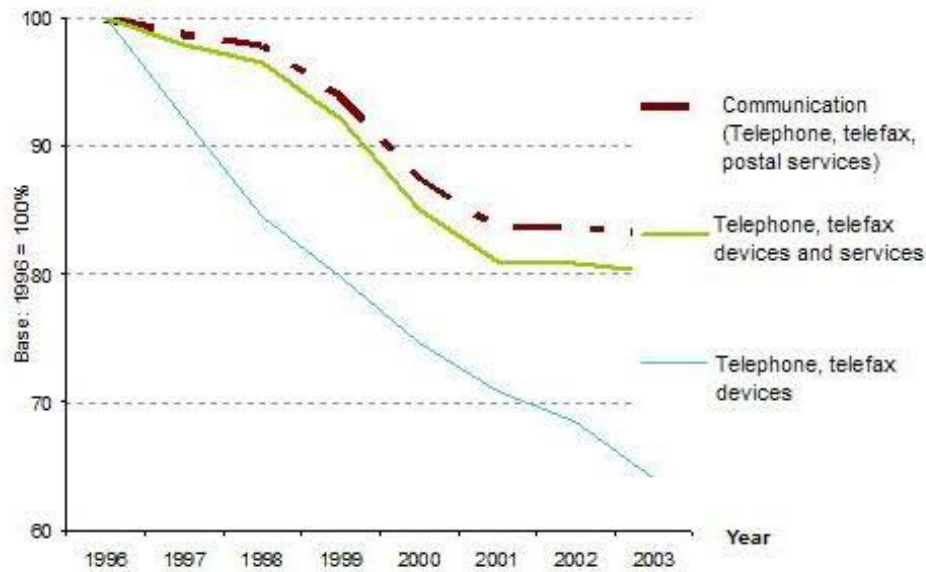


Figure 2: The development of the telecommunications price indexes in the EU 15 (OECD, 2006)

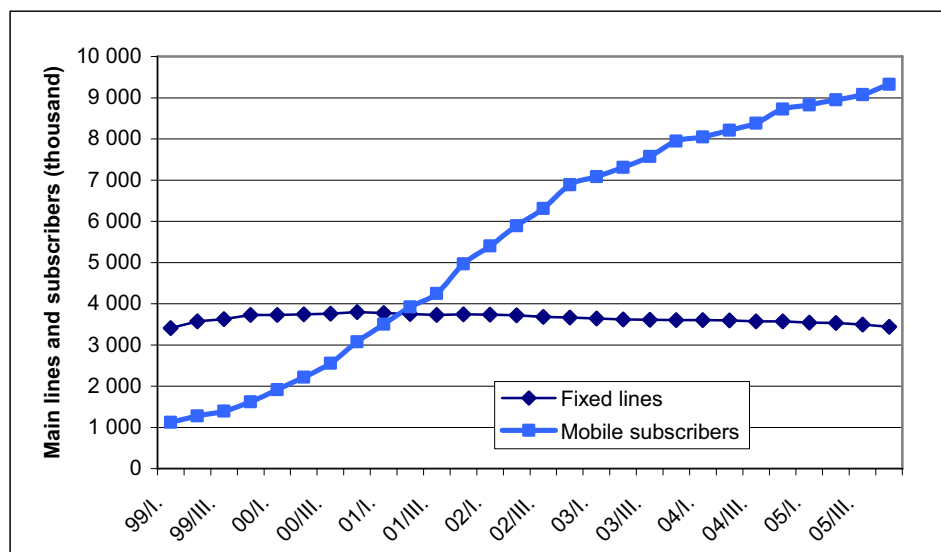


Figure 3: The development of live main lines and mobile subscriptions between the first quarter of 1999 and the third quarter of 2005 (NHH, 2006)

3.2. The results of the studies concerning economic effects and innovation factors

The studies on the innovation factors of the devices and application of mobile communication can be summarized as follows. None of the measurable and non-measurable advantages of IT can be picked out as they have to be analysed in a complex system. As regards the trio of datum, information and knowledge it is knowledge and the demand for and ability to transfer knowledge that stand out, which can be realised quickly and effectively through mobile

technology. Economic and social trends as well as technological opportunities create a contiguous system. The relevant social groups of mobile communication (producers, civic groups, companies, consumers, workers) and the relationships between them are crucial factors. The ever increasing spread of mobile communication (and within it the spread of the Internet) is an obvious development, which is characteristic not only abroad but also within Hungary.

3.2.1. Innovation factors

Due to the complex factors mentioned above, the innovation factors linked to mobile technology can only be characterised only following careful studies. Innovation, adaptation and diffusion are influenced by several factors. The costs related to the environment (economic, cultural influences) and knowledge transfer are crucial factors. The model-like interpretation of usefulness throws light on the link between practical use, social acceptance and the subjective feeling of usefulness. I did not fully accept Nielsen's usefulness model and introduced the overall concept of utility in place of the concepts of usefulness and usability. The model that was modified by me is seen in Figure 4.

The technological life cycle must not be forgotten either. The correct identification and interpretation of the current stage in the life cycle will define the future position of the technology. The relationship between the profitability of a company and the existence of the Internet has to be studied carefully since personal and business communications do not separate from each other clearly. The Internet cannot be made use of at each and every stage of the decision making process but it can be accelerated by using the Internet. Due to the peculiarities of agriculture mobile technology may become the right answer to the question of providing the necessary information "just in time". The demand for securing information is not a problem of our age only and emerged in earlier decades but the technical potentials could not give a perfect solution then.

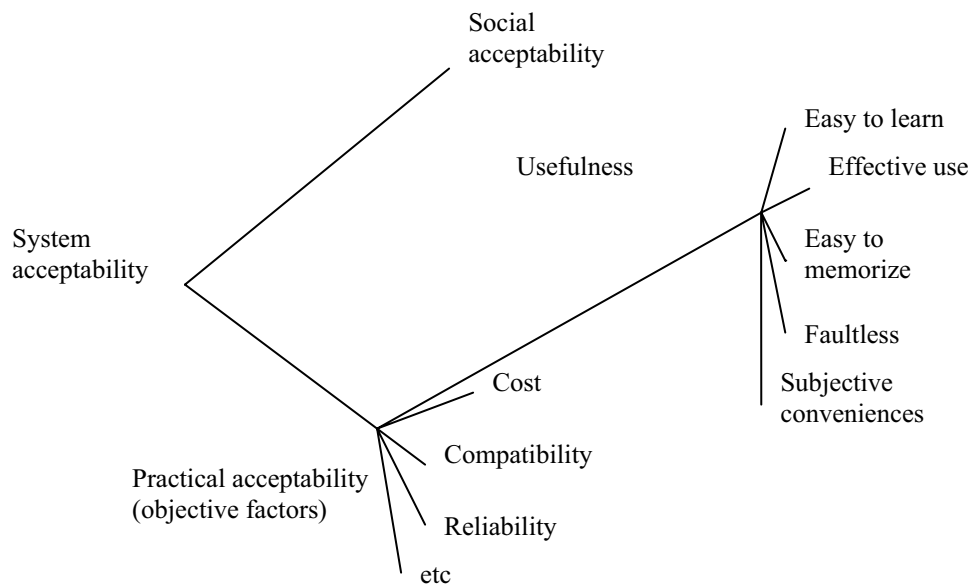


Figure 4: Nielsen's modified usefulness model (based on NIELSEN, 1993)

As regards innovation the following measurable and non-measurable major IT factors can be highlighted.

Measurable advantages include:

- Reduction of costs,
- Higher productivity,
- Higher profitability,
- Bigger market share,
- Saving man working hours,
- Bigger consumer surplus.

Non-measurable advantages are as follows:

- Better service,
- More efficient organisation,
- Better knowledge of consumers,
- Outstanding product quality,
- Knowledge transfer, knowledge management,
- Better co-ordination.

3.2.2. Results of the structured interviews on the evaluation of the mobile Internet

For the purpose of analyzing mobile Internet user expectations I have gone through a series of structured interviews. There are two parts of this analysis: I have talked with experts and farmers. In this paper we present the results of the survey conducted in July and August 2006, based on interviews with the experts. I have tried to contact 400 experts based on the e-mail address list in National Rural Development Plan (Nemzeti Vidékfejlesztési Terv). 87 of them replied to my query. I have interviewed 16 rural agronomist in Hajdú-Bihar county in person. Breakdown of the 87 experts by location: Northern Hungary 12%, Middle Hungary 5%, Western Transdanubia 11%, Southern Transdanubia 4%, Southern part of the Great Plain 16%, Northern part of the Great Plain 45%, Middle Transdanubia 7%.

My statements are mainly based on the questionnaires of experts. Regarding the ownership of telephones, mobile phones or computers the respondents are pretty well supplied. On the other hand only a few of them has PDAs (Personal Digital Assistant). Looking at technologies and services these experts use we can see that e-mail, WWW and SMS are widespread (77%); other services such as weather forecast data, e-bank or professional guidance are not so common (25-45%). 22% uses WAP, this proportion corresponds to the current Hungarian average. The cause of low WAP usage probably can be found in the scarce content of WAP services. 47% of them are using these mobile phone services (WAP, M-bank, SMS) during work.

Examining the reasons mentioned by those who do not use mobile Internet we can see that the most important factor is money. At the same time about 2/3 of them said that they would use this new technology in the near future. It can be stated that according to the results of my examination mobile technologies are very important in keeping contact, organizing work and other social activities (Figure 5.). Looking at mobile applications work anytime anywhere and flexible access has a leading role.

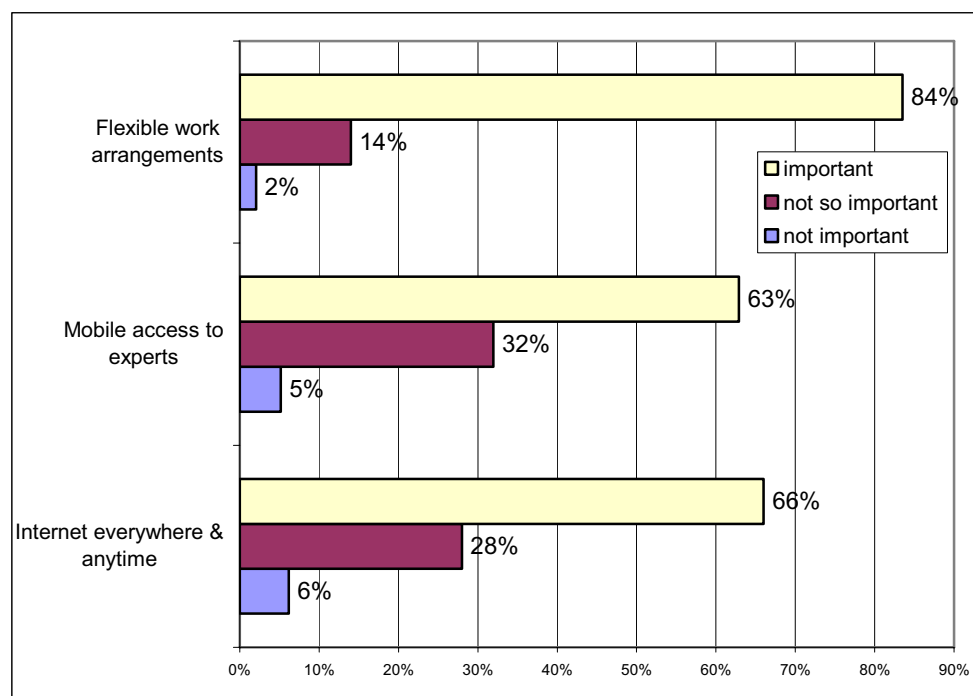


Figure 1.: Human aspects of mobile work (own source, n=103)

Assessing applications getting information and e-government is important in the eyes of the experts as the result show (both at 53%). We think it is welcome news that precision farming

(33%) and food safety (35%) are getting more significant (and so do environment monitoring and e-learning – 37% and 33% respectively). 26% of experts is understanding the importance of mobile data input, and 24% sees the advantages of a mobile information system (Figure 6.)

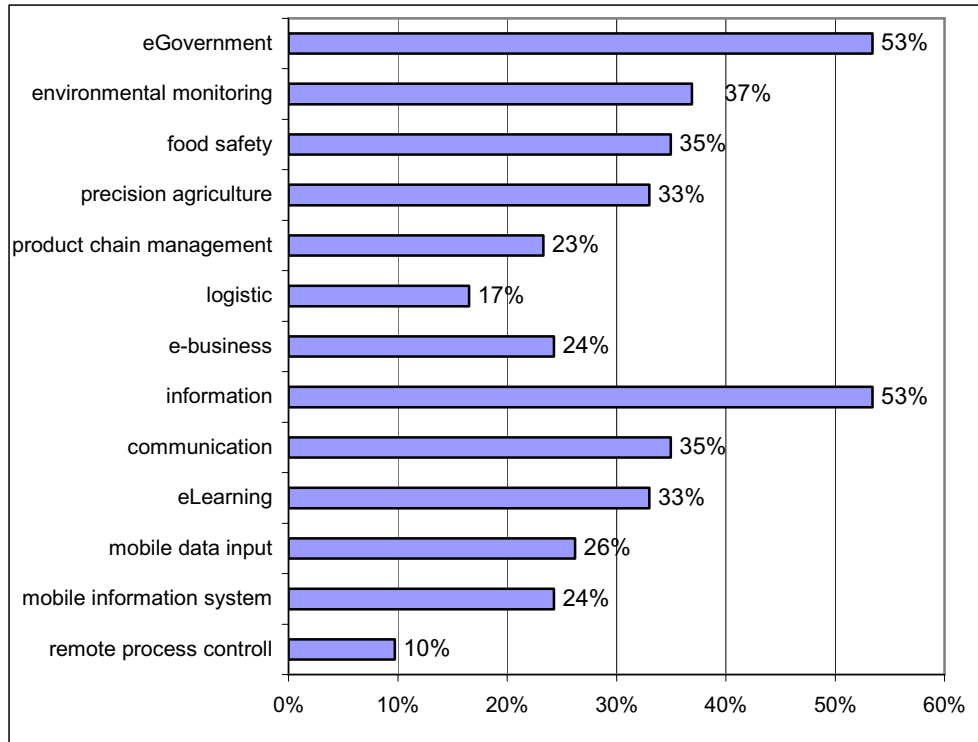


Figure 2.: Assessing mobile application attributions (own source, n=103)

3.3. Results of the study on agricultural utilisation potentials

In the course of assessing the agricultural applications built on mobile Internet technology the areas where this technology has already been applied were analysed. The study had a dual objective: on the one hand an outlook on the applications was given and on the other hand ideas for new improvements could be obtained. Most of the applications deal with data exchanges, due to which the compatible data format is of crucial importance. Due to the peculiarities of agriculture German researchers are trying to make the data exchanger simpler by developing the agroXML programming language. The range of problems faced by decision-makers in agriculture can be broken down into three major areas:

- uncertainty due to natural influences (weather, sunshine, temperature, etc.),
- uncertainty due to the insufficient knowledge of biological and physical systems,
- uncertainty due to the random nature of processes.

Wireless data transfer technologies can very well be utilised in precision management. Such a form of management cannot even be thought of without the use of wireless technologies.

Handling map data required by precision management cannot be solved without wide broadband applications. As regards the wireless technologies it is the satellite transmission and WLAN that offer good alternatives. The advantage of satellite data transfer is the coverage of large areas and its disadvantage is that its price is still high.

Mobile devices in crop production, horticulture are primarily used for data surveying. The more efficient and instant data recording is considered to be the biggest utilisation advantage of PDAs with GPS connection. The most important criterion in agricultural data surveying is simple handling and that the device should be resistant to wear and tear. There have been applications prepared already for the distant management of irrigation and production. Their greatest advantage is the opportunity to intervene regardless of time and location.

Food safety cannot be imagined without tracing. The already available RF-ID (Radio Frequency Identification) technology coupled with mobile devices offers an excellent solution for tracing purposes. Pest control can efficiently be supported by using handheld computers. The application makes it possible to register data in the field and then download them on a central PC to run models necessary for decision-making. The registration and veterinary control of utility animals are tasks extending across countries. The E-blana project, which is supported by the EU, has prepared services that are available through mobile devices. The protection of the supply chain and the efficient and timely service can be highlighted from among the several advantages it has. Electronic trading, transportation and logistics also have applications the spread of which has every opportunity. Complex business applications, which primarily serve the flexible access to internal data, must not be overlooked either.

The Agricultural and Rural Development Agency (Mezőgazdasági és Vidékfejlesztési Hivatal) is bringing the Integrated Management and Control System (Integrált Igazgatási és Ellenőrzési Rendszer) in motion. This system controls the management of direct and market-based agricultural support of the Community. From spring 2006, all tasks related to controlling field-based support and pieces of land taking part in the Agricultural Environmental Management (Agrár-környezetgazdálkodás) project, as well as anything related to measuring territory PDA-based GPS systems are used. In every case the basis of the system is an extra sensitive THALES MobileMapper CE GPS-receiver. With the help of this receiver exact land measuring can be carried out right on the spot to help management.

The increasing interest in mobile Internet applications is also indicated by the increasing number of EU research projects. I have reviewed some of the more important research projects. Wirelessinfo was a Czech IST project in EU 5 framework programme between 1998 and 2002, which aimed at preparing high-tech mobile communication applications for rural areas. The whole project was geared towards obtaining GIS applications with wireless devices. The main communications platform was based on the Internet and was built on 2G and 2.5G networks (GSM, GPRS, HSCSD).

The objective of the AMI@Netfood project was the preparation of a Strategic Research Plan (SRA) to study and develop IST technologies and devices that can be applied in the fields of agricultural-food industry and rural development. The project is to map AMI and Collaborative Working technologies that are suitable for the agricultural-food industry and determines and defines the further R&D activities aiming at possible technologies.

The A-BARD project studies the spread and the utilisation of broadband Internet in rural areas. The project continuously assesses the difficulties related to the access to the broadband Internet. The research also covers the effect of the broadband Internet on rural development.

The AMI4FOR project aims at realising the integrated agricultural, viticultural and forestry utilisation of Ambient Mobile Intelligence between 2005 and 2007. The realisation mixes mobile communication, navigation and geographic information system-related services. The starting point of the development is the heterogeneous network environment, which can mean GPRS, Wi-Fi and satellite Internet connections. As a result of this project the flow of information may become less complicated.

The MobiLife project has 22 partners from 9 countries. The importance of the project is shown by the fact among these partners are many producers like Nokia, Alcatel, Motorola, Ericsson, Siemens, etc. and the European subsidiary of Japanese DoCoMo. The main goals of this project are:

- User centricity.
- Practical applications and services.
- Architectures and technologies.
- Evaluation.

3.4. Results of the development of applications

In the course of studying the technical literature and consulting farmers there were two directions of developments emerging. One application was related to the field register while the other concerned obtaining market price information using mobile phone. The mobile field register was prepared by using Java while for reaching market price information WAP developmental environment was used. The prototype of the modern field register makes it possible to record and reach data for arable fields. Figure 7 shows the major characteristics of this application.

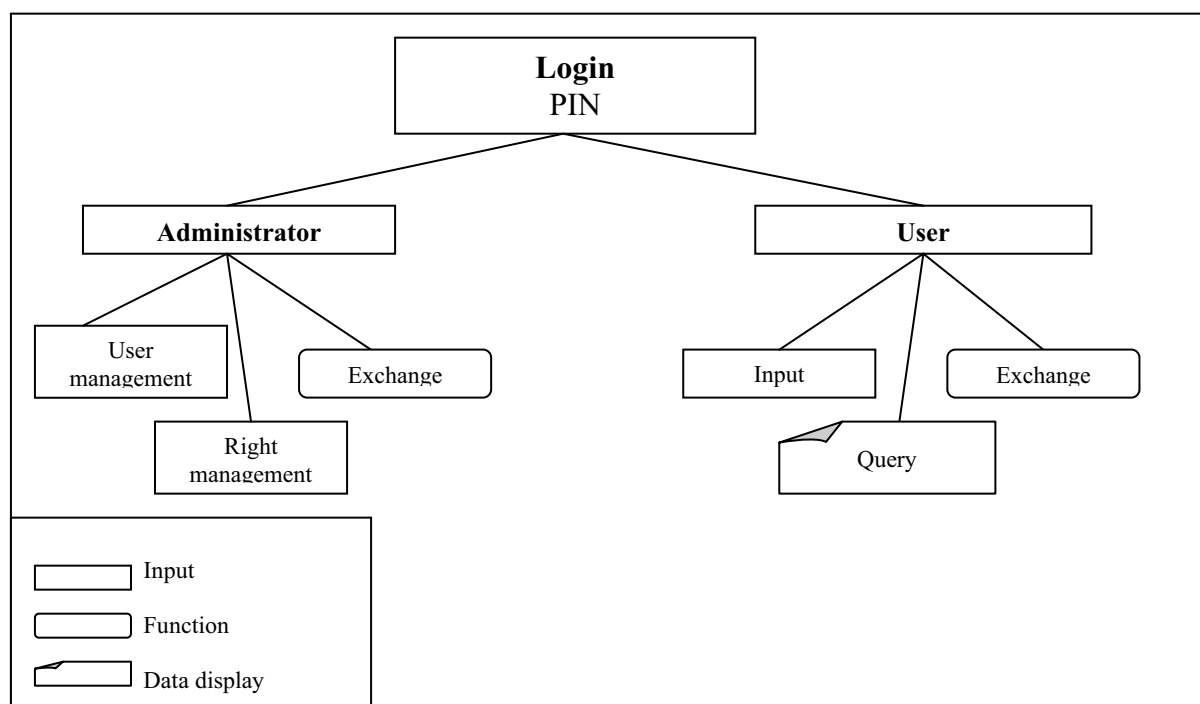


Figure 7: Major functions of the mobile field register application

During the implementation work the necessity of developing a simple and clear user interface was borne in mind (Figures 8 and 9). The use of the application is made easier by including a unit of measurement exchange function.



Figure 8: Selection of the fields

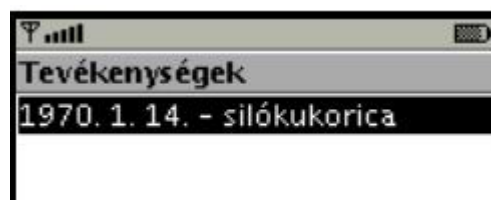


Figure 9: List of activities

The demand for reaching market price information on mobile devices appeared as a result of repeated consultations with Agrárgazdasági Kutató Intézet (Research institute of Agricultural Economics). In the course of the consultations it became clear that no mobile access had been

made available when the system was prepared. With the help of the WAP interface demo version I prepared prices can be accessed any time by using a mobile telephone. In the course of developing the application considerable attention was paid to the amount of data that can be displayed as mobile telephones have small screens.

Figure 10 shows the data links of the system. The database found on a WWW server can be accessed with a mobile telephone with the help of a WAP Gateway. Navigation is carried out with the help of links and the menu items can be accessed easily. In the course of the practical testing session the demand that data input should also be made possible emerged. Data input is possible in possession of adequate authorisation.

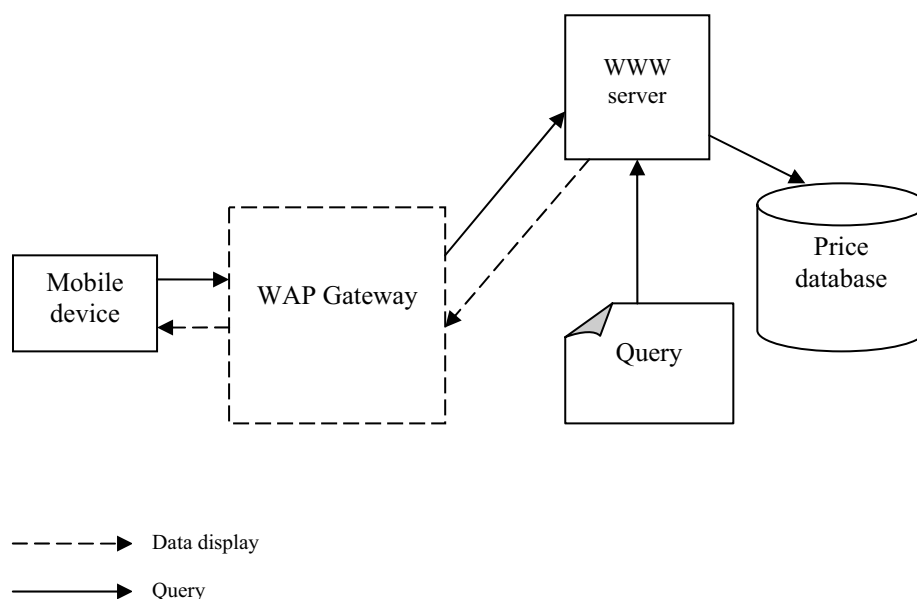


Figure 10: Data links of the system

A Nokia S60 SDK was used for the continuous testing. This developmental environment uses a larger than normal screen. The use of the larger screen was thought to be more advantageous because this is what pieces of equipment coming out in the future will be characterised by.

Figure 11 shows the structure of the system. On the opening page one can choose between the functions of asking for and inputting prices. When asking for prices the search parameters have to be entered (Figure 12) and following this step the price of the product will appear (Figure 13). In order to access the price input function one has to log in by using a PIN code. In the course of inputting the data one has to choose the parameters of the product and give its price. Before storing the price the system will ask whether to record it.

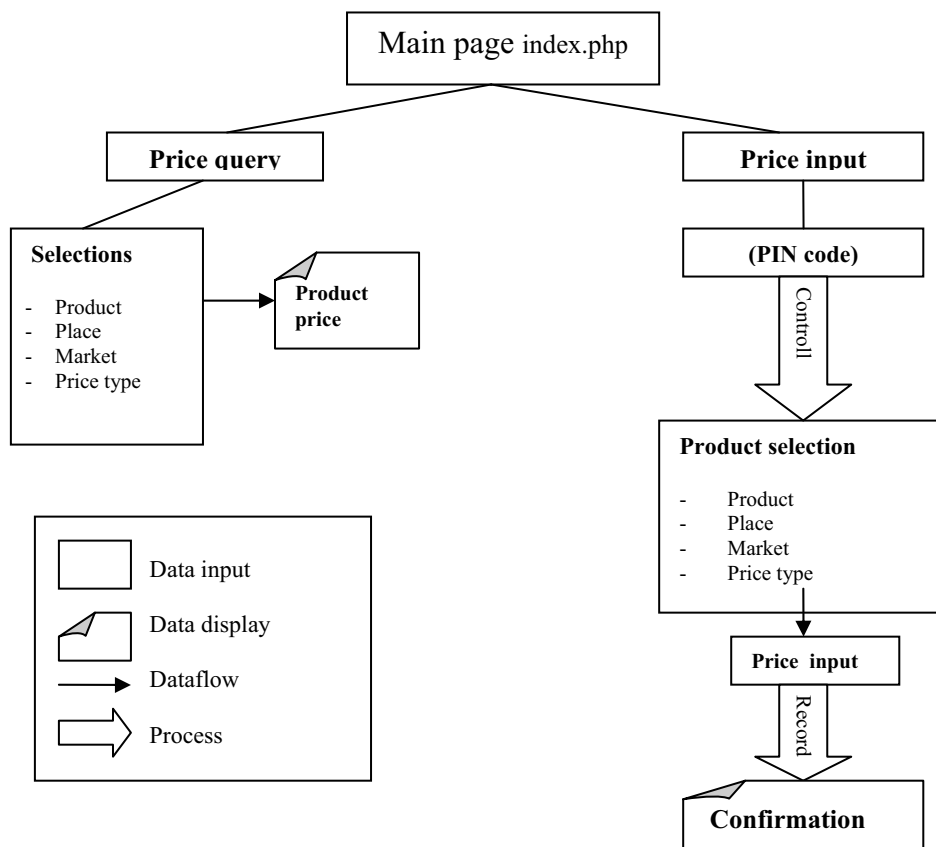


Figure 11: The structure of the system (application process)

AKI adatbázis

Termék:
gyumolcs

Származási hely:
belfold

Piac:
Budapest

Ár:
fogyasztói

Options Back

Figure 12: Parameters

Piaci árak

Fajta	Ar1	Ar2	Ar3	Ar4
Idared	47	98	78	78

Options Back

Figure 13: The visualisation of prices

The applications developed underwent practical testing. The existence of the limiting factors (small screen, simplification of navigation, restricted data input method) also described in the technical literature was verified. In the trial sessions the applications were used by persons with different degrees of informatics literacy and the pieces of equipment were also different. The defects found were corrected and comments were made notice of to the extent they were possible. There are several factors limiting the spread of the applications. A certain caution as

regards the application of mobile technology can be observed. Some users are distrustful and can only be made to use the applications with difficulties. Due to the limitations to our own funds, however, it was not possible to find a perfect solution.

In the course of my research I got acquainted with and made use of three developmental environments. The three environments are: WAP, JAVA (J2ME) and Microsoft Visual Studio.Net 2003. The developments were done under WAP and JAVA. WAP is a technology which makes it possible to link Internet and mobile tools to each other. WAP works through a Proxy server, which links the Internet to the wireless network. In the course of the developmental work the application could be tested with SDK (Software Development Kit).

The Java 2 Micro Edition (J2ME) environment was developed for mobile tools. Its main advantage is that it works well with less developed devices too.

Microsoft Visual Studio .NET 2003 is a technology used for Windows and Web applications development. Its advantage is that it supports a number of mobile devices.

Out of the devices mentioned above WML and J2ME are free but Visual Studio .Net2003 is not. It is likely that .Net will become more widespread in the future although J2ME is also popular.

4. NEW AND NOVEL RESULTS OF THE DISSERTATION

In surveying the databases and studies prepared by the EUROSTAT, the OECD and Nemzeti Hírközlési Hatóság (National Telecommunications Authority) it was concluded the technological trends clearly indicated the ever widening spread of the technology. South-Korea, Japan the United States of America and Western-Europe are among the leading users. Studies of the situation with mobile communication and the mobile Internet in Hungary revealed a trend that was similar to the international one. Hungary's lag as regards wired mobile Internet penetration is clearly seen but the population's state of supply with mobile telephones indicates that both the interest and the potential volume of users are given and every chance is there to exploit the opportunity. As regards the devices they can be said to have more and more functions, which is ensured by the high level of integration. The wider than earlier application and innovative spread of the wired and the Mobile Internet are primarily limited by economic and social factors, and the lag of the country is basically brought about by these two factors.

As regards the numerous new and novel results I wish to highlight the following ones:

1. Based on the technical literature and various studies I explored the utilisation and spread potentials of the innovation factors of the mobile Internet as an information technology thought to have excellent perspectives, and made structured interviews in order to study its domestic agricultural use. The investigations were carried out with the involvement of large-scale agricultural businesses, consultants of the National Rural Development Plan and local agricultural agents. On the basis of the interviews and the analysis of questionnaires the following conclusions were reached:
 - the essence of mobile Internet technology is well-known to users,
 - its use is low due to high service prices, the low number of the pieces of software for users and the moderate offer for service providing content,
 - The inclination and willingness to use the technology is good due to the penetration of the mobile telephone.

An even more wide-spread application in the near future is primarily expected in the fields of the electronic mail and World Wide Web contents. This may be enhanced by the implementation of the Intervention Plan named "Tudásalapú Vidéki Társadalom" (Knowledge Based Rural Society) and the expected decreases in the prices of mobile communication devices.

2. In order to assess the application potentials for and practical experience gained from the agricultural application of the mobile Internet foreign and domestic applications were collected and analysed. The developments used in practice were organised and analysed according to application areas.
 - In the course of assessing and analysing precision farming, animal husbandry, transportation, logistics and general uses it was concluded that this technology provides wide-ranging opportunities for agricultural businesses and the management of the agricultural industry.
 - Side by side with general purpose uses (electronic mail, access to information) the applications studied verified demands and opportunities for place- and time-independent uses.
 - Data collection that can be conducted anywhere and anytime, place- and time-independent data-exchange and the distant supervision and management of processes are among highly important agricultural application areas.
 - Communications technologies were also studied in agricultural mobile Internet applications. On the basis of these studies it can be concluded that communications technologies relevant to the applications (Wi-Fi, GPRS, 3G, PDA, GPS) are applied.
 - Side by side with the current heterogeneous technology the development of a uniform mobile platform is expected, which is also indicated by the R&D projects supported by the EU. In the „MobilLife” integrated project, which is supported by the European Union, for example, all the leading mobile technology developing and producing companies take part and also an European mobile technological platform has been developed.
3. A field register prototype application was prepared the can be run on the mobile telephone. The application makes it possible to input, remotely access and manage data. The exchange of data is done with the help of a mobile Internet solution. The objective of the development, i.e., access to information anywhere and anytime was realised and this in turn ensures a faster flow of information.

4. Based on the Market Information System operated by Agrárgazdasági Kutató Intézet I prepared a (WAP) prototype to access it via the mobile Internet. As a result of this development price data for fruit and vegetables can be accessed and recorded. In possession of adequate authorisation the mobile system enables the user to record price data. In comparison to the currently operating Internet solutions this system offers an opportunity to access price information independently of the user's location.

5. PRACTICAL USEFULNESS OF THE RESULTS

- Controlled interviews carried out with experts and at agricultural businesses in Hajdú-Bihar County have shown that already there is a domestic demand for the mobile Internet and the applications based on it.
- The study of the technical and economic interpretation of the mobile Internet points towards area that may become the bases for future research.
- Surveying the area of application opportunities gives ideas to starting new developments. Due to the international outlook areas will also appear that have not been well-known before.
- The experience gained from the developmental work provides a good starting point for developing new applications. In order to exploit the opportunities inherent in the technology even services working on a market basis may be developed through the involvement of developers from the outside world.

6. RELATED PUBLICATIONS

Scientific articles

1. **Szilágyi R.**: A farmmenedzsment döntéstámogatási lehetőségei, Agrártudományi közlemények, 2003 Különszám, 287-292. p., ISSN 1587-1282
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