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Major Features, Benefits, and Prerequisites for Intelligent Enterprise Managing System

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Abstract

The modern conditions of high-tech and highly competitive markets require the evolution of the enterprise automation systems. Such new, the post-ERP systems should meet the conditions for the provision of customer self-service and other counterparts, the dramatic decrease of the manual labour through automation, robotic application, integration with other systems and external contracting systems, multi-channel marketing and distribution, reduction of supply chains and other current trends. These systems should be built on the new IEM Automation Paradigm (Intelligent Enterprise Managing) and therefore belong to the IEM system class. As stated in the IEM paradigm article, a modern approach to solving the task of automation is based on the application of "best" solutions for each separate entity or business unit. In practice, however, this approach has resulted in a series of significant problems. The scale of the problems is increasing with the growth in transactional load, competitive pressures on the market, requirements for accelerate optimization, and business processes changes.

Key words: *Management system, Structure, Solutions, Automation paradigm, Scale, Intelligent system, Neuroinformatics.*

Introduction

Research in the area of "Intelligent Systems" has received State support (Order No. 701 of the USSR Civil Code on Public Education from 30/08/1989). A research program "Intelligent Systems", has been approved, according to which scientists of Research and Development Establishments and universities of the country have been tasked to design Intelligent System (prototype), based on achievements in the area of systems theory, neurophysiology, computer technology and computer science (The USSR State Committee on Public Education, 1991).

The contribution to the establishment of the «Intelligent systems" scientific area was made in due course way back by Pavlov (1949), Russian physiologist, researcher of the higher nervous activity

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mechanisms. Pavlov (1949) concluded that the highest nervous activity is the ability of the body to adapt to the environmental conditions. In the "Lectures on the Work of the Cerebral Hemispheres" Pavlov (1949) suggested that, in the near future, mathematics would cover many areas of expertise by converting natural sciences data into language of mathematics. Intelligent systems of the beginning of the 21st century are designed and built on digital technologies with digital coding using the characters "0" and "1". Neuroinformatics, based on the neural networks theory, is studying ways to describe the cerebration by mathematical tools, and to develop such mathematical models that are appropriate to human nature.

The study under the government program "Intelligent Systems" (1989-1991) clarified the concept of the intelligent system. The Intelligent System was defined as a range of means (programs, hardware and software) together with a man included into an information process which are able to conduct the synthesis of a goal, act, find more effective ways to achieve the goal (Pupkov & Konkov, 2001; Tarman, 2010; 2016;2017; Tarman, Baytak & Duman, 2015; Tarman & Baytak, 2011).

The concept of intelligent system has many definitions, and it is multidimensional. An intelligent system is an information technology system that has the required knowledge data base, an operating procedures, intelligent assistance, and thus it solves tasks without the help of an operator (the operator is the expert outlining the way of proceeding and responsible for decision-making). Intellectual support is understood by us as a multipronged support, including software and tools, algorithmic and mathematical support, which can help solve various complexity problems.

It should be noted that the intelligent system is designed that it can:

- solve various complexity problems no worse than a human being, and just as he does;
- learn; systematize, compare, explain, analyze, generalize, and gain the experience of solutions and actions.

An information technology system with the required knowledge data base, operating procedures, intelligent assistance, but not capable of solving tasks without the help of the operator, the person responsible for decision-making is defined as the intellectualized system. Thus, the difference between the intellectual system and the intellectualized one is determined by the fact of presence of the person, the professional operator in the decision making process.

The intellectualized system, as a system, is capable to work in conditions of self-management, indeterminacy, dynamism, scarcity and immensity of information, with different objects, different objects life cycles.

Intelligence, intellectuality, intellectual are the words which are attributed to the qualities, characteristics of man, capture a person's ability to think, make decisions that are based not only on knowledge and experience, but on a variety of factors (intuition, imagination, etc.), and intelligent systems implement this through the system interface with the user in a programming language that is close to the natural language.

In a scientific literature in a narrower sense, an intelligent system is understood as a program system developed on the basis of the technology that defines the database, its structure, how to obtain and process information, and how to take decisions.

An intelligent system is also understood as a computer system capable of dealing with tasks that only the man could solve.

Materials and Methods

Ostroukh (2015) relegates the intelligent system to an automated system category with a knowledge component. An intelligent system is understood as a set of tools (logical, mathematical, linguistic, software, interactive) designed to work with information and to assist a person in different types of activity (Anokhin, 1935; 1978; 1998; Kilinc, Tarman & Aydin, 2018; Ritter et.al, 2011; Tarman & Chigisheva, 2017).

Researches by Anokhin (1935), neurophysiologist of the life forms, adaptive reactions and adaptive abilities, mechanisms for achieving goals, functional system theory, form the basis for the concept of the intelligent system.

Anokhin (1935) in the work of "The problems of the centre and the periphery in the physiology of neural activity" develops and defines the concept of a functional system. A functional system with feedback and an exchange of information about the results of action mechanisms is an enclosed physiological formation. The functional system provides an adaptive effect with multiple paths, channels of information moving from the periphery to the centre (see fig. 1).

Adaptation of the organism in accordance with the Anokhin (1935; 1955; 1978; 1998) functional system theory is achieved through mechanisms:

- Afferentation synthesis of data entering to living organisms;

- The living organism decision-making;
- Building an afferent model of the expected result;
- Results action acceptor as a model for the result prevision; reafference model in the form of a ring-net of interacting neurons covered by a ring interaction (Anokhin, 1955).
- Action to implement the decision (Anokhin, 1935).

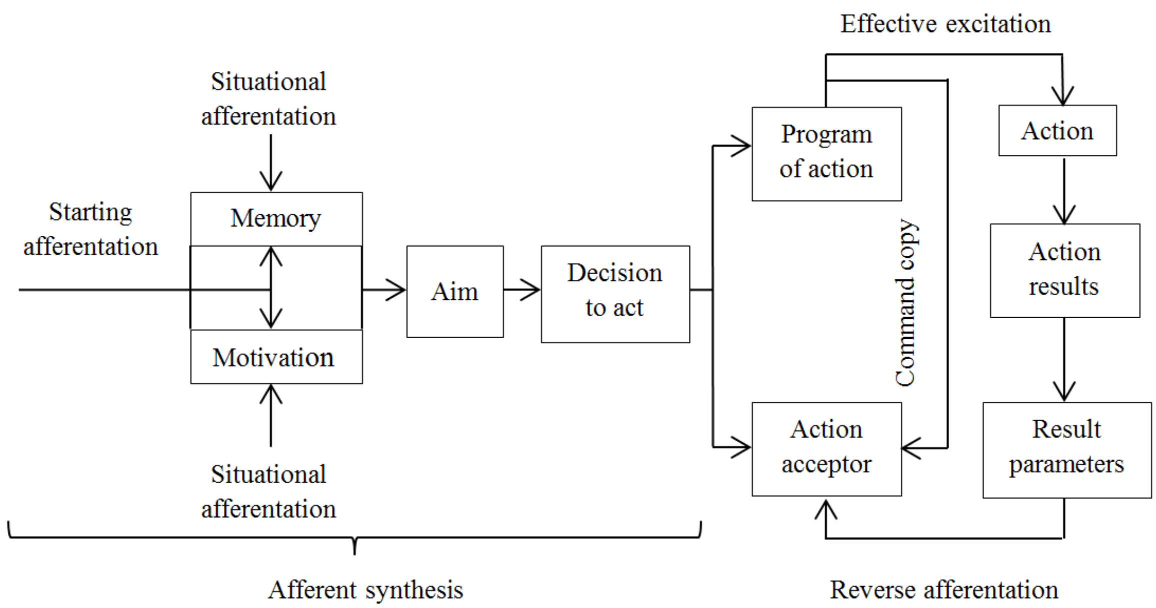

Figure 1. Block scheme of the functional system (Pupkov & Konkov, 2001).

Anokhin (1998) introduced the neurophysiology principle of action acceptor, which is that the nervous system continually (in every action) builds a model of expected, presumed reafference (passing of the nervous agitation from the periphery to the brain) from the result of the action. Reafference, feedback, makes it possible to compare the expected result, the prediction, and the results of the action that are received. The operation of comparing the parameters of the action acceptor and the result obtained has an emotional component in the sense of satisfaction/dissatisfaction.

Anokhin (1998) found, that the defining characteristic of any result that works towards the goal is that achieving the result of any level and complexity is possible on the basis of the principle of self-regulation. The mechanisms for achieving results are certain: Afferentation synthesis; decision making; Efferent program and action acceptor, reafference, recognizing similarity between the result and the prognosis. In a situation when the actions reach the expected result, the act of adaptation ends. When the model and the real reafference are mismatched (passing of the nervous agitation from the periphery to the brain), the living organism reacts differently, he acts in an indicative and exploratory manner. In a situation where actions do not achieve the expected result, the afferent synthesis and the action program are changed, and this occurs until the result has been matched with the action acceptor parameters. After the achievement of the result, the living organism feels satisfied.

Anokhin (1935; 1955; 1978; 1998) research results of the functional system has been put into practice only when information and computer technologies have been actively developed. The creation of fast-acting, technology-based microprocessors with a large amount of memory, which provide the high productivity, the development of networking technologies, the need to obtain and process vast amounts of information, and the handling of information and databases to develop effective solutions, such as management, has been an objective reason for designing, constructing of intelligent systems. The current level of research in the area of intelligent systems involves the design of systems that are based on knowledge, actions, algorithms, up-to-date information about their state and the state of the environment, and can meet the challenges of different complexity.

Any system as a whole is a complex of interconnected, interacting elements, parts with uniquely defined features and functions, which provides the implementation of the system functions. By looking at the structure of the system, you have to assume that the structure is a steady set of unchanged, persisting for some time (for example, in the observation time interval) relationship.

By describing the structure of the intelligent system, it is necessary to rely on the structure definition above. Based on this, the structure of the intelligent system consists of elements such as the purpose of knowledge, dynamic expert systems and acceptor, actions, subject to management, and feedback mechanism (see Figure 2). The invariant nature of the goal should be noted because, with regard to the intelligent system, it can only be a synthesis of the goal based on available memory, motivation, information on own and the environment state. The objective, as a component of the system, is linked to a dynamic expert system, the function of which is in the expert assessment, being the basis of the decision on the necessary action to be taken and the prognosis of the intended result (see Figure 2). The solution is accepted, and then the object control algorithm is developed.

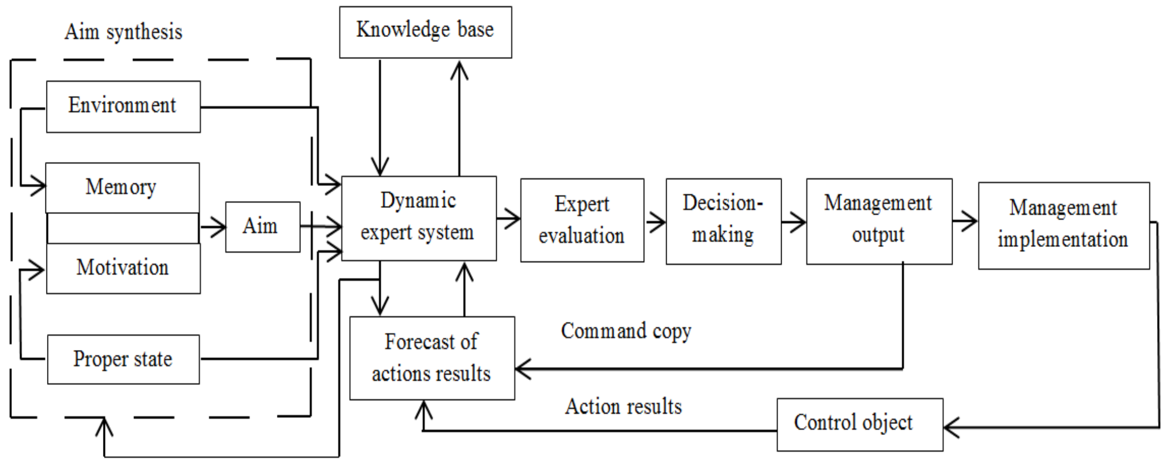

Figure 2. The structure of the intelligent system (Pupkov & Konkov, 2001).

In the "Intelligent Systems" research area, the problem is the classification of intelligent systems, the choice of grounds for classification, and the identification of the common and special. The common, in our view, for all intelligent systems are:

- the adaptability (in the conditions of objective changes, the system's ability to develop and software configuration);
- communicative maturity (grasp of ways of user conversational interaction with the system);
- the ability to solve difficult formalized tasks (tasks with dynamic, undefined data, original algorithm);
- self-learning (ability to build knowledge of acting experience).

If the characteristics data are taken as a basis for intelligent systems classifying, we can form out:

- Adaptive Intelligent Systems;
- Intelligent systems with intelligent interface;
- Intelligent systems to solve difficult formalized tasks, or expert systems;
- Self-learning Intelligent Systems.

For the "methods" criterion, the classification of Intelligent Systems (IS) would be as follows: self-organizing IS, communication IS, IS developed using heuristic programming technologies.

There are intelligent systems of common (solve tasks by algorithm, generate new procedures to solve new tasks), and special (solution of defined while designing tasks) purpose

Another basis for classifying of Intelligent Systems can be the solvable problem, then the intelligent system (IS) can be formed out: Game IS, administration IS, IS with informative task type, computer linguistics IS, IS with identification tasks, IS on solving tasks of intelligent information system creation.

If you take the "used methods" criterion for the classification base, you identify types of intelligent systems, such as hybrid, soft, and rigid.

Let's take a look at some of the designing and engineering approaches of the intelligent systems, shown in the work of Chinakal (2008).

The logical approach comes from the Aristotle logic and the Boolean algebra, it is based on the human ability to think logically. The development of science has enabled the introduction of subject symbols, the designing of the basic data representation system, creation of knowledge and data bases. The structural approach involves modelling of the human brain with its inherent structural components- neurons, neural networks. The evolutionary approach is characterized by the development of not only the basic model of the intelligent system, but also the rules, following them the system can evolve. The simulation approach is linked to the objects like "black box" (everything is unknown, high uncertainty), "gray box" (something is known or there are hypothetical assumptions), and the "white box" (minimum level of uncertainty). As you can see, named objects differ in the level of data uncertainty about their characteristics. The model of such objects is designed to take into account the specific behavior in the system of the "impact-response" and the relationship between response and external influences.

On the basis of the above, a number of conclusions can be drawn on the relevance and focus of research in the area of intelligent systems. Among the problems that are currently being faced and addressed in the "Intelligent Systems" research area, which are of a theoretical and innovative nature, are:

- The problem of synthesizing the purpose, the mechanism of target components interaction, because the target is a system forming factor;
- The problem of identifying (capturing) the critical potential of such a set of components of a goal when the purpose is synthesized;
- Development of intellectual management theory, theoretic apprehension of object-orientated systems;
- Finding and designing mathematical models that are adequate for wildlife based on information process theories and management;

- Model constructing: The action program model, the action acceptor model, and its practical implementation into intelligent systems.

Findings

The main research areas of in the area of intelligent systems that are currently being developed should also be outlined. By defining the research object as a basis for the line of research, priority may be given to: A study of the human brain, its structure and operating mechanisms, intelligence models; intelligent systems research and computer-based modelling; develop intelligent systems with dialogs in the "man-machine" system, interactive characteristics.

So here are the main issues:

1. Heterogeneity. Developers of systems that implement one or another functionality unit to make their products more attractive have to adapt it to different landscapes. As a rule, this means that the product must run on different operating systems, use a large set of database management systems and other technologies to store data (including support for various application integration mechanisms, including aging or outdated ones) that allow the product to be used in a specific environment at the enterprise. Developers face a combinatorial explosion of possible configurations, which entails both a significant increase in development costs and a reduction in the reliability of the product itself.
2. Disruption of a single information field. Using some of separate applications (such as CRM, ERP, HRM, WMS as a "standard" set for a modern enterprise) breaks the enterprise's single information field. Even if there are integration mechanisms between applications, each application uses its own dedicated database. As a result of unavoidable synchronization errors, the data accumulates discrepancies that distort the real picture of the enterprise. In view of the constant data gap, it is extremely difficult to reconcile, and in practice it is not done, and errors are suppressed by the periodic introduction of amendments to the data based on subjective representations of the employees and/or auditors of the enterprise. However, the data remain inconsistent and unreliable. With the growth in data volumes, the technical possibilities for their real reconciliation are only reducing. During the final (and foreseeable time), the error is not suppressed, and the enterprise is losing the picture of reality.

3. Flexibility and full-functionality Any two enterprises cannot operate on identical algorithms, they are located in different geographical locations, they work with different people, and so on and so forth. In reality, each enterprise is unique and can implement process even with the small difference, but with it. Many of these enterprises are "best" in their field, and the implementing software product is forced to co-opt a big set of different settings, rules, and exceptions. Such way leads only to one result that is the radical complication of the product until it would not be possible to modify it further.

As a result, with an increasing number of implementations, companies are asked to adjust to a specific solution, and in future companies face the impossibility of changing the product at the time set by the external environment.

These issues have a cumulative effect of reducing the performance of your application. And as a result, the implementation of multi-way marketing (especially on the Internet), user self-service implementation, integration with a variety of sensors (RFID, Pressure Transmitter, GPS, etc.), automatic settlement mechanisms through blockchain or smart contract implementations are extremely difficult or impossible to implement.

As can be seen, many of the decisions that were "good" for the technology of 80-90 years could withstand the practice tests in current circumstances. To solve these challenges, it is necessary to move to modern automation systems based on the IEM paradigm (see the evolution of enterprise automation systems from ERP to the new management and automation paradigm -Intelligent Enterprise Managing).

Thus, the obvious requirements for IEM systems are as follows:

1. Common information space
2. Real-time transactions
3. Reliability and consistency of data at any point in time
4. High customization level
5. Uncompromising performance, ability to withstand high transactional load

To meet the requirements, the IEM systems should be built on the following principles:

- Centralized data storage (as a private case of the IEM paradigm requirement of a system unicity). In this case, it is intended any version of the database management system that will ensure data consistency and the transactional atomicity.

- A closed multifunctional platform, invariant for all enterprises. This platform provides only technical tasks for the entire system operating and does not have any business information.
- The open business logic space. The platform must provide the mechanisms to implement an arbitrary configuration of the business logic space without any necessity to make any changes to the platform itself.
- Close integration with featured data management system to achieve maximum performance and data consistency.
- A rich data model. The enterprise is described by high-level abstractions (more high-level than the "records" currently in use).
- Modern, industrial, high-standard language. The lack of integration with a wide range of DBMS dramatically reduces the cost of developing and testing of the functionality and the functionality itself is tightly divided into the platform and business logic space. Integration with favorite DBMS allows you to move a large part of the data processing closer to the data itself, dramatically speeding up the transactions. The transporting balance of processing mechanisms, however, is limited by the high-level development language use requirements. In this way, all DBMS capabilities are used to fetch, aggregate, and filter data, but direct processing is done by the defined algorithms of the business logic space.

In turn, the business logic space implements only that functionality which is needed at the particular enterprise and nothing more. This allows you to reduce multiply the code base and simplify the application support.

Agile development techniques using continuous integration provided by the platform and performed business logic space over it.

IEM system is as a process changes driver in the enterprise. Strict regulation of processes in the system and a requirement for symmetry (see the IEM paradigm) allow you to directly manage processes through the automation system.

One-time data entry and data reuse as a natural consequence of centralized data storage and the general monolithic system

Endurance to unskilled intervention. A closed platform, according to the principle of integrity, controls itself and provides mechanisms for implementing independent verification of the validity and consistency of data in the business logic space. This reduces the risk of changes to the software code that can cause data degradation.

Reducing of owning cost the use of the common development languages (not obsolete/proprietary) provides access to a broad marketplace of developers, development tools. In turn, platform tools, together with the requirement of a rich data model, significantly (up to 10 times) speed up the development and implementation of new enterprise functionality.

The period of implementation of the system is reduced to months with unacceptable conditions in the current year.

Independence from software manufacturer. Due to the full openness of the business logic space for modification, an enterprise can completely abandon its interaction with the manufacturer and maintain a completely closed development.

Any production can be introduced as a sequence of operations which, apart from production, also includes organizational processes, planning processes, raw material and financial support process, etc. As part of this concept, standard resource planning and distribution tools and multi-faceted production and corporations management tools have been developed today and brought about in the form of powerful tools, like ICS (Integral Control System). With their help it is possible to automate planning, tracking, control and analysis of company business processes.

In the previous chapter we saw that ICS includes subsystems of information support for production, supply, distribution, storage, technical, material, financial support, etc. Having such information allows for setting tasks to optimize material and financial flows of the company, optimize business process themselves and their structure, and lessen the expenses.

Certainly, the usage of MRP / ERP systems itself allows for securing more efficient production management due to:

- regulation of resources, elimination of deficiency and finding no sale, sunk financial resources and storage expenses,
- authenticity of order executability assessment based on production assets available,
- reduction of expenses and time by means of optimizing business processes,
- reduction of production cycle duration and flexible reaction to demand,
- monitoring actually produced products, their comparison with target tasks and, as a result, correcting production plans, etc.

New possibilities of an extended ICS application appeared with more active usage of the Internet when managing production processes, including when managing deliveries and sales. More complete and efficient information influences the efficiency and timeliness of making management decisions. The role of efficient usage of databases, DBMS system tools, their logical structure and interconnections becomes more important.

A prominent spot of the agenda of today is given to the tasks of optimal organization of information flows in the management system, creating and positioning responsibility centers, need for technical problem solution. This also includes the tasks of singling out standard objects, information processing tools with the consideration of occurring events and changing situations, software standardization.

That said, tracking and control remain principal management functions of ICS modules.

Certainly, at the stage of ICS creation and implementation, completely new problems requiring their own solution arise. These are, primarily, determining the composition of business processes, their analysis and optimization, management of information flows. Problems of management both in a separate responsibility center and in a responsibility center as a whole become independent problems.

However, further quality leap in development of MRP / ERP systems lies on the path of their intellectual possibilities development.

That is why IICS (Intellectual Integrated Control System) MMC sets the task to extend intellectual possibilities of ICS by means of integrating databases, mechanisms of logical entry, information rollup, etc. into their composition, i.e. its task of improving the existent ICSs by means of "intellectual add-on".

Great significance is given to the problem that there was an attempt to solve when creating IICS MMC by the need of efficient management of big arrays of information typical of large industry. Total number of indexes characterizing material and financial flows is at least several thousands of units which must be taken into account when looking for and making management decision.

That is why, when creating IICS MMC, great significance is given to analysis of the informational structure of a company management system, and such tasks solved with the help of specially created databases as diagnostics of management object status, identification of discrepancy reasons, formation of management decisions are determined. Functioning of databases as subsystems of the highest hierarchical level in the information structure of the company management system is based on:

- informational arrays formed by means of automatic registration with the help of automate workstations module stubs intended for manual entry of the final data about business processes,
- databases in which data used in the process of developing and making management decisions is archived and updated, and data coming from direct information sources is combined,
- elementary images (functions) with the help of which queries are formed, data is transformed and analyzed, recording documents on separate business processes and company as a while are formed.

At the same time, already at the level of elementary images (functions), usage of integral assessment and logic conclusions is expected. At this point using standard software tools provided by system and other shells is virtually impossible. Therefore, there is a need for special methods and technologies that have original applied scientific nature.

This is primarily caused by the necessity to provide real support for the process of developing and making management decisions at the company. There emerges a need for expert evaluation usage, adequate description of situations where a management decision is to be made, and tracking of multi-criteria nature of ratings used in decision making. Management process becomes especially complicated when decision making is needed in time crisis or close-to-crisis situations.

This means that the need to use situational analysis tool in the process of company management becomes current. The toolkit applied in the development of methodical system support is extending. It includes both elements and technologies of expert analysis, and results of collective decision making theory, and "fuzzy" logic, and results of game theory and prediction theory.

But for us, from the point of view of analysis of management technologies used when creating IICS MMC, application of different forms of expert assessment technologies. Starting from formation of databases and logic entry mechanisms in a certain subject area and finishing with multi-aspect assessment of complex management situations, determining principal tendency of their development and preparation of recommendations and alternative options for management decisions.

Constructing a database structure must primarily take into account "horizontal" automation principle, i.e. based on consequent interconnection of business processes.

At the same time, to provide support for management system at all hierarchical levels actually existing in a modern company it is also necessary to use "vertical" automation principle allowing taking into account management communications actually working in the company. Using "vertical" approach implies increasing depth and numeric composition of business processes in order to improve company management efficiency.

When implementing IICS MMC, the administrative functional company management pyramid is used (Fig. 3).

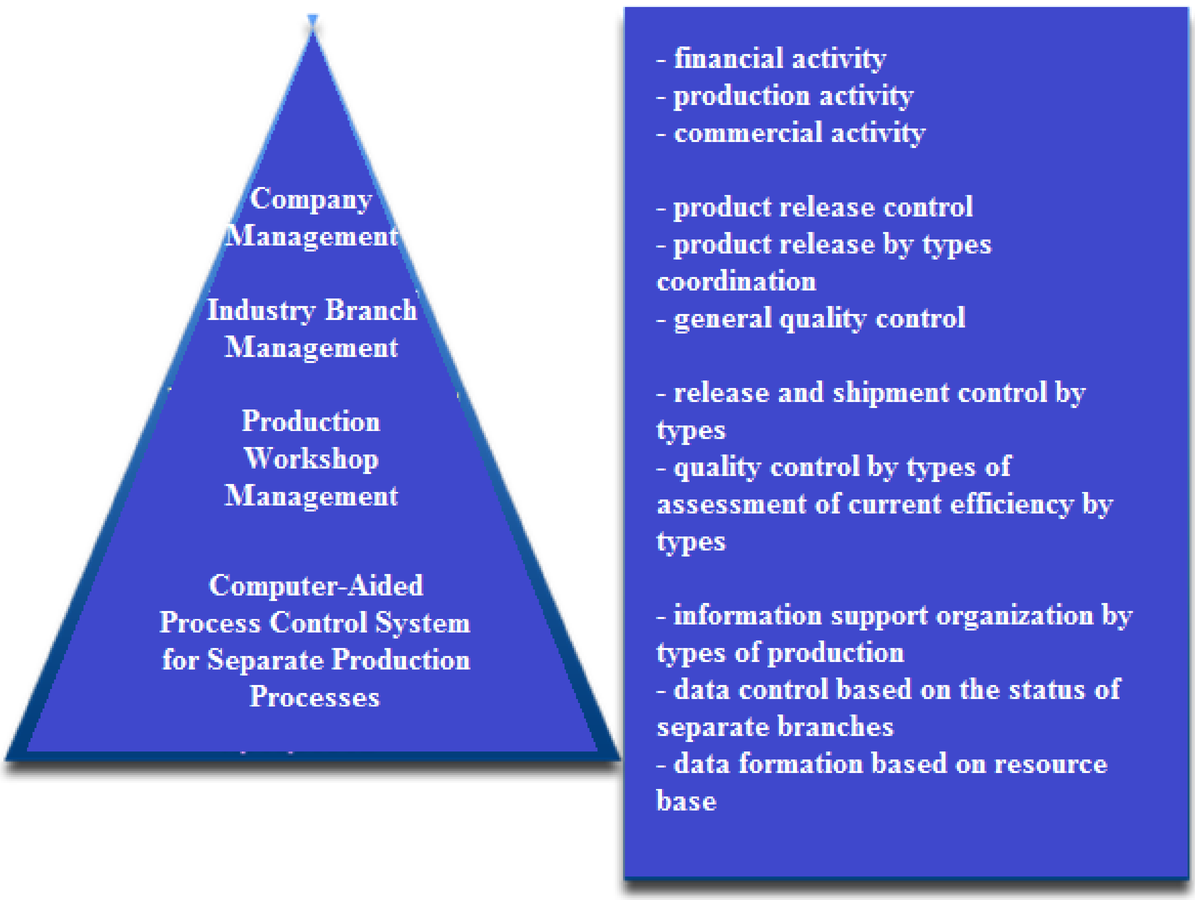

Figure 3. Administrative functional company management pyramid.

At the base of the pyramid we have information support organization by types of production, data control based on the status of separate branches, data formation based on resource base. At the second level of the pyramid there is release and shipment control by types and quality control by types of assessment of current efficiency by types. I.e. it is not only original data summary but also information about product quality and management efficiency at the level of workshops. At the third level we have general control and coordination of product release by types, as well as general quality control implemented when managing workshop activity. At the fourth, highest level there is industrial complex management; production, commercial and financial activity management of the company as a whole. Management at this level of managerial hierarchy is executed by company top managers.

When organizing the company management system, the composition of the principle administrative functional pyramid can also include other management pyramids of a lower hierarchical level correspondent to separate responsibility centers. Particularly, these can be a subsystem of main power engineer's service control or financial economic service control, etc. Composition, specifics, nature of information in such pyramids is defined by both general information requirements effective at the company and requirements of certain activity of a responsibility center.

Such structure of information flows organization at the company among which expert information plays an important role benefits to the improvement of manageability of its activity. It also allows for defining logical interconnection, necessary analysis and information processing, as well as priorities in the process of its usage when preparing and making management decisions.

The mentioned information flows serve as starting point information for the work of intellectual subsystems IICS, as well as for creating entry rules, mathematic models, expert procedures used in intellectual subsystems of IICS.

Certainly, the sphere of application for intellectual subsystems is primarily the forth and third levels of administrative functional company management pyramid. At the same time it is often easier to work out, test and adapt them at the third level of management, since the activity at this level of management is less complicated, and the volume of information undergoing analysis is less. At the same time the nature of decisions made is essentially kept.

Since the main task of any management system is making efficient management decisions based on the upcoming information about activity of the company and its subdivision, it becomes an important task to create and implement into usage intellectual subsystems IICS providing adequate analysis of management situations. Based on this analysis, preparation of alternative options of management decisions with assessment of expected efficiency of their implementation is performed.

At this stage of management process, usage of expert information in interaction with the feedback mechanism functioning when making management decisions is expected. At the same time, management decisions made might also concern reorganization of the existent management system at the company. With the usage of intellectual subsystems IICS, tactical and strategic goals of the company might be modified if external or internal situation demands it.

One of the features of IICS MMC is the possibility to work with large volumes of information and integrated account of multiple factors, indexes, criteria, complex classification and diagnostics tasks, necessity to develop decisions in complex management situations. This makes it worthwhile to use technologies of situational analysis to provide efficient work of company management system.

Because of diversity and multi-faceted indexes, factors, criteria based on which management decisions are prepared and made, the role of expert assessment, group decision preparation and making technologies, multi-criteria choice increases. This brings special significance to the necessity track composition, interconnection and combination of different indexes and factors, their correspondence to the goals set and the tasks planned.

The foreground is given to the so-called problem of observability of indexes used in the management process. It can be direct, indirect, or expert depending on its nature and application in the process of decision preparation and making.

As we know, it is only possible to manage what is measurable. In our case one of the main company management tasks is to determine the composition of indexes to be measured, to determine or assess their current values, to provide their planned values.

For every responsibility center, its own composition of indexes values of are to be controlled in the management process is determined. The task of determining the composition of indexes to be controlled in the management process is one of the primary tasks of management system formation.

Next task of no less importance is the task of measuring their values for appropriate decision preparation and making. In the management process, it is not sufficient to determine the value of issue of a certain type of product in the current moment of time. It is necessary to be able to assess how much the current index value corresponds to the management goals, and if the correction of planned tasks or taking other measures are necessary in case of discrepancies in the planned and actual values. No to mention the fact that not all characteristics to be managed in the course of complex production activity can be directly measured.

Besides, when assessing product quality or solving marketing problems, numeric data is not always enough. If, say, maximum speed of the vehicle is 130 km/hr, is it good or bad? If it is a car, it is clearly not enough today to be able to meet sales market competition. But if it is a truck with great weight-bearing capacity, it might absolutely satisfy the buyer.

When managing complex diverse company activity, we must also be able to assess management quality which sometimes could be a rather difficult task. This is necessary in order to introduce timely corrections into the management system which, according to recommendations of leading specialists in the quality sphere, must be implemented at least once a year. For example, it might be worthwhile to single out new responsibility centers or correct an existing system of such centers. When changing goals, it might be even the composition of the measured indexes that could be subject to revision, not to mention weight coefficients characterizing their comparable importance in achieving goals.

A considerable amount of indexes taken into account in the management process makes the assessment of the current status and the expected result of alternative option implementation more complicated. Form the point of view of efficient functioning of the management system, it might be more worthwhile to choose a relatively small amount of key indexes and monitor their values in the course of achieving of the set goals. But the choice of the index system and determination of current status assessment mechanism, as well as the overall facility work results assessment mechanism, and even assessing their values can be performed only with the help of certain methods of expert assessment. Development of correct integral assessment indexes is also only possible using modern methods of expert assessment.

One more type of problems which must be solved when managing a company are problems of optimal resource distribution, especially in case of deficit types of resources. If we take into account that the resources in the management process today are thought to include virtually all of them, necessary or beneficial for achievement of the set goals, it becomes clear how complicated this managerial task is, especially when managing a large-scale company. Because today, it is even information that is included in main management resources. This problem can also be solved to a considerable extent only using expert management technologies, i.e. intellectual systems. They are especially important in case of high sensitivity of the situation towards the management decision made when even minor changes in the chosen resources can cause considerable changes in the result, including quality characteristics of the output product.

In order to prepare information about management situations introduced by a set of correspondent indexes, as part of situational analysis, we can break down statuses into normal, standard and abnormal with different degrees of deviation from the expected or the planned status. In standard situations, results of the management decisions made are predictable. Abnormal situations, as well as situations with a high degree of uncertainty require a bigger volume of analytical work and imply using expert assessment methods to a greater extent. In this case, the significance of quality preparation of alternative options of management solutions rises.

As part of the situational approach, expert systems to use when managing facilities of different purpose are developed (30 Ip). The type of management decisions requiring a higher quality level from the company management system also include situations where a transition from one management situation to another is provided for, since the degree of uncertainty is higher in them than in a usual standard situation. It is worthwhile here to use intellectual subsystems especially designed when managing a company (42 Ip).

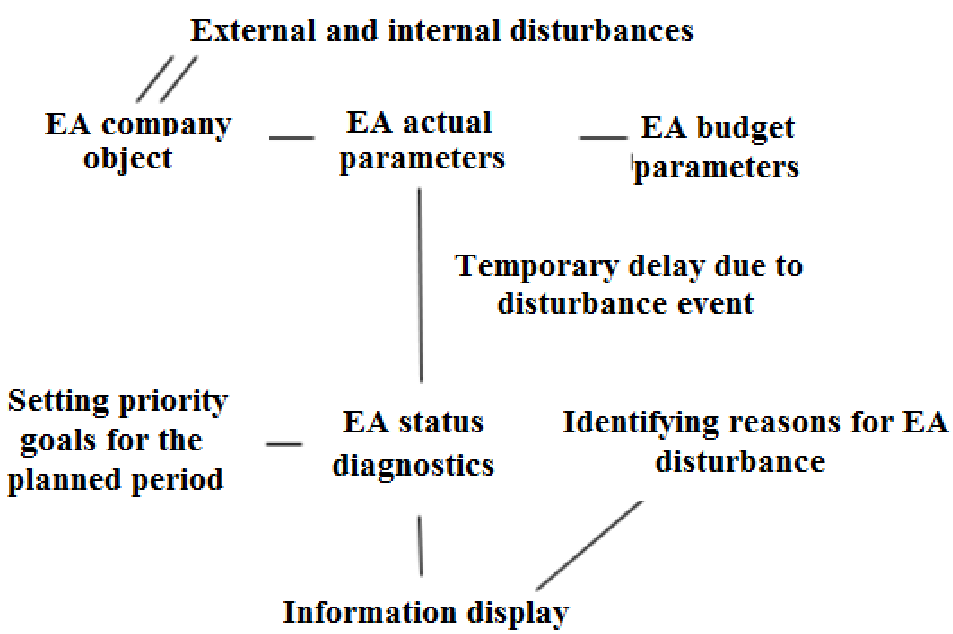

Figure 4. EA as a management system object.

In IICS MMC the management system feedback loop includes subsystem of status diagnostics of economic activity (EA) of the management object (Fig. 4), its production, commercial and financial component.

Subsystem contains a database in which, apart from other data, the information about decision maker's goals and their corrections, and the information about their priorities when making management decisions is entered. The information about priority goals can be entered in an interactive mode.

When using situational analysis technologies in IICS MMC in the process of company management, the assessment of management situations with the help integral ratings introduced by integral indexes (Chapter 2.6). This also implies active usage of expert assessment methods, i.e. intellectual subsystems of types AEAS (Automated Expert Assessment System) or DSS (Decision Support System). Particularly, the possibility of analysis of nature of changes in separate indexes, their influence on the course of decisions made earlier gains special significance. The analysis results are used in preparation of recommendations on achieving the index values that meet the set goals.

IICS MMC implies managing three types of resources: universal, unique and non-renewable, as well as mutually substitutable with the possibility of their recount with the help of specially entered non-dimensional scales taking into account their maximum consumption and minimum acceptable value. The author introduces an interesting term of production potential characterized by the smallest value of the most deficit resource. The group of management rules determined when developing the system is intended for preparation of management decisions when distributing resources of different types. Essentially, the problem of optimal resource distribution is viewed in the system as the main company management problem which is solved based on application of intellectual subsystems being a part of IICS MMC.

Playing a definitive role when managing modern company, responsibility centers in which, based on using intellectual subsystems IICS MMC, major management decisions are made, also use expert information to a considerable extent. It is on the basis of expert information, being an integral part of informational flows, that decisions are made by manager of different hierarchical levels of company management.

Databases determined based on expert information allow performing diagnostics of EA status of both company as a whole and its responsibility centers. On their basis recommendation on preparation of management decisions are formed necessary for prevention of emerging deviations in reaching index values characterizing EA and correspondent to the goals of company activity. They use coefficients of confidence identifying the degree of influence of emerging deviations of the results of EA calculating the accuracy of emerging deviations and assessing changes in EA status.

It is important for successful functioning of IICS MMC to organize the process of information processing and rollup for assessment of company EA as a whole or a separate responsibility center. Main components of this process are introduced on Fig. 5.

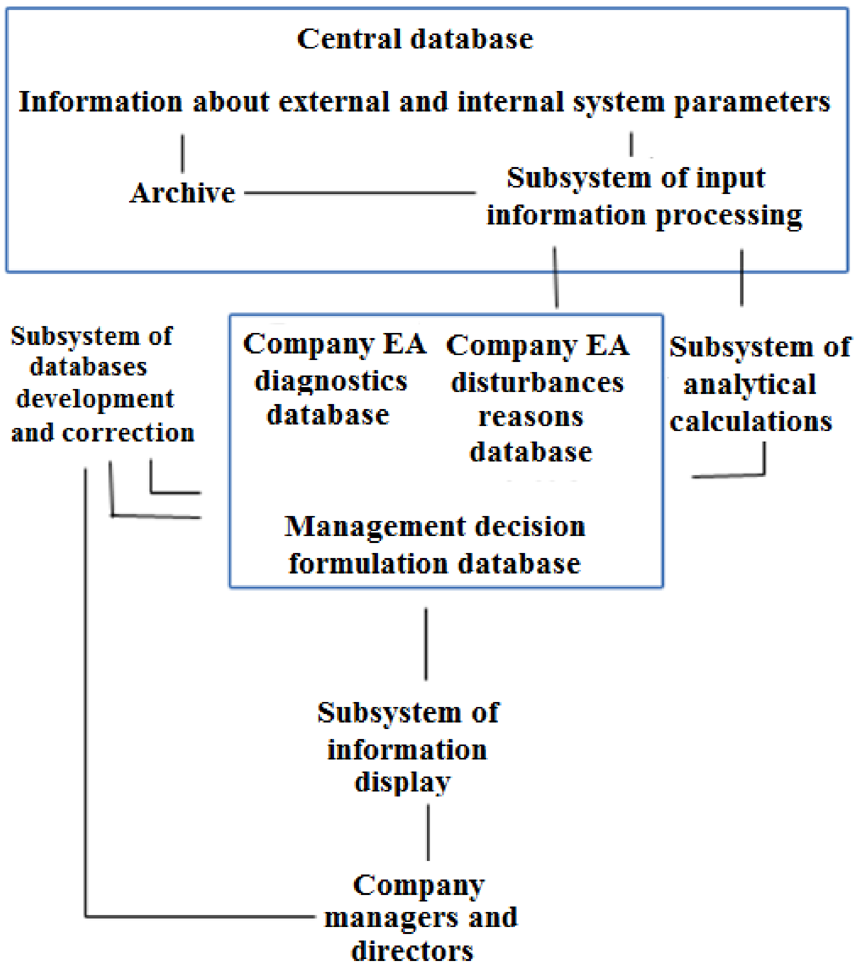

Figure 5. Structure of Intellectual System of Management Accounting of Company Economic Activity.

Particularly, it implies functioning of management decision formulation database updating which must be performed constantly when new information comes. Management influences are formed in the occurrence of deviations in the results of production, commercial and financial activities, of unstable or transitional EA status, as well as standard EA status.

Thus, IICS MMC created by Y.V. Ipatov includes intellectual subsystems of IS types we have looked at earlier, and, above all, expert systems (ES) and decision support systems (DSS).

We believe that the area of intellectual integrated control systems (IICS) creation and development is a valid way to improve efficiency of the ICS generation used today when managing the largest companies and organizations. When preparing and making management decisions having, to a considerable extent, multi-criteria and collective nature, the possibilities of automated expert assessment systems (AEAS) must be applied to a bigger extent. This is determined by the fact that AEAS are intended for improvement of efficiency in the usage of experience and knowledge of professionals of high qualification in the management process.

The future of the next generation of integrated control systems belongs to efficient combination of the possibilities of expert management technologies with the possibilities of modern informational systems and computer technologies.

Conclusion and Implications

It can be seen that almost all giants, working in highly competitive markets such as Amazon, Ebey, Walmart and similar, work on their own development systems, which are very similar to IEM systems except for some details. Successful solutions to the classical scheme in modern markets, the author is not known.

Correspondingly, it will not be a significant deviation from the truth to say that the IEM systems are implementing all the benefits of self-development systems, sparing operators from the risks of developing such a system ab initio. You can even estimate the risks of such a project (developing your own automation system) by estimating the number of success stories in several dozen companies and the number of forgottens on this path, which are many hundred thousand. Just statistical probability of success is the share of the percentage.

On the other hand, following the classical approach will statistically result in a 100% probability defeat.

To sum up, it can be seen that the use of the IEM approach makes it possible to make significant progress in the development of enterprise automation systems. In the marketplace, are not only the transitional-level systems from ERP to IEM (not meeting the 1-2 requirements), and fully compliant with all requirements.

In the next 10-20 years, the market for IEM systems will rapidly develop along with large-scale migration to the IEM system, the transition to automated and robotic production, the shortest and most integrated supply chains from the producer to the final consumer.

IEM systems allow you to step directly to an autonomous (Unmanned, Humanless Enterprise) enterprises and, in turn, they are as a link to the new technological revolution.

You can guess how the "Internet of Enterprises (IoE)" has been created. Each of the companies under IEM systems associated with other transaction chains can make excessive more than 90% of the global economy inventory together with their infrastructure processing and shifting.

The IOE nodes, unlike the modern Internet, interact solely with structured information nullifying the mistakes and the probability of the attack, including virus one.

So the Internet of Enterprises is an integral meta-IEM:

- Self-organizing and self-balancing economic environment of planetary scale, the global homeostatic self-regulation mechanisms of which are extremely resistant to the imbalance of interference of any nature.
- Completely unmanned processes of wealth creation, operated by the world-wide network of IEM systems, in the next few years will realize the centenary dream of mankind: Getting rid of the routine work.

A similar approach has been shown with a "value network" concept developed by a number of authors from the middle of 90th. According to value network ideology IEM Enterprise is the analogy of internal value network while Internet of Enterprises is the analog of external value network. Again, IEM System is the intelligent infrastructure basis of value networking. Despite of mathematical derivation of IEM Paradigm, value network is based on practical business analysis and currently more like a set of empirical techniques and approaches than a science theory with a elaborated mathematical basis. Whoever it is important to mention the equality of the results of two fundamentally different approaches: a fabulous evidence of high reliability and practical effect of conclusions.

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