USE OF INFORMATION TECHNOLOGIES IN RETROSPECT OF THE CZECH AGRICULTURE

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A retrospective look at the use of information technologies (IT) in the Czech agriculture shows some difficulties to which implementation of IT had to face. The purpose of creation IT in agriculture was different in centrally planned economy and in market economy. The main problem consisted in the technical level of agriculture, which formulated the need for data. In this paper the background and important factors influencing the IT in agriculture have been analyzed on the basis of available professional documents and long-lasting author's experience.

centrally planned economy; agricultural informatics; automation of IS (Information Systems); system of models; simulation approaches; complex prognostic modeling; IS in agriculture; hardware; software; Internet

Introduction

At present, no human activity can be managed without an adequate information technology (IT). Trends show that new technologies are permanently arising and their efficiency and productivity are increasing. There is a tendency for bringing the means of technologies closer to each other so as to facilitate application of information to users.

Development of IT depends upon development of computers, construction of which started in 1946. The ENIAC is considered to be the first computer (Electronic Numerical Integrator and Calculator) at the Pensylvanian University, USA. This computer was mainly the initiation of an enormous expansion of computers and computer technologies that have significantly marked the further development of almost all human activities.

In the 80s of the past century, there was an important change in computer technologies, since the personal computers (PC) were produced and were available to individual users. At the same time, a number of Information Systems (IS) was created to support the decision making at different levels. This became a strategic tool in competition process. The tremendous expansion of computer technologies is also called "revolutionary".

The use of IT in agriculture has always been difficult because of specific features of this branch. The production process in agriculture is subordinated to biological factors and strongly depends on external stochastic conditions. Agriculture has always been considered as an important part of national economy and in spite of permanently decreasing share in the national income, its role remains significant. From the very beginning of implementation of IT and various mathematical models, managers mainly appreciated the possibility of treating problems in a broad context. The need for unified IS turned up and was conceived as a permanent process of improving management and administration.

At present, the role of agriculture has broadened. A multi-functional agriculture includes not only alimentation, but also landscape and environment, waters, forestry etc., which is calling for adequate information. The use of IT in agriculture is conditioned by:

- Quality and type of economy and political system,
- Specific feature of agriculture and livestock production,
- Attained level of IS and IT,
- Attained level of science and research.

In addition to this, there is also the traditional conservatism of rural population and limited finance which have to be taken into consideration.

Creation of IS in agriculture in centrally planned economy

Agricultural informatics has to fulfil the following functions:

- Automation of administration,
- Database of knowledge,
- Statistical data for headquarters,
- Support to marketing activities,
- Support to decision making and management.

In the period of administrative centralism the production structure of individual holdings was determined according to the centrally formulated plan for all agricultural units. The main disadvantage of such directive planning was evidently the fact, that not the producer, but the administrator should have been responsible for the production results that he/she, in fact, was not. The central link of the administrative chain was not in the position to react to all modifications of the process, which occurs in agriculture in the course of a year. This was discouraging for managers at the farm level searching for ways to the best results and the smallest cost, as well as for optimum use of available sources.

From this philosophy of planning, in the second half of the 70s (K a d l e c et al., 1978), resulted endeavor for Automated Branch System of Planned Indicators (ABSPI) which was conceived as a tool for automated compilation of uniform models and a special database for preparing plans on all levels for Agro-Industrial Complex (AIK).

The ABSPI on the farm level included basic information subsystems such as stocks, remunerations, accounting, etc. It included also some decision making processes in the area of livestock reproduction. The library of "AGRODAT"* contained series of programs for compilation annual farming plan, which included normalized use of fuel and energy, labor, machinery, chemicals, finance, etc. Basic insufficiency of this plan calculation was the purely mechanical processing of elementary data and the result was an elementary information with limited informative value. ABSPI contributed a little to the development of business initiative and left no space for creative farm management.

Automated System of Planned Indicators (ASPI) was created within the framework of Automated Management System (AMS). It was built up in the years of 1973–1980 as a unified complex, which included human factor, information base, tools for collection, processing and transferring data. It also contained methods and principles for managing this complex. The AMS aimed at improvement of management, mainly at the increase of reliability and accuracy of individual stages of the management so as to intensify effectiveness and productivity (H i r š, 1977).

This complex has never been finalized for various reasons. In spite of this it played an important role in exploitation of IT. It represented a stage of science development and practical management, within the results of diverse areas of science and ways of implementation were combined and interlinked.

In the branch of agriculture for example, Automated Information Systems (AIS) for beef and veal, pork, veterinary services and testing experiments in plant-production (V i n š, 1977) were created. These information systems were applied for checking and managing livestock reproduction, developing veterinary services, taking measures in plant-production, improving health care in animal husbandry.

Positives of AIS can be found in

- Access to computer technologies for larger farms,
- Transfer of important series of socio-economic indicators to computers (mainly the accounting),
- Possibility of getting information for management and compilation of individual places.

Mathematic methods in rural economy as a source of information

Endeavor for the use of mathematic methods facilitating management of rural economy started in the 60s of the 20th century. Due to the central planning, the considerable potential of this tool was not much used. At that time it was the Research Institute of Agriculture Economy in Prague entrusted with collaboration and implementation of mathematic methods and computer technologies in farming; this was a commission authorized also within the countries of the Council of Mutual Economic Cooperation.

Compilation of models for planning and managing agriculture was rather complicated regarding a quite large size of farms (a few thousands of hectares) and multi-commodities production and confusing relations between farms and state administration.

Among the dominated standard optimization models of agricultural production, that had to optimize the use of available production sources of the farm, and especially to fulfil the centrally fixed production plan.

There were numbers of other reasons making the use of mathematical models in agriculture difficult, in the sphere of creators as well as users. It was e. g. absence of knowledge of these tools, back of experience, insufficiency of data needed for the model, because primary data and statistics did not satisfy the requirements, and finally, the inadequate computer technologies.

At the beginning isolated mathematical models of various classes were implemented to solve the problems of technological type. Compilation of such models occurred in very scanty conditions as compared with the present situation. Authors of the models were limited by the low level of computer technology. They mostly missed adequate programs. In such conditions it was hard to prepare the right input data and interpret the final results.

After a few applications of individual models, not very successful, it has become obvious, that the complex problems of agriculture can only be solved through a complex, i. e. system approach. This approach started to be practiced in the 70s at the Department of Operational and Systems Analysis at the Faculty of Economy and Management of the Agricultural University, Prague. This system approach was promoted namely by prof. Habr** (H a b r, 1978) and applied by the members of the above-mentioned department to solve some problems of agriculture. The system approach requested interlinked application of several models, the compilation was time-consuming and calling for automation (V r á n a, 1969). This was the start of automated model systems for that adequate programming basis was needed. In the Research Institute of Agriculture Economics in Prague the first automated model systems were

* AGRODAT, a departmental enterprise founded with the aim of providing IT services for the Ministry of Agriculture, possess a central library programs for 8-bit micro-computers

** Prof. Dr. Jaroslav Habr, member of the Czechoslovak Academy of Sciences, was in 1979–1985 an external head of the Department of Operational and System Analysis

developed and were composed of a few blocks of linear models for regions and production territories.

Considerable attention was also paid to simulation models, which are the most convenient for stochastic type of problems current in agriculture. At the Department of System and Operational Analysis, there were developed simulation models for solving problems of economic and organizational type, related to centers of auxiliary production, the so-called SAP (Simulation of Auxiliary Production) models (Švasta, Váňa, 1976). These centers (e.g. group of harvesters, drying machines, assembly for fertilizing soil, centers of heavy machinery etc.) functioned at order of the main management. The purpose of the simulation was to synchronize activities of specialized centers with current farm activities and to minimize the cost. The simulation result was a number of the center operations variants, following different criteria.

In the Institute of Management of Rationalization and Labor in Prague, in the years 1980–1984 a method of Complex Prognostic Modeling (CPM, Prouza, 1984) was developed. The corresponding simulation model enabled to verify the efficiency of a decision made by the farm management. Implementation of this model was affected by limited time series data that is inadequate for agriculture. There was also lack of some input data about investment and labor and a poor reliability of other data. Analyzing the results, which were of rather stochastic type, heuristic approaches had to be applied.

As a goal of communication with the computer were used in the 1950s the general programming languages, such as FORTRAN, PASCAL, PL/1, and others, in the 1960s then specialized simulation languages such as SIMULA, GPSS, SIMSCRIPT, etc. which had certain advantages. In the 80s more sophisticated object-oriented languages (Objective Oriented Programming), e.g. C++ Smalltalk, were applied.

Starting the 90s, the development tendency can be followed towards the program equipment, which liberates the solver from procedural activities and simplifies the formulation and solution of the problem. Universal simulation programs were found out and the solver had to master a relative simple set of instructions, for communicating with the program that is usually indicated as simulation language. For example, MODELICA is one of very useful simulation languages, convenient for physical modeling created in 1997.

Evaluating the past use of mathematic models in farming practice we can see two extreme standpoints:

- Empirical, which follows the practical need of a universal automated model system within AIS,
- System-based promotion of the idea that mathematic models in economics are a way of thinking and a sort of approach to problem solution.

It has also to be mentioned that in the centrally planned economy the farm managers were kept to fulfil instructions and orders so that they had limited possibility to make decision themselves. This has created a psychological barrier in the market economy conditions.

An important role in using mathematic methods in farming played also the technical infrastructure. Before 1980 a direct communication with a computer was not possible. The situation was awkward because of the data-media (perforate cards, magnetic tapes) and rather complicated form of outputs. Data processing was made in specialized centers and the cooperation with them was clumsy and time-consuming. The information needed was often available too late etc.

In the 80s, the information technologies introduced micro-computers (e.g. Robotron 1715, TNS etc.). Later, these were replaced by personal computers PC/XT and PC/AT. Basic inconvenience of their practical application was, that introduction of PC in agriculture missed preparation and formation of personnel. Managers were supposed to use them in old conditions without transformation and/or assistance.

The transfer of data processing from the data processing centers to the farms at personal computers under responsibility of the farm managers gave back the responsibility, where it belonged to. This strengthened the farmers' authority.

At present farms IT is understood as open systems, the management of which follows different principles than it was in the past. Other decision making tools are used. The role of human factor in exact formal methods has been reinforced and the new software products respect much more the creative thinking. The general development aims at such information technologies that will provide not only information needed, but also knowledge of the matter (Získal, 2001).

Information system in agriculture after 1989

After 1989 the previous system of statistics related to planning and reduced reporting about production and financing was left. Transformation of the directive administrative system of management into the market economy system called for principal changes of the information system in agriculture. This IS was built up under patronage of the Ministry of Agriculture. The supported information services in business sphere and agricultural public and the decision making in the state administration were secured by the state and had a full governmental assistance.

The function and content of central institutions' activities have changed. New information about the market was needed. The structure and number of farms within the agro-industrial complex (AIC) have changed; so has changed the legislation related to protection of information; etc. Information system of the AIC has been classified into seven sub-systems, which were supposed to become parts of the centralized information system of the Ministry of Agriculture. These parts are as follows:

- State statistics
- Branch statistics
- IS of the fund of market regulation
- IS of regional workplaces of the Ministry of Agriculture

- IS of the land estate registration
- IS of the Agrarian Chamber
- Sample data of tested farms

The purpose of the individual systems was to enable monitoring of the supply and demand, grants and their use, controlling the land use, reporting about transformation and privatization and regulating entrepreneurial activities (Získal, Hampl, 1998).

The sample of tested farms followed the idea of the need for a particular methodology of monitoring economic, financial, structural and other activities. The data are collected through a sample survey, the sample being chosen in representative manner.

Use of IT in agriculture, at the end of the 80s, was not much developed, including in EC countries. The development and the use of these technologies was at the beginning and depended on the state's interventions. In Great Britain, Germany and France, there were 10% of farms equipped with micro-computers employed mostly in accounting. In Italy and Spain only 2% of farms were equipped with micro-computers (Raschas, 1991).

In 1994 the firm "DeloitteTouche" carried out a survey about announcement of IT use in central and east European countries. The users from central and east Europe gained free access to the most recent technologies (in previous years importation of these technologies was limited) and started buying IT available at the market without rational justifications.

It was the same in the Czech Republic. Because of neither clarified nor unified conception of IT, inadequate hardware and insufficient software were bought. Basic criteria for the use, good functioning and compatibility in available local language, were often neglected.

Proposal of a branch IS in agriculture find for example in Hampl (1998). A new dimension and function of IS of agriculture can be seen on the level of up-to-date way of commerce with agricultural commodities by means of IS. E. g. in cooperation of the CUA Prague and the Institute of Data Processing in Liberec, there was elaborated a public IS AGROS (Agrarian Business System). Its purpose was to monitor supply and demand of enrolled users (Vrána, 1993).

Among the new possibilities of getting information belongs the Internet. The survey of the Information and Advisory Center of the Czech University of Agriculture in Prague found out that 78% of agriculture enterprises were connected to Internet in 2003, but only 8% of them used it as an information source for decision making. The use of Internet in agriculture is advancing slowly. It is mainly used for the electronic mail and commercial transactions. In addition to various kinds of information Internet brings also new programs for data processing.

Conclusion

Development of information technologies had a direct effect on the level, up-to-dating and accuracy of data processing, but an indirect effect on the farm management.

It was rather clear from the very beginning of IT use in agriculture that a broader application of these technologies in the decision making process would need creation of a complex system of planning, managing, registration and processing of data. But, creation of such a system was not in line with centralized management, neither with technical level of the computerization. After 1990, the disintegration of big cooperative farms and leaving of highly qualified specialists, who sought better paid jobs, were not favorable for expansion of IT.

Nowadays, there are more items of information available to farmers, than they can operate with. A standardized data processing and presentation, and methodical assistance to farmers which could make the use of IT more effective has not been very developed, yet.

It would be very useful to introduce free counseling services, mainly in finance, possibly also by means of Internet. Experience has shown up to now, that IT has a large applicability in agriculture, but it would need a special offer of technical assistance to farmers, who are often conservative. Relationship of farmers to IT can be considered as a problem of generations.

REFERENCES

HABR, J.: K vývoji ekonomicko matematických metod a modelů u nás (To the development of the mathematical methods and models in the Czech Republic). EMO, 1978, No. 2.

HAMPL, O.: Tvorba systémů pro podporu rozhodování v rámci resortního IS zemědělství (Formation of the systems for the support of decision making processes within branch IS agriculture). [Dissertation.] Czech University of Agriculture, Prague, 1998.

HIRŠ, J.: Metodické vytváření automatického systému řízení v resortu zemědělství a výživy (Methodological creation of automatic system of management in agriculture and nutrition). Zeměd. Ekon., 1977: 401–410.

KADLEC, J. – KUNDRÁT, J. – KRAJÍČEK, J.: Uplatnění matematických metod a výpočetní techniky v plánování zemědělství (Application of mathematical methods and computer technology in planning of agriculture). Vols I and II. Praha, SZN 1978.

PROUZA, B.: Zpráva o modelu AGRO – výsledky ověřování metody KPM (Report on the AGRO model – results of testing of the KPM method). Praha, ÚŘRP 1984.

RASCHAS, M.: Seminář agrární politiky (Lecture on agrarian policy). VŠZ Praha, 5.–6. 12. 1991.

ŠVASTA, J. – VÁŇA, B.: K některým problémům využití simulační techniky v zemědělství (To some problems of use of simulation technology in agriculture). Sborník PEF, VŠZ Praha, 1976.

VINŠ, J.: ASŘ organizace služeb biologického charakteru (Automatic system of management – organisation of services of biological character). Zeměd. Ekon., 1977: 441–456.

VRÁNA, I.: AGROS – Veřejný obchodní informační systém pro zemědělství (Public business information system for agriculture). Zeměd. Ekon., *39*, 1993.

VRÁNA, L.: Využití počítače při úvahách o struktuře výroby zemědělského podniku (The use of computer in considerations of the structure of production of agricultural enterprise). Stud. Inform. ÚVTI, Zeměd. Ekon., 1969, No. 2–3.

ZÍSKAL, J.: Nové směry ve využívání modelové a výpočetní techniky v globální společnosti (New trends in utilisation of model and computer technology in global society). Sborník Slezské univ. v Karviné, 2001.

ZÍSKAL, J. – HAMPL, O.: Problémy tvorby a využívání resortního IS zemědělství (Problems of formation and use of branch information system of agriculture). Sborník Agrární perspektivy VII, ČZU Praha, 1998: 805–811.

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Retrospektivní pohled na využívání informačních technologií v českém zemědělství ukazuje na obtíže, se kterými se jejich prosazování muselo potýkat. Vytváření IS v zemědělství mělo jiný cíl v období centrálně řízené ekonomiky a v období tržní ekonomiky. Základním problémem byla kvalita materiálně-technické základny, která rozhodujícím způsobem ovlivnila rozvoj informatizace zemědělství. V příspěvku je na základě dostupné literatury a dlouholetých zkušeností autora s touto problematikou provedena analýza prostředí a faktorů, které využívání IT v českém zemědělství ovlivnily.

centrálně řízená ekonomika; zemědělská informatika; automatizace IS; systémy modelů; hardware; software; simulační přístupy; komplexní prognostické modelování; IS v zemědělství; Internet

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