Architectural insight to complex information systems of management of agricultural enterprises dealing with innovative cultivation of plants

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Abstract. The cost price and viability of plants grown by agricultural enterprises depend not only on their biological characteristics, but also on the environment, which provides them with water, air and nutrients in addition to light and heat. Moreover, water is the most important factor in the yield of cultivated crops, which determines all vital and technological processes in plants, the quantity and quality of the crop etc. The increase of the viability and quality of plants can be ensured by monitoring and controlling both the growing process of a plant and the environment, fertilizers and irrigation water applied into the soil. Designing an informative solution for an agricultural enterprise within the framework of an architectural approach is based on the architectures of databases, applications and communications subordinate to the architecture of the business and is supported by modern IT: data processing centers, transmission channels and application systems. Such solutions will allow monitoring the acidity, temperature and moisture content of the soil, which, for example, can be increased with the help of technological innovation - polymer-mineral material (PMM) introduced into the soil. PMM accumulates water, improves productivity and plant vitality and saves resources.

1. Introduction

The quantity and quality of cultivated plants essentially depends on fertilizers, water, physical and chemical properties of the soil and climatic conditions. Therefore, it is necessary to regularly monitor the characteristics of the soil, the environment, the cultivated plants and the work done with them, which can be carried out automatically using ICT on the basis of IT architecture, which is subordinate to the business architecture. In particular, various sensors, counters and controllers can collect and digitize signals from the objects under study and transfer them to application and data servers for processing and making timely management decisions for creating favorable confditions for growing plants.

The introduction of ICT solutions will enable us to use the surrounding nature more efficiently, to reduce its pollution, to reduce cost price of growing plants and their processing, as well as the costs of various resources and to increase their viability and productivity in various climatic conditions.

Let us note that plants grow and develop normally in cultivated structural soils containing the required amount of water, fertilizer and air. Various ameliorants and IT are used in agriculture to improve the physical properties of the soil.

The purpose of this study is to assess the impact of an integrated information system (IIS) for managing an agricultural enterprise acting within the framework of IT architecture on the cost of growing plants as well as on increasing the competitiveness of companies engaged in this activity.

Let us note that the IIS do not fully provide the required level of labor productivity sufficient for successful competition. Only the joint use of IT with technological innovations will make it possible to obtain significant results in the cultivation and processing of agricultural crops and to ensure the stability of the company in the market [1].

The use of polymer-mineral material (PMM) in the soil will allow, for example, to increase the vitality and yield of winter wheat, to reduce the amount of crop loss as well as the amount of consumption of fertilizers, water, electricity, human and other resources [2].The purpose of automation in this case is to increase the yield of winter wheat in rainfed conditions and to reduce its cost price as well as to regulate its vitality through the dosed introduction of ameliorants, water and air into the soil [3].

Obviously, in order to increase the competitiveness of companies involved in growing crops, it is necessary to reduce the cost of resources for their production, to take into account the shortage of fresh water in arid regions and to increase their productivity. The reason for the decrease in soil moisture is not only an increase in ambient temperature and a decrease in precipitation but also anthropogenic impact on it [2,4]. Intensive and deep cultivation of the soil, enhanced loosening and traditional seeding lead to rapid soil degradation. In this regard, minimal or no tillage becomes important by using effective agro technical measures such as scientifically based crop rotations, the use of organic fertilizers and ameliorants. To quickly improve the agro physical and agrochemical properties of the soil and to increase crop yields, various ameliorants of polymer and polymer-mineral origin are used, for example, processed dacitic tuff which is rich in potassium and also organic fertilizers along with mineral ameliorants [3].

In order to improve the physical and chemical properties of the soil for increasing yields and to reduce the cost price of growing plants, it is necessary to automate the process of regulating the water regime in the soil using PMM material originated at Moscow State University and to determine the economic effect of its impact on plants in real time [1].

In particular, grain yield in rainfed conditions is significantly lower than in irrigated soils of the same region during drought period. Therefore, the cultivation of crops without monitoring systems for their vital activity and, in extreme cases, without artificial irrigation, leads to uncompetitive production up to its complete loss. Various technological innovations will improve the water regime of plant nutrition, will reduce the amount of applied fertilizers and will increase yields including the reduction of their root system.

In the conditions of rainfed agriculture the sources of moisture in the soil are precipitation and groundwater. The level of soil moisture is influenced by the type of vegetation, the relief of the site, the processing system, the presence of winds and air temperature etc. Soil fertility also depends on filtration and moisture content. Falling on the surface of the soil the water penetrates into the soil through large pores and then it is filtered into the depths through small pores and capillaries which surround the particles of the soil. If the soil is rich in calcareous compounds, then small particles stick to each other thus forming strong and porous grains between which middle size cracks are formed and such clay soils gain good filtration characteristics. The more porous is the ground, the larger amount of water there is in it.

Therefore, knowing about the moisture content of the soil and regularities of its formation and change over time, the establishment of the dependence of the crop on storage of soil moisture has great significance for tillage and for determination the efficiency of agro technical measurements.

Soil temperature and surrounding air are the most important factors of the life of plants and microorganisms. Germination of plant seeds begins only when the soil warms up to certain positive temperatures. Photosynthesis, respiration, transpiration, assimilation of nutrients and other physiological processes are carried out in them only in a certain degree of air temperatures.

Humidity of air has a noticeable effect on plants. At low air humidity, evaporation from the soil surface increases sharply and plant transpiration increases. Fluctuations in the yield of cultivated crops are largely due to fluctuations in precipitation during the growing season.

Wind promotes pollination of plants, transfer of seeds, trees and grasses. However, strong winds increase non-productive evaporation from the soil surface resulting in drought, erosion and plant damage.

The indicators of evaporation which reveal the properties of the soil also have significant impact on plants. All properties of the soil which contains sufficient amount of water, air and nutrients are important for growing and development of the plants.

Hence, traditional methods of preserving the structure of the soil are based on deep tillage, intensive loosening and furrow turning. The use of crop rotation and fertilizers, the treatment of acidic soils with limestone and gypsum of saline lands lead to their rapid degradation. Today conditions with minimal and no tillage are created for maintaining and improving the structure of the soil and increasing its fertility with the use of scientifically justified crop rotation, ameliorants and fertilizers.

Therefore, the task is set in order to improve the physical and chemical properties of the soil for growing plants and to regulate the water regime in the soil using the PMM material. To determine the characteristics of the soil (moisture content, humidity, oxygen content, acidity, temperature) and the environment (temperature, humidity, wind speed, precipitation, etc.) as well as to control the processes of plant growing, appropriate sensors, controllers and information systems (IS) are needed corresponding to IT architecture. Depending on the method and amount of the ameliorant used, the specific mass and volume of the soil, porosity, moisture content, absorption capacity, humidity, displacement and unavailable amount of water for plants in the soil, the dynamics of moisture changes during the vegetative period, field germination of seeds, plant safety during the growing period, the number and weight of nodule bacteria on their roots, the number and weight of grains in spikes, biological and total yield and economic efficiency are recorded.

The concept of using the Internet of Things (IoT) in agriculture has long been one of the main requirements for improving the quality and productivity of agricultural products. The Internet of Things is a concept of building a network of physical things that can exchange information by interacting with each other or with the external environment without human intervention. Examples of the use of IoT in agriculture include solutions for monitoring climatic conditions. For this purpose, meteorological stations located in the fields are used which collect data on the environment using sensors. The data received from these stations will allow using them to verify climatic requirements, to select appropriate climatic conditions for growing crops and to prepare a plan for increasing yields.

The use of meteorological stations using the Internet of Things is also possible in the design of "smart greenhouses". Such greenhouses will be able to automatically maintain the required temperature and humidity level in real time to maximize plant productivity.

In agriculture the technology of Internet of Things is used to collect data related to agriculture. The sensors provide a wide range of data starting with measurements of temperature and rainfall to the overall health of crops. The technology allows us to control plant growth and the occurrence of possible anomalies. Online monitoring will allow early detection and prevention of development of disease in plants. An integrated approach to IoT in agriculture involves establishing a farm management system. These solutions include not only IoT devices, but also a functional monitoring analytical network with adjusted functions of economic analysis of cost.

Improving business efficiency, producing high quality products, making justified management decisions, strengthening strong ties with consumers – all are the most important tasks of agricultural enterprises in the era of the digital economy. The winners are those companies that make decisions quickly and adapt to the latest changes in market competition.

It is difficult and often impossible to become such a company in the market without changing the current IT architecture with poorly integrated mutual systems. For successful development in the market, agricultural enterprises must not only rethink over their business, modernize the management system but also reengineer and automate the main business processes for growing and processing plants.

Using an architectural insight to IIS of the enterprise management which automates all activities based on the target IT architecture, subordinate to the business architecture, it becomes possible to function effectively in a competitive environment as well as to reduce the impact of most of the problems arising in the process of its activity [3].

CIS is an automated control system (ACS) necessary to achieve the mission of the company in accordance with its vision of the future market depending on business tasks, technical and IT services, covering all divisions involved in production and sales activities. It provides work with consumers and automation of business processes thus making effective management decisions at all levels. CIS is created through the integration of existing IS in the enterprise and new market applications based on the concept of IT architecture and more broadly - the architecture of the enterprise based on justified investments in information systems, people and automation of business processes.

However, making and implementing such a decision to invest or improve the communicative information system in accordance with the enterprise architecture methodology is an expensive and time-consuming task accompanied by difficulties and problems. Agricultural enterprises have been using software products that are not integrated with each other since many years even before the adoption of the generally accepted architectural insight to IS.

The current architecture of applications - one of the most important components of the IT architecture of an agricultural enterprise - includes application ICs which are often without documentation and poorly supported by their developers. Part of the problem is also related to the reluctance of managers to change anything at the enterprise who often want to limit themselves by cosmetic measures to meet the needs of the business. Besides, the introduction of a new one is always accompanied by sabotage of some of the employees of the enterprise [1]. Consideration of an agricultural enterprise through the prism of methodology of enterprise architecture requires not only competence and strategic thinking but also courage and willingness to invest resources in establishing a targeted IT architecture at the same time irrevocably abandoning the old architecture.

2. Theoretical background

The architecture of an agricultural enterprise consists of a business architecture that can be described using a business pyramid (built on the basis of the vision of the future market and the place of the company place in it) at the top of which its mission and strategic goals are situated and at the bottom products, material and technical base are situated for their creation including IT architecture [5,6].

The IT architecture ensures the meet of applications to business needs and technical infrastructure to application needs. IT strategy is a process of controlled changes in the IT architecture to meet the future needs of the enterprise. IT architecture and IT strategy are interconnected thus subordinating to the business architecture and the business strategy subordinating to the enterprise, respectively [5,6].

Automation of the activity of an agricultural enterprise is the introduction and use of hardware and software tools and methods for effective management of the process of growing plants, its resources, departments and project teams by marketing strategy.

ACS is a complex of technical, software, informational and organizational solutions for automating the activities of enterprises the development of which involves the creation of seven interrelated types of support: technical, informational, mathematical, methodological, software, linguistic and organizational.

Today the abbreviation ACS is supplanted by ERP-systems on the basis of which communicative information systems are created. ERP automates the functions of resource planning, operational management and control of the implementation of plans, analysis of economic activities, management of after-sales and warranty services, quality and transport management, sales planning, management of market demand, planning of materials, powers and resources, inventory management, life cycle management of plant growing and material incomes, financial planning, forecasting, project management, delivery chains, product sales and others. ERP is an integrated product based on a single data storage which allows the departments of an agricultural enterprise to exchange information and use the processed information to create systems of supporting decisions and relationships with consumers.

ERP-system is a logical continuation of planning systems of material requirements (MRP - Material Requirements Planning) and planning systems of production resource (MRP II - Manufacturing Resource Planning) [7].

In MRP the information about the requirements for materials for the production process is converted into purchase orders and production which is provided by the formation of a sequence of operations that allows correlating plant growth with planned indicators and minimizing supplies in the storehouse. According to the production plan, material documents, the state of supplies in the storehouse, the production program for growing plants and the need for resources are determined which makes it possible to increase the turnover of working capital and the profitability of the business.

The standard - MRPII (Manufacturing Resource Planning) which provides effective planning of requirements (CRP) for production and planning of distributed resource (DRP), allows to realize modeling and production planning of resources in natural conditions and cost units of measurements for agricultural enterprises as well as to reduce the amount of supplies and costs on purchase, time and transportation, to contract the personnel, to improve customer service and to increase labor productivity as well.

ERP-system is an integrated IS on a single database and a methodology for effective planning and management of resources of an enterprise which is necessary for the implementation of sales, production, purchases and accounting in satisfying consumer needs.

3. Methodology

CIS is an operating environment for planning operations, their execution and analysis and a system for describing the full cycle - from business planning to analyzing the results of its activities. It allows us to fully and comprehensively represent the activities of an agricultural enterprise, helps to reduce costs and increase revenues, which are achieved through the following: quick service, standardization and acceleration of production processes. A characteristic feature of CIS, designed and established on methodologies of advanced enterprise architecture, is its openness to platforms and DBMS, its increased adaptability to market conditions and support for multiuser network activity.

The introduction of automated workstations (AWS), the formation of standard reports on the work performed in departments on different software products, the lack of proper automation and systemization led to "scrappy automation" and to the storage of information in a variety of DBMS, which the unification of disparate AWSs into an automated control system (ACS) was conditioned by.

Thus, the unification of AWSs will allow to solve the problems of optimal planning and distribution of resources at an agricultural enterprise. The effect of the CIS is in the formation of a database of information for the analysis, control and planning of the activities of an agricultural enterprise, standardization and management of business processes leading to cost optimization and the creation of an effective motivation system.

Due to the lack of a module for processing the analytical data and modeling real-time processes in ERP, the expansion of functionality of ERP systems has occurred and the following have been noted: ERPII systems that provide users with the ability to work through mobile portals; APS–systems (Advanced Planning and Scheduling Systems) and CSRP (Customer Synchronized Resource Planning) systems covering the interaction of the enterprise with customers at all stages of the life cycle of growing plants and their processing in which MES systems (Manufacturing Execution Systems) are added to traditional ERP functions - automated systems of control of production (ASCP); CRM-systems (Customer Relationship Management) - management systems of customer relationship, SCM-systems (Supply Chain Management) - supply chain management; OLAP- technologies (On-Line Analytical Processing) - analytical processing of multidimensional data in real time.

The information gap between the automated systems of control process which automate the strategic level of management of the production process of growing and processing plants and the automated systems of control process focused on the operational management of production close automated systems of controlling the production process (ASCPP) or MES which monitor production processes in real time. The main functions of the ASCPP are: control of the state and distribution of resources;

operational planning; dispatching of production; management of production processes, documents and personnel, product quality; establishing links between personnel and equipment, production and suppliers, consumers and employees of departments etc.

Thus, based on the concept of architecture of application the designed CIS information can be represented by four levels responsible for supporting the tasks of strategic, tactical and operational management of an agricultural enterprise:

- APCS - automated systems of control of technological processes;
- MES (Manufacturing Execution System) - automated system of production control;
- ERP (Enterprise Resource Planning) – system of planning and management of enterprise resource;
- OLAP (On-Line Analytic Processing) - data analysis and processing with the preparation of dynamic reports on sales and marketing aimed at management [8-10].

Depending on the specifics of the agricultural enterprise, we can also use: BPM (Business Performance Management - management of business efficiency); EAM (Enterprise Asset Management) - a system of management of fixed assets, BSC (Balanced Scorecard) - a balanced system of company indicators, ABC (Activity Based Costing) - a method of distributing overhead costs, EVA (Economic Valued Added) - a system for recording added value and comparing alternative investments to the project, Docflow – system of electronic document circulation. The integration of these systems into the CIS will allow effectively planning and managing production, to transfer plans and reports to the heads of structural departments.

MES-systems solve the issues of how products are produced in a given time and quantity, have information that allows to quickly correct the plan and optimize production, to connect the financial, economic and operational activities of the enterprise subdivisions.

So, CIS provides the following functional opportunities and integration with application systems: MIS (Management Information System) - a system of providing information for decision making, SCM (Supply Chain Management) — management of delivery chain, CRM (Customer Relationship Management) — management of relationship with customers, FRP (Finite Resource Planning) – detailed management of resources, SCE (Stand Alone Configuration Engine) – configuration of systems, SSM (Sales & Service Management) — management of sales and service, EC (Electronic Commerce – electronic commerce) for interaction with delivers and clients; SCADA (Supervisory Control and Data Acquisition – dispatching management and data collection) – system of management of technological processes and deleted data base; HMI (Human Machine Interface – human-machine interface); BI (Business Intelligence – business-analytic) for analysis and collection of information to make decisions; APS (Advanced Planning and Scheduling – synchronic planning and optimization) – planning of production issues and materials, production plan and planning of loading the productive powers, forecasting the sale and demand and re-planning, JIT (Just In Time – in time sharply) – for providing the enterprise with all the materials, components and semi fabricates of necessary quantity in necessary place and time.

The scientific novelty of our research is total reconciled application of CIS for monitoring and management of various objects participating in the processes of life cycle of the cultivation of plants. Among them we have:

- soil and its characteristics - temperature, humidity and saturation of fertilizers during the period of growing the plants and the processing and sale after harvesting;
- surrounding air – the weather and climatic characteristics of the territory: wind speed, pressure, air temperature and humidity, amount of atmospheric precipitations, height of snow cover;
- cultivated plants and their characteristics - height, thickness and condition of roots and green foliage;
- water, fertilizers and other components added to the soil;

6

- various systems of life support (systems of notifications, security, climate of control and others) for cultivating the plants.

For estimating the impact of soil and atmospheric factors on physiological peculiarities of cultivated plants it is necessary to monitor the concentration of cellular sap, intensity of transpiration, water retaining properties of the leaves, deficit of moisture in the soil and measuring the amount of water.

4. Research results

Let us list the main problems of the implementation and use of IT the agricultural enterprises face:

- the existing ISs solve individual problems and their own developments where huge databases have been accumulated are morally outdated and do not meet the requirements;
- current ICs are not compatible with each other which leads to "scrappy" automation and their ineffective use;
- lack of a project-based approach to IT implementation;
- the lack of a centralized and integrated approach to automation of an enterprise leads to disintegration of work on the implementation of IS, conflicts, lack of personal responsibility and coordinated efforts to overcome difficulties, to slow down the process of decision-making and an increase in the period of IT implementation;
- underestimation of the psychological aspects of the transition to new IT and the dimension of resistance to innovation;
- the lack of normative-legal base for CIS leads to the fact that automation does not give the expected effect. Lack of standards of quality management leads to low efficiency of IT projects and problems: difficulties in planning activities; lack of unified forms of reporting; difficulties in identifying the causes of failures in the work of subdivisions and others [8,11].

Note that only 15-20% of IT projects are completed according to the stated schedule; 30-35% do not reach their goals; 50% increase price by more than 100%; in completed projects only 60% of the requirements are implemented; 60% of IT investments are unprofitable or ineffective. Among the reasons: insufficient attention of managers to automation; lack of clear goals for the implementation of the IT project; chaotic business processes that cannot be automated; unpreparedness of employees for changes; instability of legislation; lobbying of IT projects with lack of resources; low IT qualifications of personnel; insufficient funding for IT, incorrect assessment of the amount of forthcoming implementation of work.

The development of IT requires the construction of a new IT architecture including IT services that support the operation of an agricultural enterprise. The task is to create a corporate IT architecture for the implementation of a model of digital enterprise in the center of which a database is an environment for storing and processing corporate information for all IT tasks and applications: design, technological, production and others. Such approach is a reflection of a new paradigm for building production and doing business: the integration of internal and external information flows, management in real time, the development of analytical methods and tools in the interests of development of an enterprise.

The IT structure must work with the IT assets of the company, methodologically support the corporate data model and manage the information lifecycle. To reach this it is necessary to assemble the available non-standard IT components into a stated structure with the integration of all applications, to provide IT products for all tasks and stages of the life cycle of plant cultivation and processing and also to think over the organization and stages of transition to the target IT architecture and how it will be integrated into the information relief of the enterprise.

The selection of performers for the investment group should take into account their deep understanding of the subject area as well as the ability to manage complex IT projects. Mastering IT is the process of interaction of the entire group of an enterprise within the framework of its professional activities. The formation of IS should be subordinated to a single thing: concept, goals, ideology and

should be aimed at solving strategic problems. Therefore, to obtain the desired results, the detailed IT projects, a high-quality management structure for the implementation of these processes supervised by the company management are required.

CIS should encompass and bring together the means, tools and methods of information support for the production of the company and its sales activities as a solution which takes into account the best industry and world practice. Therefore, as a basic life support system and a general strategy for its development, it is necessary to include the IT service in the organizational structure of the enterprise and honour the director of the enterprise a high status - the deputy director of the company.

The effect of the introduction of CIS based on the methodology of the architecture of an enterprise is first of all manifested in a well-organized production. At the same time, the correction of the structure of the enterprise should be carried out gradually as the automated business processes are put into operation in order to reduce the risk of appearing psychological barriers for innovation among employees.

As a result of the introduction of CIS the following is ensured: the uniqueness of data of all types of accounting; implementation of management procedures; control over resource costs; a high degree of independence of enterprise management from the individual characteristics of managers; increase of the capitalization of the enterprise and its attractiveness in terms of investment.

The choice of CIS, the task setting for the automation of an agricultural enterprise must be carried out on the basis of a long-term strategic plan, its mission which has resources and timely concern taking into account all qualitative and quantitative effects received from its operation. The use of CIS is the reduction of operational and management costs, the saving of turnover means, the increase of the goods circulation, increase of control quality of cost price of the products, optimization of the storage, increase of sales on account of rising the quality of client service.

Hence, in order to regulate the regimes of growing plants and to reduce the cost price of their production, ICT are offered for timely information and/or implementation of the necessary actions in addition to technological innovations. For example, to assess the characteristics of the environment and to maintain a given state of the grown plants, various humidity sensors, PH meters, dosimeters and executive valves implemented in the form of the Internet of Things (IoT) powered by solar panels or batteries are provided. The used ISs and hardware and software systems are inertial, and, therefore, all these IoT sensors can be turned on according to a given time schedule or at the time of a precedent and transmit information to a data processing center (DPC). Depending on the landscape, moisture sensors and PH meters are installed in the soil equipped with radio modems at a distance of up to 3 km. from each other. Two types of IoT are of particular interest: those operating according to LTE standards and over individual communication networks. Such remote control systems based on IoT using Wi-Fi are economically expedient to carry out using smart phones connecting with the central server via any communication channel.

Monitoring systems of the monitoring objects listed above can be easily integrated with each other and include: a meteorological station, various video cameras, dosimeters and mixers as well as a subgroup of security systems and warning systems designed to fight against various natural disasters, rodents, insects and flocks of birds etc.

4.1. Expected results of the research and their scientifically applied significance

Based on the experience of the authors in the implementation of ICT at enterprises of various industries and the practice of other specialists as well, the following conclusions can be made which the CIS allows: to reduce the cost of production, spoilage, supply and storehouse losses, the cost on product quality by 15-30%, time for collecting and processing information for decision making by 50%; to improve the accuracy of specification and delivery times by 30%; to efficiently use production power by 20%; to accelerate time for new products to be brought to market by 20%; to increase sales and company revenues by 20%; to reduce the cost for preparing commercial offers by 20%.

Automation of plant growing processes will make it possible to give well-grounded offers for solving the most important national economic problems. Ideas, technologies and methods for monitoring and

managing the process of growing plants and their further processing as well as the economic expediency of introducing PMM into the soil must be verified by field tests on large areas, which, in case of success, can be recommended to agricultural producers.

Expected scientific and practical results: to prove the feasibility of PMM for increasing the productivity and vitality of plants, to create an ecological filtration layer with a given filtration coefficient; to increase the moisture content of the soil; to slow down the evaporation of moisture from the soil; to reduce the costs on fertilizers.

Through the use of ICT and technological innovation based on PMM, it is possible to reduce the amount of irrigation water and the amount of fertilizer and thereby to reduce environmental pollution by reducing the toxicity of wastewater. The results obtained will allow to grow plants in field conditions and greenhouses and to increase the productivity and adaptability of plants as well, to improve the agro physical properties of the soil and replicate the results.

5. Discussion

There are many ISs for the automation of agricultural enterprises but their functionality and popularity are different. Besides, the information and managing structure of an enterprise can also be represented by a different number of levels responsible for supporting management tasks of an enterprise, particularly including applied ISs responsible for the operation of an enterprise on the Internet. Portal solutions, cloud services, online storage technologies, virtual and augmented reality, contact centers and others are in demand without which the work of modern agricultural enterprises in the era of digital transformation is impossible.

The introduction of CIS suggests itself the formulation of automation goals and, in accordance with them, the choice of IS to automate the main business processes as well as their integration to other systems. Having designed the CIS by taking into account the chosen IT architecture, it is possible to make an initial calculation of the total cost of ownership of the new solution and also the necessary changes in the work of departments, to pass to the purchase of IP and other components of the solution. After installing software, setting up equipment and databases as well as the transfer of information from the existing IS of an enterprise to a new target system by implementing and testing it, one may pass on to pilot operation and then to industrial operation simultaneously rejecting old ISs.

Projects for the implementation and operation of CIS are associated with risks: failure to comply with the terms of the project and excess of the cost, the functionality of the selected information systems is inadequate to business processes; the excess of outlays and terms of implementation of IS; change of the goals and priorities of the enterprise; decrease in the efficiency of its work. The goal of risk management is to minimize the negative factors that lead to problems and difficulties in the enterprise. The risk management process involves: identification, analysis and assessment of project risks, selection and application of the selected methods of their assessment and assessment of the results of risk management.

CIS is a complex product that can only be implemented by joint efforts of an enterprise and a developer. In the field of IT, the success of a project largely depends on the competence of specialists and managers as well as on the support of the project by the management of the enterprise. When introducing IS, one often has to face a situation of rejection of the system by the personnel of the enterprise, their reluctance and sabotage at all stages of implementation of the designed solution. Sometimes employees of the ACS department of an enterprise negatively perceive the new system. A clear understanding of the goals and objectives by the management of the enterprise for the implementation of which CIS is being implemented, the readiness of the joint group of specialists (developers of CIS and the employees of the enterprise) as well as the desire of management of the enterprise to make changes and the consistency in making such changes will ensure successful implementation and productive use of the stated solution.

The development of modern technologies leads to an increase in the complexity of the implemented IS which involve both technical innovations and new solutions in the field of business. IT must be used

wisely as a tool for business efficiency. A positive effect is achieved only if the management of the enterprise has a clear idea of how to solve the goals and objectives set forward.

Thus, it is necessary to develop a general strategy for enterprise automation within the framework of an architectural view for the successful completion of an IT project, to take into account and to control possible risks, to develop a project and a plan for its implementation as well as the interest of management of CIS.

6. Conclusion

CIS management of an agricultural enterprise is an "expensive pleasure" that requires a lot of time and resources for their investment and maintenance including infrastructure, software, system design, process automation, application configuration and refinement of their functionality as well as implementation, experimental -industrial and industrial operation and staff training. The process of implementation and operation of CIS is accompanied by risks that must be foreseen and measures must be taken to eliminate the reasons causing them.

A clear definition of the goals of introducing CIS and the interest in this project of the top management of the enterprise as well is the starting point in assessing the expediency of cost on automating its management activities.

In particular, the CIS, being established by using the methodology of IT architecture, can improve the quality and efficiency of enterprise management, each structural unit and project, the productivity of products and labor, company revenues as well as reduce costs. An architectural insight of CIS is especially relevant in the modern era of universal automation of business processes.

The solution of tasks set forward will allow to provide food security of the country and to create competitive technologies and products for market.

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