ASSESSING THE EFFECTS OF COMPUTERIZATION ON FOREST MANAGEMENT

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1. ABSTRACT

In the last decades, significant IT investments have been made in the Hungarian state forest sector. Investing in IT infrastructure has been a "necessity", because company management requires timely information, and maintaining digital connections is also a crucial factor in business. Information technology support for planning, management and recording of professional work became commonplace only later. This can be explained by the fact that the subject of management usually does not require fast actions or actions on a daily basis. Administration of different phases of forest work became effective only when geographic information systems (GIS) emerged and compatible professional applications were developed. In this paper the steps of adoption of IT tools, IT solutions and their effects are examined.

2. INTRODUCTION

Examining the implications of information technology for forest management, we find that no comprehensive analysis has been done in this respect. The articles published highlight only specific areas concerning this question, and they describe them only briefly.

Reviewing the volumes of Az Erdő (The Forest) and Erdészeti Lapok (Forestry Journal), the first article referring to computer can be found in the volume published in August 1963. The second article consists of two parts, the first one published in 1966 and the second one in 1969. They describe the functioning of the electronic computer. At the end of the decade, two articles were published on work organization topics, both of them emphasize that these tasks can only be effectively dealt with by using computers.

In January 1968, László KIRÁLY [1] reported that the Állami Erdőrendezés Fejlesztési Csoport (State Forest Development Group) had successfully developed volume equations based on tree volume tables in use, and that experiments had been conducted in automation of forest management planning using electronic computer. The results were published in an article in January 1970 [2].

In 1970, all articles in Vol. XIX., No. 11 of Az Erdő (The Forest) were related to information technology. This could be accounted for the fact that this was the year when digital storage of annual survey data and computer-based preparation of management plans were introduced.

From the mid-1970s on, articles were published presenting not specific principles, methods or programs, but organizational problems. These articles looked at administration and management as a whole. 20 years later, András CSIZMAZIA, IT team leader of the Parkerdőgazdaság (Park Forest Company), reported in an article on the experience he gained during a study trip to Ireland [3]. He described the introduction of the computer-based forest management system in Ireland and analyzed its organizational and economic impact.

In my doctoral thesis, I would like to give a comprehensive review of the informatization process in the Hungarian state forest sector and assess its effects. The present paper aims to outline my research findings gathered to date.

3. MATERIALS AND METHODS

Due to the nature of the science field, my doctoral thesis is a case study. I have used data collection instruments like questionnaires and interviews providing data that replace measurements obtained in field experiments or laboratory experiments. In my study, I have tried to encompass a wider period so that trends can be better recognized. My data were collected by using questionnaires from 2001, 2005 and 2013.

As for personal interviews, they were arranged in both formal and informal settings. I was provided a lot of information as being member of the Alföldi Erdőkért Egyesület Informatikai Szakbizottsága (Information Technology Committee of the Association for Hungarian Plain Forests) and the Országos Erdészeti Egyesület Informatikai Szakosztálya (Information Technology Committee of the National Forestry Association).

4. RESULTS AND THEIR EVALUATION

4.1 Stages of computerization

Reviewing the timeline detailing the stages of information technology diffusion, we can state that the stages of technology adoption specified in the Gibson-Nolan model apply to the use of information technology in the forestry sector as well.

The period of initiation lasted from the 1960s until the early 1980s. First, the Állami Erdőrendezőségek Műszaki Iroda (Technical Institute of State Forest Management) made attempts to adopt automated data processing [1; 2], and the Faculty of Forestry of the University of Forestry and Wood Sciences launched the education of computer science [4]. Forestry companies had used bookkeeping machines for automatic data processing in those years. In the late seventies, automatic bookkeeping machines replaced the worn-down electric accounting machine park. Using the IBM desktop computer obtained by the University of Forestry and Wood Sciences, many professional applications were developed, such as student assignments or diploma works [5].

The period of expansion was the period between the second half of the 1980s and the early 1990s. Forestry companies acquired their first computers, typically TPA and VT types. The applications running on them were solving, without exception, accounting and administrative tasks. Towards the end of this period, the appearance of personal computers changed the order of operation. The previous single-host centralized mode of operation was replaced by a decentralized system; PCs appeared not only in the center, but also in the forest management units. When starting their career, newly qualified professionals, exposed to computers, developed applications to support their professional work.

The periods of implosion and growth started in the second half of the 1990s. The previously mentioned two stages are almost inseparable. The economic environment had changed in a way that daily management could not be carried out in the absence of the latest information. At this stage, professional work packages in addition to professional management software became available.

4.2 Two important technical milestones

Before analyzing IT developments in detail, two important milestones have to be emphasized. Without these, forest informatics would not have gotten as far as it is today.

The first milestone was the establishment of the Országos Erdőállomány-adattár (National Forest Stand Database). Centuries-old tradition of preparing forest management plans has assured sustainable forest management in our country. The first attempts at computerized storage and processing of decennial survey data were made in the mid-1960s. The successful attempts led to legal requirements for the electronic storage of data. The National Forest Stand Database has made use of digital storage of survey data, planned and executed work data since 1970. Initially, only alphanumeric data were recorded, but technology has made it possible to convert them into GIS database. The stored information forms a solid basis for development of applications supporting professional work, and constitutes a useful and reliable source of “raw material” that is important for research.

The second important milestone was the foundation of DigiTerra Informatikai Szolgáltató Kft. (DigiTerra Information Services Ltd.) in 1996. DigiTerra develops and markets GIS software recognized in the market as effective tools of vector and raster GIS procedures. Their first successful product was DigiTerra Map. Building on the experience gained during the implementation and use of this software, the Erdőgazdálkodási Információs Rendszer (Forest Management Information System) was developed. It is a GIS-based user-friendly system focusing on tasks forestry professionals have to accomplish. Implementing GIS support, the Forest Management Information System performs functions of forest operations management and control. It integrates data from external systems, such as the data repository of the National Forest Stand Database, the real estate database of the public property records, forestry and land registry maps. It supports the work processes directly in the field by implementing mobile IT devices as organic parts of the system. DigiTerra reached its greatest success in mobile information technology with the development of DigiTerra Explorer. Their latest product, DigiTerra SILVA supports forestry professionals and private forest managers performing management tasks.

4.3 Facts about changes

The first IT developments of the forestry sector were typically realized in state forest company centers in the second half of the 1980s. The first step in this process was, without exception, the implementation of automated general ledger systems, followed by the implementation of fixed asset management and financial management systems. At the end of the decade and in the early 1990s, forest management units were also equipped with computers. The first automated business procedure was wage accounting. It was followed by automation of billing and inventory management of primary wood products.

In the beginning, implementation of specific applications prevailed. They were not at all or only slightly related to each other. It was the period of so-called island systems: applications were operating independently from each other; there was no automatic exchange of data between them. Systems of different developers were used, and applications assisting with professional tasks were often results of "tinkering"[1].

By the late 1990s, it became apparent to senior managers of state forest companies, functioning as public limited companies since the early 1990s, that homogenization of their information systems, made of heterogeneous components, would increase efficiency and reduce costs: "Ignoring development may lead to competitive disadvantage and may cause a barrier to efficiency gains and cost-effective management."[2]. This recognition resulted in the implementation of information systems that could provide automated flow of and effective access to information consisting of basic data. Changes in the composition of the software portfolio reflect the change in approach. The share of bought ÷ developed for own purposes ÷ homemade software of 25% ÷ 50% ÷ 25% prevailing in the late 1990s changed for ÷ 83% ÷ 8% ÷ 9% by the end of the last decade *(Figure 1).*

The improvements were induced not only by the above mentioned recognition of the senior managements, but they were also catalyzed by external factors, such as the provisions adopted by the ÁPV Rt. (Hungarian Privatization and State Holding Company), which was exercising ownership rights over forestry companies that time. According to the provisions of ÁPV Rt. from 1999, Internet access had to be provided in all management units and the use of electronic mail had to be introduced and regulated.

At the time of the introduction of computer-based information systems, user resistance had to be overcome, too. Among the reasons for reluctance, the following factors were mentioned: ignorance, fear of anything new, fear of loosing privileged access to information – the guarantee of a powerful position –, protests against the extra investment of energy, lack of willingness to learn autodidactically and fear of loosing jobs. The latter can be factually demonstrated; the introduction of computerized administration reduced the number of administrative staff.

Since computer science became part of primary and secondary education, it can be observed that the new colleagues, who join the company, do not have an aversion to the use of IT tools; they take the availability of information technology and resources for granted. Computer literacy has become one of the essential conditions of employment by now. It can be also observed that users often want new tasks to be computerized.

Although IT developments have led to reduced workforce on the one side, they have also induced creation of new jobs on the other side: larger forestry companies have set up their own IT teams of 2-3 people. In some cases, certain services are purchased from outside companies, but for the management of sensitive applications they would have their own staff working within the organization. However, there are companies that would purchase all needed IT services from outside companies. The question is which strategy is better. Company leaders working with their own IT teams believe that information management is not a mere part of the organizational structure, but a type of organizational resource whose effective control is the basis for good performance.

The tasks of the own IT teams of the companies typically focus on three main functions: planning, doing and running. Planning means collaboration with the senior management of the company in defining business development priorities, management of resources and risk management. Doing means maintenance of the existing application portfolio. Running means operating the infrastructure and serving end-users.

Examining the frequency of computer use, we can see that administrative employees use the computer at work on a daily basis, senior managers almost on a daily basis and 80% of middle

[1] Here I use the word *tinkering* in a positive sense, referring to an application written by the user for own purposes.

[2] Overwiev of Informatics – State of the Enterprise Information System. Note. Északerdő State Forest Company, Miskolc, Sept. 2000

managers on a daily basis. Area foresters use computers for work-related purposes once a week or less *(Figure 2).*

This significant lag in the frequency of computer use of foresters is due to the fact that the choice of (weather-proof, durable) equipment for use in field conditions is rather poor compared to other kinds of computer equipment and they are rather expensive. There are several problems impeding the use of computational technologies in field conditions. Life of the currently used batteries is too short; they wouldn't last long enough after being charged. Constant data connection can not be provided either; services of mobile networks aren't available at all points far away from settlements, in hilly and rugged mountainous terrain. Unfortunately, this is in contradiction with the fact that timber trade and timber transport related activities require an on-line presence. Another significant problem is that the life cycle of these devices is almost the same as the time of the system development. It can happen that by the time the host system is ready, the field device that should be incorporated into the system is no longer available on the market.

As a result, foresters would use in their daily practice both paper-based and computer-based data recording and transmission depending on which site they are working. Continuous on-line field presence is not needed because the largest portion of the resultant information is not necessary for taking operational decisions. According to the literature of forest information technology, only service levels needed for supporting business have to be developed to the appropriate level.

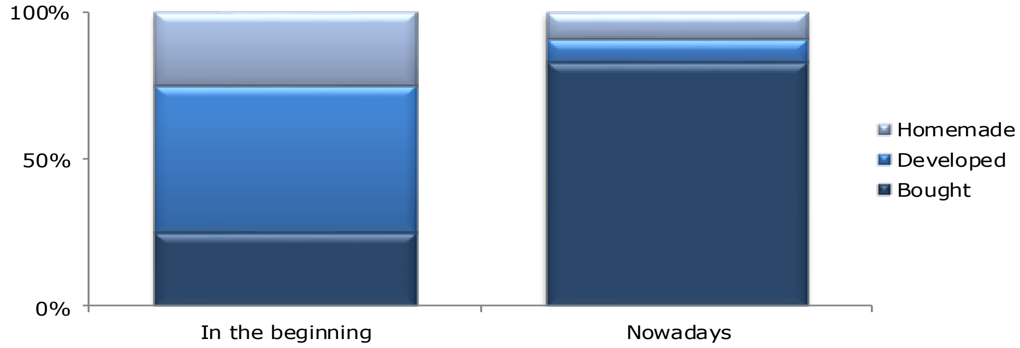

Figure 1.
Composition of software portfolio

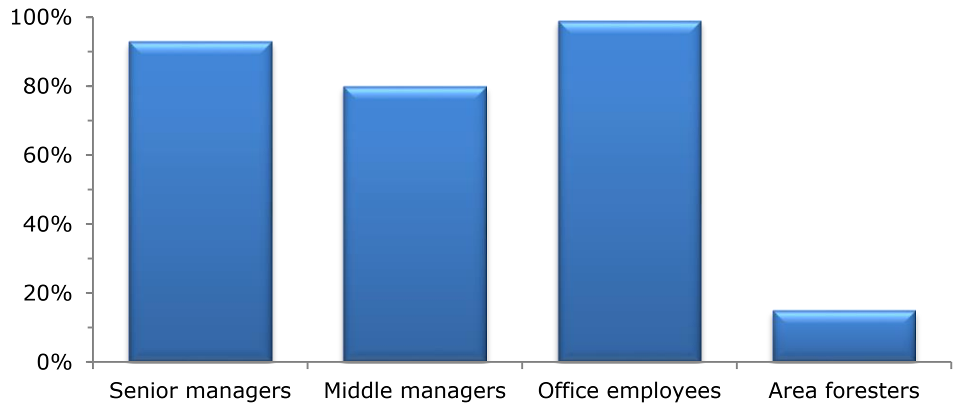

Figure 2.
Frequency of daily computer use

5. CONCLUSIONS

The implementation of IT solutions did not result in numerically demonstrated productivity improvements. This statement, however, is consistent with a report published by the McKinsey Institute [6]. According to this report, the process of informatization does not have the same effect in different sectors: it greatly increases the productivity, where the product or service is digitized. In our case, there is no such kind of product or service. However, when we compare reporting requirements for the period prior to computerization and for the current period, we can notice that their amount (more different kinds) and quality (participialization) have increased significantly. Companies solve this task with reduced administrative headcount, which means that productivity has increased if we define productivity as an index that measures output relative to the input.

Although state forest enterprises, functioning as public liability companies, belong to the same owner, they started to realize their IT developments independently. Due to the lack of coordination in this process, the purchased software portfolio is very diverse. This fact has strongly hindered the adoption of the unified platform that should be implemented according to the provisions of the owner. Managers of forestry companies are not willing to “throw away” the software they have already purchased and used and to pay for the new. Their resistance could have been overcome by giving them the chance to make the switch gradually, as their existing systems are aging and running out.

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