PROTECTION OF COMPUTER INFORMATION SYSTEMS OF AGRICULTURAL ENTERPRISES

Valentyn Nekhai, Igor Skiter, Elena Trunova

***Abstract**: The article deals with some modern methods and technologies used in solving problems of information support of the effective management of the agricultural enterprise. It contains the principles of construction systems of information protection in computer information systems of agricultural enterprises.*

***Key words:** information technology, information support, information systems, protection of information, policy of information safety, information protection system.*

***ACM Classification Keywords**: K.6.5 Management of computing and information systems - Security and Protection.*

Introduction

Activities of agricultural enterprises are characterized by complexity and system city of tasks that are to be solved: increase of arable land fertility; prevention of land degradation; improvement of yields and quality of agricultural products; minimization of costs for agro-technical measures; intra-logistics optimization and downtime reduction; minimization of economic risks of the enterprise's activity.

Everything mentioned above requires the transition to new methods of agriculture management information support, the usage of automatized control systems and modern information technologies. In turn, the rapid development of information technologies takes the form of global information revolution, which encourages the formation and development of innovative global substances - information environment and information society [Buriachok, 2013].

Over recent years, the understanding of information support impact on the process of making management decisions, takes the information to the next level – as a resource that has a certain value. Information becomes the most important strategic resource of any enterprise; its development and consumption become an important basis for the effective operation and development of various spheres of social and economic activity. The efficient activity of agricultural enterprises requires the information

that includes the complex of many factors data: grown crops peculiarities, climatic conditions, soil condition and quality, usage of fertilizers, pesticides etc.

The rapid technological development of information society, modern communicative capabilities and rapidly growing information space significantly increase the number of information sources, and thus extend the actual and/or potential sources of internal and external cyber influence, that makes the management of enterprises pay more attention to the protection of computer information systems.

The problems of agricultural enterprises' information management were described in the researches made by: I.V. Bal'chenko [Bal'chenko, 2013], V.V. Litvinov [V.V. Litvinov, 2013], V.P. Klimenko, Sayko V.F [Sayko V.F, 2006] and others. The significant part of work made by Buriachok V.L. [V.L. Buriachok, 2013], N.A. Gaydamakin [N.A. Gaydamakin, 2008] was dedicated to the problem of information security systems development and operation. But the rapid development of information technologies and the specificity of agricultural enterprises' activities require the search of new approaches to the information security organization.

The goal of the study is the research and analysis of existing information systems and their compliance with the current information needs in agricultural enterprises management, identification of vulnerabilities in terms of information security and information security system building.

Data protection

The development and implementation of automatized control systems show that none of the security information tools (methods, activities and assets) is completely reliable. Methodological and methodical bases of information security are quite general recommendations based on the international experience and the theory of systems.

Data protection is a set of methods and means that ensure the integrity, confidentiality and availability of information in terms of the impact of threats of natural or artificial nature, the implementation of which may result in damage to the owners and users of information.

Today's task of information security system is to adapt the abstract statements to the specific subject area (agricultural enterprises), where unique peculiarities and subtleties will be always present.

The research and analysis of foreign and local experience demonstrate the necessity for building an integrated system of enterprise information security, that includes operational, operational-technical and organizational measures for information protection. This system should provide flexibility and adaptation to rapidly changing factors of internal and external environment. It is impossible to provide this level of

information security without making an analysis of existing threats and potential possibilities for information leakage.

The basis for information security system creation is the development of information security policy for the enterprise. As a result, the protection plan should be created, which will implement the principles that are set out in the Security Policy.

Today, the problem of agricultural enterprises information protection is associated with the creation of large agricultural holdings and the transition to high-intensive farming. The basis for the transition to the innovative farming is the availability of information concerning the exact limits of arable land and their agro-chemical and agro- physical characteristics. This in turn requires the usage of modern information technologies and revision of approaches for agricultural enterprises information system creation.

Enterprise Performance Management

Enterprise Performance Management can be the basis for automatized control system building not only as a management concept, but also as the exact class of information systems that support this concept.

The enterprise information infrastructure can be presented in several hierarchical levels, each of which is characterized by the degree of information aggregation and its role in the management process. “Analytical stack” developed by Gartner can be an example of schematic representation of the information infrastructure. There are several levels in this hierarchy [Ysaev, 2008]:

- the level of transactional systems;
- the level of business intelligence, including data warehouses, data marts and OLAP-systems;
- the level of analytical applications (Picture 1.).

Transactional systems include enterprise resource management systems (ERP-system) and provide the information needs of management at the operational level. Despite the objective differences, all these systems have a common feature: they are designed to handle certain operations (On-Line Transaction Processing (OLTP) - processing transactions in real time). The goals, objectives and sources of information at the operational level are initially defined and have a high degree of structure and formalization.

Transactional systems are the sources of primary information, which after the appropriate processing are used for further analytical processing and presentation for making management decisions. From transactional systems, data can be passed to analytical applications either sequentially through all the levels of analytical stack or by passing one or more levels (“bypass” - “direct transfer”).

Data warehouse (DW) is defined by Bill Inmon [Inmon, 1992] as "subject-oriented, integrated, stable, supporting the chronology of data sets, organized for the purpose of management support, designed to

act as "one and the only one source of truth" that provides managers and analysts with reliable information necessary for rapid analysis and making decisions".

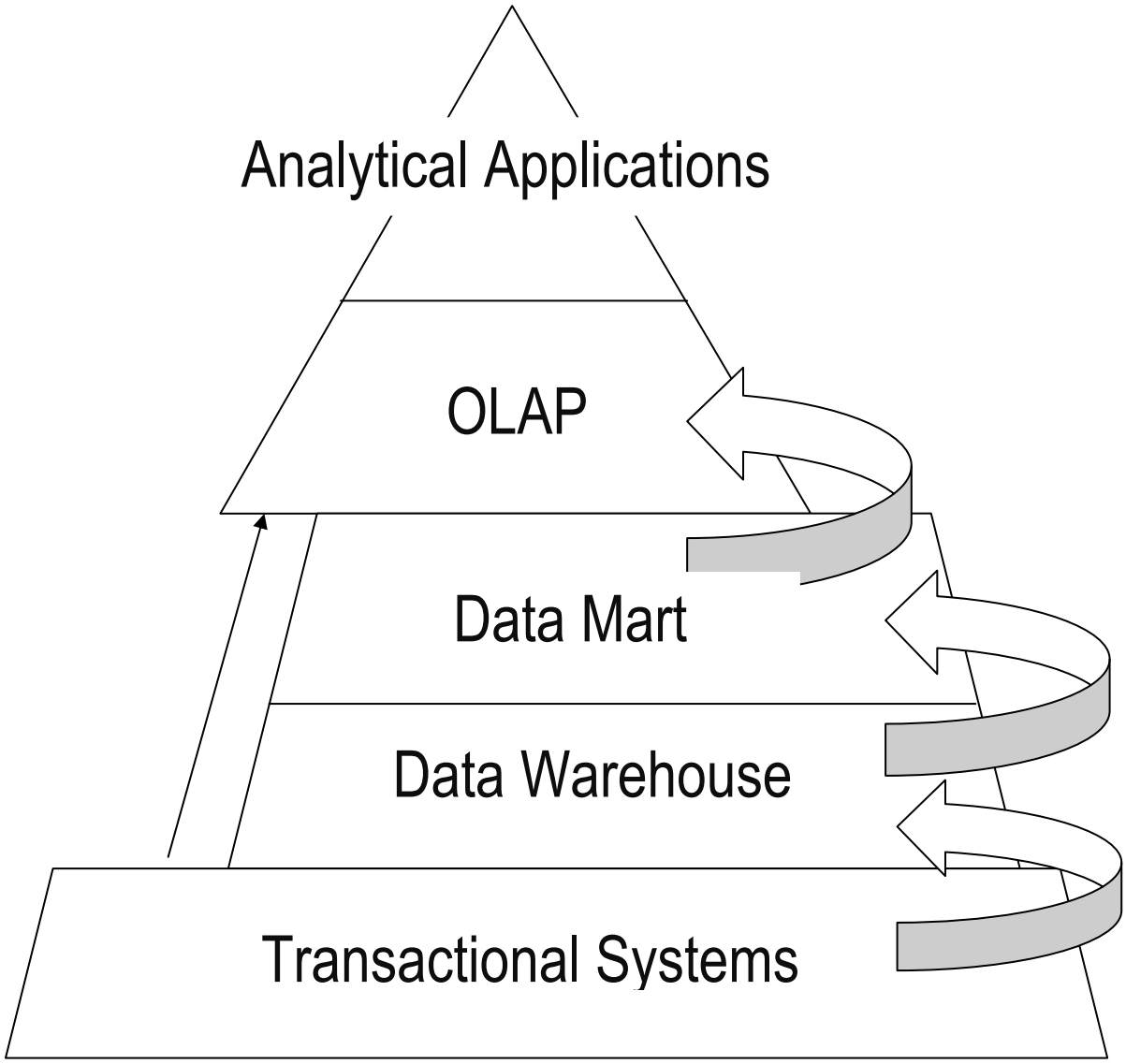

Figure 1. Analytical Stack

However, the large amount of data contained in warehouses, usually make them unavailable for processing in real time. This problem is solved on the following hierarchy levels – data marts and OLAP-systems.

Data marts are structured information files, but their difference is that they are subject-oriented, the information is stored in data marts in the most favorable form for solving specific analytical problems.

The next level of the analytical stack is occupied by On-Line Analytical Processing (OLAP-system). This is the system of analytical data processing in real time that can provide the solutions of many analytical problems and work with relevant data despite of the company's activities characteristics.

OLAP-systems are characterized by large dimensions of stored data (as opposed to relational tables), preliminary calculation and aggregation of values, which makes it possible to build quick independent requests to operational database using a number of different analytical measures.

At the highest level of the analytical stack there are analytic applications, aimed at the analysis and decision support at the strategic level. The information system on the strategic level (Executive Support Systems, ESS) provides the support of making decisions concerning the implementation of promising strategic aims of enterprise development on the basis of solving unstructured problems, special problems that require professional judgments, estimates and intuition.

Peculiarities of construction of the automated control system of the agricultural enterprise

To ensure the information needs of agriculture enterprises management various information systems are used nowadays:

- monitoring system of agricultural resources conditions and crop yields forecasting;
- supporting system of agricultural products quality control;
- operational control system and productive processes optimization;
- information and reference systems of marketing orientation;
- analytical and modeling systems of tracking the emergencies and their impact on production, agricultural products quality, and many other specialized information systems of different orientation and level of detail [Sayko, 2006].

Based on the agricultural enterprises management needs, the following main aspects of creation of agricultural information systems that allow justifying their structure and functions, can me defined [Savchenko, 2006]:

- the necessity for creation of new management and agriculture systems, that take into account natural conditions and organizational and technological capabilities of the company, maximal use of its soil and climatic potential;
- the inextricable connection between technology and biological objects (soil, plants, etc.), which are characterized by occurring continuous processes and cyclical products;

- the need for continuous monitoring of a large number of parameters, including geographically distributed;
- variety of processes and operations in the processing plants, which are usually set out in huge technological maps;
- significant differentiation of agricultural manufacturers in terms of amount and production structure, sustainability, etc.;
- agronomic data is characterized by significant volume of different data that is difficult formalized.

In works [Bal'chenko, 2013], [Litvinov, 2013] the analysis of modern methods and technologies that are used in the process of solving the issues of effective management of agricultural enterprises is made. The approach for building the automated management system of agricultural enterprises is given. The major functional subsystems of information managing system of agriculture enterprise are specified:

1. Normative reference and infrastructure subsystem (system administrators) - to conduct the regulatory information that is required for use in solving management problems.
2. Subsystem of collecting primary information concerning the management object (system administrator, manager) - to collect primary information on the status and processes of the enterprise and the transfer of urgent messages and instructions from the control center to the performers.
3. Subsystem of crop/livestock work planning of and their resources' provision.
4. Subsystem of operational dispatch management of crop/livestock works and operations of and corresponding resources' provision (managers, agronomists/livestock specialists) - automatizing the distribution and initial data processing process concerning the state of management facilities, supporting in the process of making decisions.
5. Subsystem of facilities management assessment - for use in solving dispatcher problems.
6. Logistics subsystem.
7. Subsystem of keeping mapping information (cartographers, land surveyors) - presenting information concerning the state of management facilities in form of digital maps.
8. Subsystem of notification and exchange of urgent messages and instructions between the control center and the performers - designed for messaging between the employees of distributed system.
9. Subsystem of modeling the enterprise activity - for imitating modeling of possible consequences of the prevailing situation in the enterprise activity.

The fundamental concept in the sphere of computer systems information security is the security policy. It means an integrated set of rules and regulations that govern the information processing, the implementation of which provides the status of information security in the given space of threats. The formal expression of Security Policy (mathematical, schematic, algorithms, etc.) is called the security model.

Security models play an important role in the process of development and research of protected computer systems as they provide the system engineering approach that involves the solving of such critical tasks:

- selection and justification of the basic architecture principles of secure computer systems, that defines the mechanisms of protection means and methods implementation;
- verification of systems' properties (security) is developed by formal confirmation of compliance with security policies (requirements, conditions, criteria);
- making a formal specification of security policy as an essential part of organizing and documenting software protection, developed computer systems [Gaydamakin, 2008].

Security policy of computer informational systems

There are the following types of information computer systems security policy [Devyanin, 2005].

Discretionary security policy is the security policy, based on the Discretionary Access Control, which is defined by two properties:

- all subjects and objects are identified;
- the rights of access to system objects and subjects are based on some external rules in relation to the system.

The main element of discretionary access control systems is the matrix of access - the matrix of size $|S| \times |O|$, the lines of which correspond to subjects and the columns correspond to objects. In such a case every element of the access matrix $M[S, O]$ with R determines the access rights of the subject S to the object O, where R is the set of permissions.

The advantages of discretionary security policy include the relatively simple implementation of access control systems; the disadvantages include the static of defined rules of access therein.

Mandate (authority) security policy is a security policy based on Mandatory Access Control, which is defined by four conditions:

- unambiguous identification of all subjects and objects of the system;
- given hierarchical levels of information confidentiality;
- every system object has the level of confidentiality that determines the value of information;
- every system subject has the access level.

Mandate security policy application helps to prevent the overflow of information from the objects with higher hierarchy level to the objects with low access level; on the other hand, the introduction of systems based on the security policy of this type is complicated and requires significant hardware and software resources of information system.

The approach of information flow security policy should be mentioned. It is based on the sharing of all possible information flows between the objects of the system into two disjoint sets: the set of enabling information flows and the set of adverse information flows, the purpose of implementation of which is to ensure the unavailability of emergences in the computer system information flows.

Role differentiation of access is the development of discretionary differentiation access policy, and the rights of access to system objects are based on their application-specific basis, defining their roles thereby. Role differentiation of access allows realizing flexible access control rules that take into account the dynamics of the computer system operation process.

In addition to the abovementioned policy we can name the policy of isolated software environment implemented by determining the order of safe interaction of system subjects that ensures the impossibility of influence on information and security systems and their settings modification or configuration.

Thus, the development of information system security policy should include three levels: basic, segment and marginal. The security policy of base and segment levels must ensure the protection of information flow within the information system, the marginal level of security provides the protection of information exchange with the environment (figure 2).

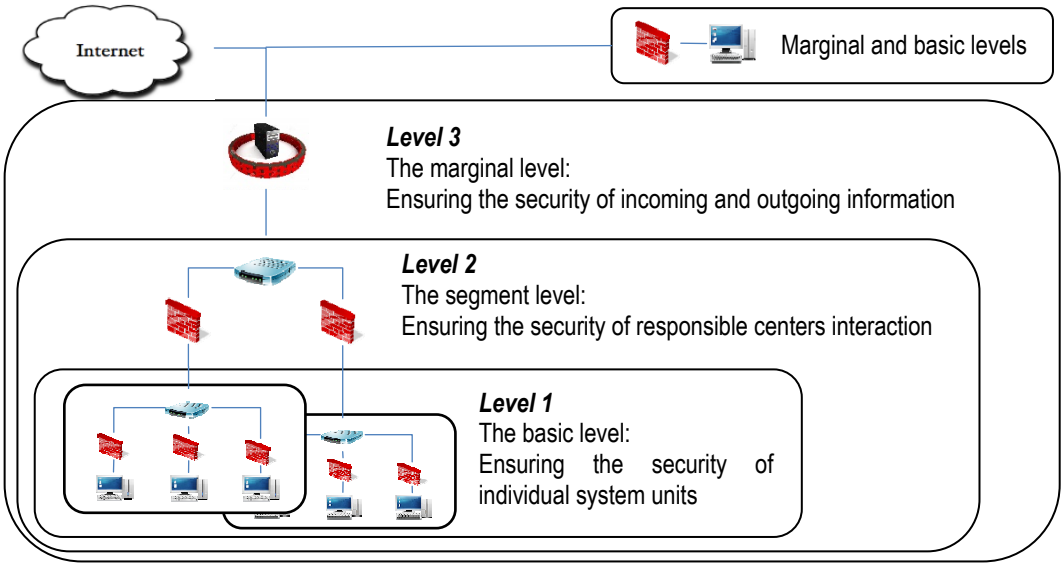

Figure 2. The hierarchical model of information security policy

Conclusions

The basis for constructing a system of information systems protection is the development of the security policy that is based on: organizational and management structure of the company; informational management needs of the enterprise; used organizational, technical and software; processing technology.

The security policy development should be based on a strict hierarchy; this means that the protection degree of different system units cannot be the same. Thus, the data that is being processed in these sites will be under the thread of unauthorized exposure risks. Having divided the information in several categories according to its importance (critical and non-critical), the model of any company's protection can be optimized.

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