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This book maintains articles on actual problems of research and application of information technologies, especially the new approaches, models, algorithms and methods of membrane computing and transition P systems; decision support systems; discrete mathematics; problems of the interdisciplinary knowledge domain including informatics, computer science, control theory, and IT applications; information security; disaster risk assessment, based on heterogeneous information (from satellites and in-situ data, and modelling data); timely and reliable detection, estimation, and forecast of risk factors and, on this basis, on timely elimination of the causes of abnormal situations before failures and other undesirable consequences occur; models of mind, cognizers; computer virtual reality; virtual laboratories for computer-aided design; open social info-educational platforms; multimedia digital libraries and digital collections representing the European cultural and historical heritage; recognition of the similarities in architectures and power profiles of different types of arrays, adaptation of methods developed for one on others and component sharing when several arrays are embedded in the same system and mutually operated.

It is represented that book articles will be interesting for experts in the field of information technologies as well as for practical users.

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INFLUENCE ANALYSIS OF INFORMATION TECHNOLOGIES ON PROGRESS IN CONTROL SYSTEMS FOR COMPLEX OBJECTS

Boris Sokolov, Rafael Yusupov, Michael Okhtilev, Oleg Maydanovich

***Abstract**: Current status and perspectives of an interdisciplinary knowledge domain including informatics, computer science, control theory, and IT applications were analyzed. Scientific-and-methodological and applied problems of IT integration with existing and future industrial and socio-economical structures were stated.*

***Keywords**: computer science, informatics, cybernetics, control theory, information technologies, control systems, information systems, industrial applications*

***ACM Classification Keywords**: A.0 General Literature - Conference proceedings*

Introduction

Informatisation and information society (as the final aim of informatisation) are characterized by active development and mass introduction of information technologies into all areas of human activity, namely [Yusupov, Zabolotskii, 2000]: social life, material production, power engineering, health protection, education, science, culture, business, transport, communication, military science and so on. By now, some attempts were made in order to evaluate the role and influence of IT on the progress (enhancing effectiveness) of the above areas.

In the present paper we are trying to draw attention of specialists to the influence of ***information technologies*** (IT) on the progress in such an area as processes and control systems for objects of various kinds.

The main aspects of IT influence on progress in control systems for complex objects

We note that for realizing control process it is necessary to have information on control goals and objectives, state of the plant and environment. This information is formed on the basis of processes of data measurement, transmission and handling by means of sensors (receptors, detectors), communication channel and computational facilities, which are fundamental elements and subsystems of any control system. Currently general topics related to collection, processing, representation, transmission and protection of information are studied in ***informatics***. Results of these investigations are realized as IT. This term means a family of methods for realizing informational processes in various fields of human activity aimed at manufacture of informational product, including those in control systems. It is obvious that operational effectiveness of control systems depends on the progress in informatics and information technologies. Constructive identification and investigation of the above dependence is an actual scientific-and-technical problem, in the framework of which leaders of modern large-scale enterprises are trying to get an answer to the question: "***in which of perspective IT's we should invest and why?***".

Business and state are ready to pay for exactly such amount of information resources that they really need for information support of management. Moreover, they proceed from such classical efficiency indices, used today in the market of computer services, *as return on investment (ROI), total cost of ownership (TCO), and quality of service (QoS)*. Superfluous information resources and redundant IT are frozen investments and resources (moreover, they are lost resources, with account for fast obsolescence of hardware and software facilities and equipment). Insufficient informational resources mean a loss of profit ([Perminov, 2007], [Seletkov, Dneprovskaya, 2006], [Sokolov, Yusupov, 2008a], [White, 2004]).

Discussing modern control processes and systems, we hereinafter will separate ***two classes of control systems*** for objects, namely: ***automatic*** and ***automated*** control systems for the corresponding objects (or groups of objects). It should be noted right away that information technologies, which are realized by means of the corresponding hardware-and-software facilities and computers, played and still play the determining (central) part in the aforementioned control systems. Moreover, historically, the tightest integration of these technologies and facilities with control systems is shown by the fact that computers were called ***cybernetic machines*** during the first years of their existence ([Gerasimenko, 1993], [Mertens, 2007], [Sovetov 2006], [Sokolov, Yusupov, 2008b]).

The above features objectively lead to necessity of development of ***automated control systems***, by which we mean "man-machine" systems that ensure effective operation of the corresponding objects. In these systems, information gathering and processing, which is necessary for realization of control functions, are performed with the use of automation facilities and computer engineering ([Sovetov, 2006], [Starodubov, 2006]). According to realized control functions, kinds of controlled objects, and used generations of information technologies and facilities, there are various types of automated control systems (ACS) for complex objects (CP): supervisory control and data acquisition systems (SCADA); manufacturing execution systems (MES); ACS for flexible manufacturing systems (FMS); systems of computer-aided design (CAD); automated systems for scientific investigations (ASSI); integrated ACS; AS for organizational control (ASOC); branch-wise ACS (BACS); corporative ACS (CACS); enterprise resource planning system (ERP); storage-and-retrieval system (SRS); storage-and-advisory systems (SAS); management-information system (MIS).

Previous investigations demonstrated that both in Russia (in USSR, in the period 1960-1980) and abroad the most widespread and economically effective were automated systems at enterprises that manufactured various kinds of products ([Mertens, 2007], [Sovetov, 2006]). As a rule, such systems incorporate SCADA, MES, and ERP. An aggregate of the aforementioned systems form a computer-integrated manufacturing (CIM).

Directions of evolutionary progress in ACS CP, as well as control systems, were always determined by tendencies of development of related information and communication technologies and systems, which form the material basis for realization of existing and perspective technologies of automated control and have, by their nature, specifically informational character, as was already mentioned.

Fig. 1 represents, in a generalized form, evolution of basic information technologies that were used as the basis of the corresponding ACS for industrial enterprises discussed above. Let us take a quick look at the influence of these information technologies on the progress of this class of automated systems. For Russian ERP-systems the following three stages of their evolutionary development are usually separated (see Fig. 2).

Stage I (from the mid-1960's to the end of the 1970's).

At this stage of development of ERP-systems based on the computers of the II^{nd} generation (M-20, M-220M, M-222, Minsk 22, Minsk 32, SM-4) at enterprises manufacturing goods and services in various specific fields, only some functions of dataware and production activity control were automated. Among such functions were, first of all, gathering, processing, storage, representation and analysis of some kinds of industrial and economic information. The first attempts were made to integrate various information technologies in the frameworks of the corresponding SCADA and MES.

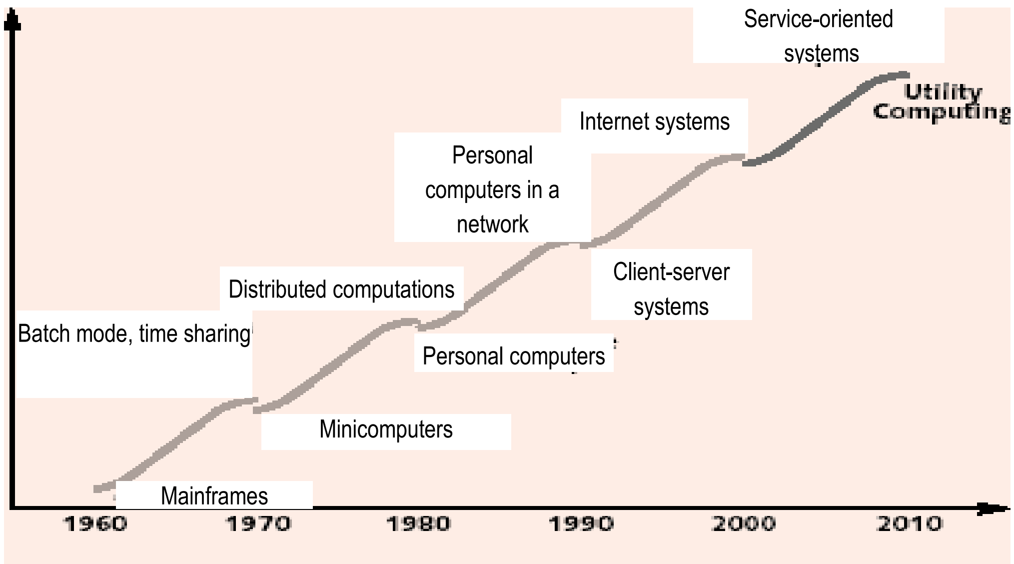

Fig. 1. Evolution of basic information technologies (Chernyak, 2003a).

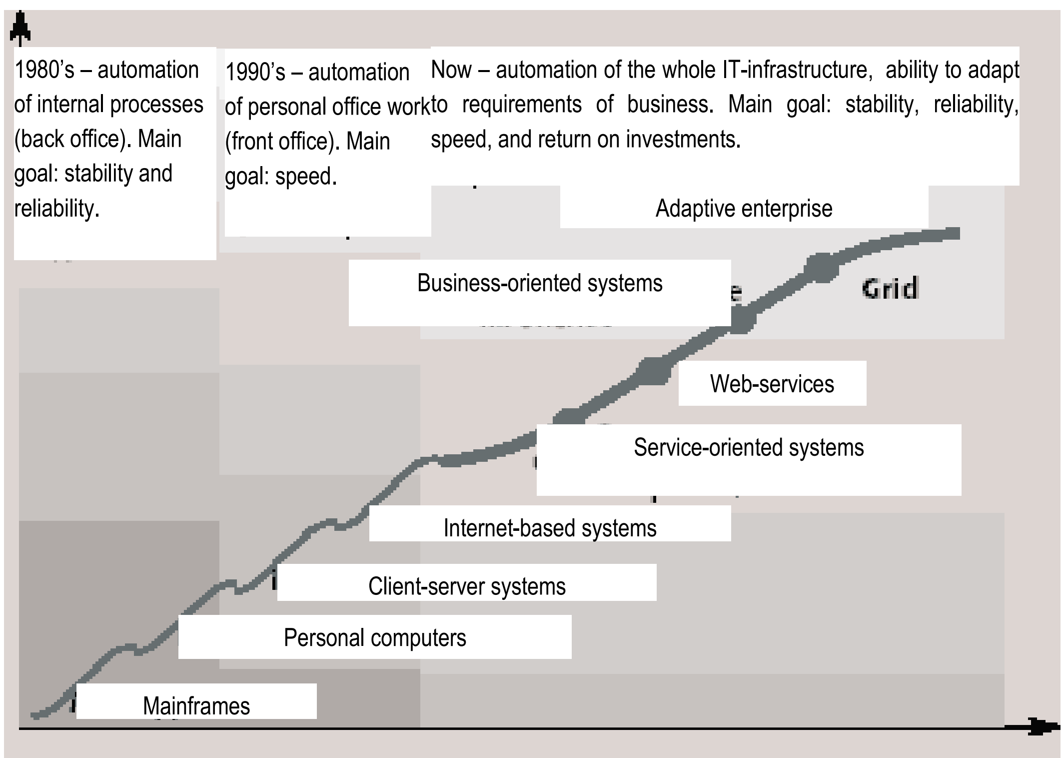

Fig. 2. Stages of evolutionary progress in automated and information systems (Chernyak, 2003a).

Stage II (from 1980 to the beginning of 1990's).

In this period, after learning the lessons of Stage I of automation and informatisation of industrial activity, works were carried out for unification of processes of using IT on the basis of wide introduction of standard automation modules (SAM). As the main element of technical basis for realization of concept of typification and unification of complex automation facilities (CAF) computers of series "Ryad" (ES) were chosen. On the basis of this concept more than 6000 ACS of various classes were created in the USSR to the beginning of 1990's [Sovetov, 2006].

Stage III (from 1990's to present stage of progress).

At this stage, evolutionary complexation and integration of information resources and technologies, proposed by Russian and foreign companies, take place on the basis of wide distribution of personal computers and modernization of previously used medium- and large-scale computers (mainframes). Information technologies that supports operation of distributed data banks and databases, as well as protocols of such local and global telecommunication networks as Intranet and Internet, provided for material basis for a new integration level for various classes of ERP-systems.

It should be noted that disintegration of the USSR in 1992 caused negative consequences for Russia, because financial support and amount of works on creation of automated systems (AS) of various classes have been greatly reduced. Instead, not very successful copying and adaptation of foreign counterparts of Russian enterprise-oriented ACS (systems of classes ERP, MRP, MRPII, and SCADA) started. One of the main problems in introduction of these systems was that Russian legislative and juridical base in accounting, financial and management spheres differs from the respective foreign base. Moreover, there was a lack of necessary technical and technological standards and information databases that determine specific features of manufacturing process. Due to these reasons, integrated automation appeared to be impossible.

Nevertheless, as time went by (in the end of 1990's) domestic replicable ERP-systems, called corporative information systems (CIS), began to appear in Russian Federation. Such domestic automated system as "Galaktika" and "Parus" can be mentioned among them. But this automation performed at industrial enterprises "from above" (at the strategic level of control) without corresponding complex automation of control processes at lower levels of control (where, in essence, wealth and surplus value are created) gave no planned effect and did not justify productive investments.

Today, owing to saturation of world market by all kind of products as well as due to general accessibility of high technologies (including those in the infosphere), the ***time factor*** is brought to the forefront of competitive activity. Now only those have a chance to win this competitive struggle who can successfully synchronize business-processes and manufacturing (ERP- and MES-systems) in real time (RT); develop and promote a new product (CAD/CAM/PDM-systems) in the market; have a flexible, effective and highly automated technology of control of logistic processes, which provide for decreasing cycles of delivery and off-take (Supply Chain Management, SCM); reduce order processing time (customer relationship management, CRM); ensure monitoring of resource spending in RT; realize operational control scheduling in RT (automated systems of operational supervising control, ASOSC); reduce time of return on investments (ROI-systems); reduce time needed for analysis and decision-making (OLAP-systems); provide for effective control of manufacturing cooperation in RT (e-manufacturing, co-manufacturing, m-business).

At the modern level of progress in enterprise ACS, an important role in practical realization of the above requirements must be played by **manufacturing execution systems** (MES) (they are called ACS of manufacturing processes in Russia) **and mobile (wireless) information technologies**. Now we briefly describe how these information technologies have effect on the processes of automated enterprise control, and show the main problems in distribution of the above technologies.

Today, speaking about successes in automation of complex organizational-and-technical complexes (COTC), one should mention, first of all, ERP-systems (in Russia they were previously called ACS of enterprise). The share of its successful applications in financial, administrative and trading organizations is much higher than in industry ([Len'shikov, Kumilov, 2002], [Sovetov, 2006]). At the administrative level, ERP-systems take into account any financial operation and any document, while no such a detailed supervision exists at the manufacturing levels (level of SCADA, MES). But the analysis shows that the manufacturing levels are the birthplace of the surplus value, the place of fundamental spending and main sources of economy; these levels provide for manufacturing plan and required quality of production; many factors determining efficiency and profitability of the enterprise as a whole work here. In these conditions, such a principal unit as manufacture drops out of the loop of automated control and enterprise management.

Thus being the case, today in most of implemented projects connected with creation of integrated automated control systems for industrial enterprises there is a whole strata of functions that have been covered neither by the ERP-systems nor by SCADA-systems.

Analysis of fig. 3 shows that ERP-systems do not support the level of operational control of production, being restricted by strategic scheduling only; they are not interconnected from the informational and logical viewpoint, and are not synchronized with the goals of production control in RT [Len'shikov, Kumilov, 2002]. In this layer of operational production control, which is not encompassed by information technologies, there exists a whole class of manufacturing processes that are vitally important for the enterprise, create surplus value and have an influence on its profitability on the whole.

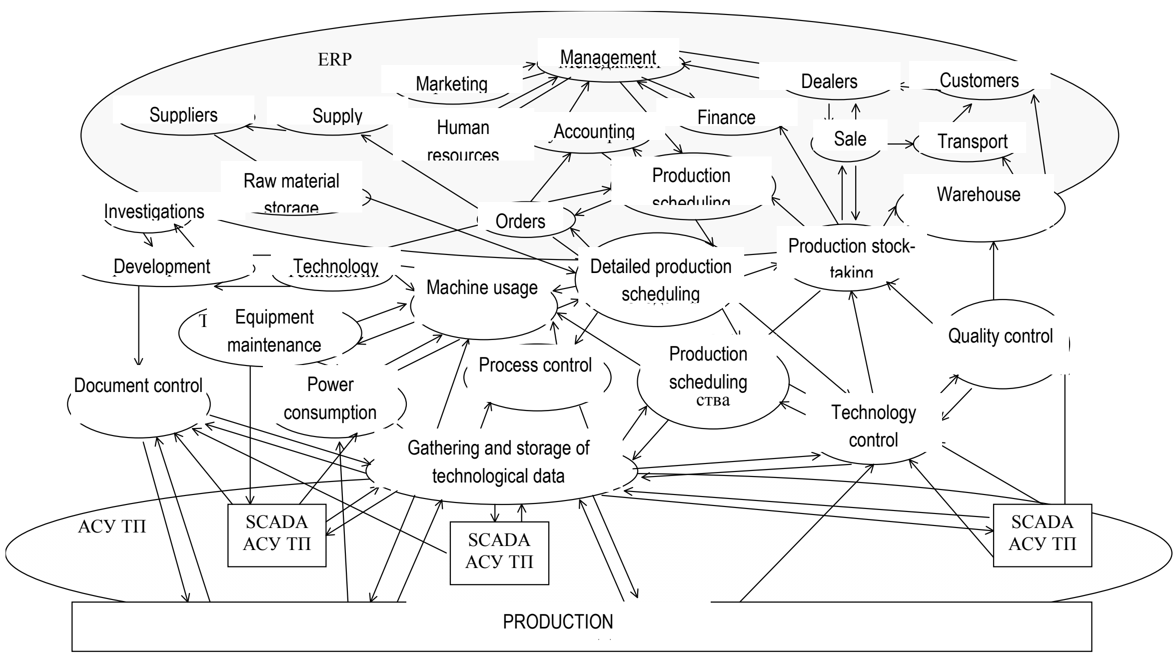

Fig. 3. Functional gap between ERP and SCADA (Len'shikov, Kumilov, 2002).

Up to now this class of processes is supported by manufacturing execution systems (MES) directed to informatisation of operational scheduling and production control, optimization of manufacturing processes and production resources, control and scheduling of fulfillment of a plan with minimal cost. Thus, speaking about integrated automated systems of enterprise control under the current conditions it is expedient to separate out the following three interconnected levels of control, namely: SCADA, MES and ERP. Each of them performs (realizes) its own control technology and is characterized by its own intensity of information circulation, time scale, set of goals and relevant tasks.

Today enterprises often face such phenomena as return of production, delay in order fulfillment by partners, order cancellation due to low quality of raw materials, too large period needed for analyzing the cause of defect and so on. To get over these difficulties, it is necessary to provide for timely and reliable handling of information. This is possible, in its turn, only if data gathering and handling are performed immediately at the very moment of the associated event and as close to its source as possible. By the way, it should be noted that errors are most often made during simple and routine operations of data input in integrated ERP-systems (IERP) ([Len'shikov, Kumilov, 2002], [Mertens, 2007]).

In general, analysis of modern tendencies in the progress of information technologies and systems (IT and IS) shows than all leading foreign and domestic companies specializing in the field built and still do build corporative information infrastructures (including ERP-systems) only by vertical principle; they are guided by particular criteria and hardly coordinate their own conceptions with requirements of business. As a result of realization of the above tendencies, traditional approaches to automation of business-processes are today in a pre-crises if not even in a crisis state. Moreover, difficulties of controlling modern corporative information systems go beyond the scope of administration of software environments. Necessity of integrating several heterogeneous environments into all-embracing corporative computer system and desire to overstep the limits of the company form a new complexity level. For example, in order to cope with diversity of external and internal queries to the corresponding business applications, modern IT-companies are forced to distribute their solutions in business-systems over hundreds and thousands servers. In these conditions, manual control (administration) of this diversity of information resources becomes impossible due to both organizational and financial reasons. By data of foreign analysts, only about 30% of companies' IT-budgets can be directed on development of IT-technologies, while the rest is spent on support of existing IT-technologies. If nothing will be done, this ratio reaches 5:95 to 2010 [Chernyak, 2004].

Among other shortcomings (and associated problems) brought to light up to date in the process of developing computer integrated manufacturing (CIM) created and exploited on the basis of existing IT, the following ones can be enumerated:

1. in a number of cases there is *no comprehensive analysis* of existing (non-automated) technology of gathering and processing information and decision-making; no propositions and recommendations are elaborated on its perfection (non-productive labor is automated) and transition to new intellectual information technologies; required degree of automation is not justified for any specific organization;
2. many AS (first of all, ACS for complex objects) are mostly information systems, where processes associated with decision-making are not automated, or the part of automation of these processes is negligible as compared with automation of information gathering and processing; possibilities of methods and algorithms of complex simulation and multi-objective choice are hardly used for decision justification and management;
3. there exists considerable inconsistence in goal orientation as well as in technical, mathematical, software and organizational facilities of AS on different control levels, and AS that are at the same level in the framework of a fixed hierarchical structure of the corresponding organization;
4. AS still do not provide for required orientation of each specific organization onto optimization of using available resources and growth of its efficiency on the whole; this thesis is supported by the fact that optimization problems constitute only several percent among all problems solved in AS;
5. in many AS there is no necessary software-and-mathematical facilities for performing system analysis for organization as a whole, operation of AS itself, and control of its operation quality;

6. quality of dataware still has not reached the required level; for instance, necessary filtering of information, its selection according to management level and representation in a compact form are not ensured;
7. development of software and technical facilities for “man-machine” communication, dialog communication procedures (creation of intellectual interfaces) is far behind the practice;
8. creation of AS is not interconnected appropriately with evolution problems and allotting the system with high flexibility and adaptation to variations of environment.

What are the reasons for existence of the above mentioned drawbacks (problems) related to creation and development of AS?

One of the main reasons, which have a **methodological character**, is that requirements of system approach to design of complex technical-and-organizational complexes are often ignored while developing AS. This is apparent, in particular, from the fact that automation is performed for some separate stages of information gathering and processing, and only some computational problems are solved on computers, without investigating the automation problem for control processes on the whole. In other words, there is no complex automation of the processes under consideration. As has been demonstrated by practice, automation should be applied only to well-known and fairly stable processes and technologies, for which constructive formal descriptive facilities (models), methods, algorithms and methods of solving applied problems have been developed.

Thus being the case, problems of creating and developing AS are, first of all, **model-and-algorithmic** and **informational problems** that require development of a fundamental theoretical base for their solution.

Speaking about **technical-and-technological reasons**, it should be emphasized, first of all, that traditional technology of creating AS calls for using a lot of specialists (designers, programmers, database administrators, managers, technicians and so on), which manually form the appearance of a future system, using traditional paper technology. For such a technology, developers of hardware-and-software facilities permanently encountered and still do encounter a number of hardly solvable problems, namely: problem of inadequacy of structuring of AS; problem of misadjustment of structural parts of AS; problem of inconsistency, ambiguity, redundancy (or incompleteness) of design documentation.

All of the above-listed problems stem from complexity of automated systems as objects for analysis and design. For a long time in Russia, due to bureaucratic barriers and backwardness in the field of microelectronics, available facilities for automated information processing and control have low level of unification, and were used for solving a small number of problems; this was also one of the reasons for failures in creating AS.

Among **organizational reasons**, it should be noticed once again that, as a rule, many enterprise managers reassigned all questions on coordination and control of work related to creation of AS to other functionaries, which have not necessary authority (*principle of the first manager*, which is one of the basic principles in developing AS, was not honored). Moreover, some conservatism often took place in organizations, owing to which structure and functions of AS were fit, deliberately or unconsciously, to existing technological-and-organizational structure (in other words, non-productive labor was automated).

Summarizing the aforesaid, it should be stated that modern stage of progress in science and engineering is characterized by fairly high level of development of hardware-and-software facilities for information gathering, transmission and processing, which are incorporated into any AS; these facilities are permanently modified and their technical and economical characteristics are improved.

At the same time, today, when national economics are transforming to global market economy that has dynamic network nature, increasingly more foreign and domestic specialists began to understand importance of a complex approach to automation of operation of enterprises and organizations in order to overcome the above-listed problems in modern IT-industry ([Dmitrov, 2006], [Zatsarinnyi, Ionenkov, 2007], [Mertens, 2007], [Sovetov, 2006], [Building an adaptive enterprise, 2003], [HP, 2001], [HP, 2003], [IBM, 2004]). With this aim in view, a principally new methodology of creation and development of automated and information systems in XXI century is to be proposed.

As a basic concept for development of information and telecommunication area, leading manufacturers of computer technologies and systems propose to use the concept of “natural”, “organic” information technologies (Organic IT), which provide for permanent dynamic balance between business queries for services (business applications) and information resources of the corresponding automated systems.

Introducing the notion of *Organic IT* into terminology of modern computer science, analysts of *Forrester Research* ([Chernyak, 2004], [Chernyak, 2003a], [HP, 2001], [HP, 2003], [IBM, 2004]) would like to emphasize necessity of more organic, natural, indirect use of IT in the interests of business applications in solving the following three groups of problems:

- effective *utilization* of information resources; here the proposed IT has to admit scaling the given resources “up” and “down” without service outage; regarding reliability, modern automated systems must be similar to modern power and telephone networks;
- *integration*: Organic IT are to combine dissimilar technologies in an easy and simple way;
- *manageability*: Organic IT are to support processes of automatic installation, load balancing, diagnostics and repair, leaving possibility for an operator to intervene in the process only in worst-case situation.

As specific examples of transition to “natural” computer systems in large-scale corporations working in the field of information services, the following technologies can be mentioned: Dynamic Computing (Dell); Adaptive Infrastructure or Adaptive Enterprise (Hewlett-Packard); Computing On Demand (IBM); Autonomous Computing; Dynamic Systems (Microsoft); N1 technology (Sun Microsystems).

As applied to industrial enterprises and appropriate ERP-systems, realization of the Organic IT conception means a transition to a principally **new (fourth) stage of creation and development** of the **automated systems** under consideration, which are to possess the following basic properties ([Dmitrov, 2006], [Kozlovskii, 1985], [Mertens, 2007], [Rostovtsev, 1992]): self-configuration, self-perfection, self-optimization, self-diagnostics and self-repair, self-preservation, “self-conscience” and proactivity. In other words, under discussion are flexible, adaptive, self-organizing automated industrial enterprises. By these terms we mean complex geographically distributed automated organizational-and-technical complexes that provide for manufacture of products under the conditions of operatively changed market demand and operate (because of high degree of automation of production and management processes) with a limited personal staff. These enterprises and the corresponding conceptions (methodologies) of their creation and usage are called (in Russia) flexible manufacturing automated factory (FMAF), the relevant foreign terms are Integrated Computer Aided Manufacturing (ICAM) in the USA and European Strategic Planning for Research in Information Theory (ESPRIT) in European Community ([Chernyak, 2004], [Chernyak, 2003a], [Building an adaptive enterprise, 2003], [HP, 2001], [HP, 2003], [IBM, 2004]).

Such being the case, the main goal of industrial enterprises of the next generation and the corresponding automated control systems for them is to greatly increase productivity and quality of manufactured products on the basis of implementation of adaptive automated control technologies, which provide for high flexibility and operative reaction on changing market requirements.

Today one should note prevailing role of service oriented architectures (SOA) and those based on business-application services. These technologies are oriented on permanent support of information infrastructure of communication, and on coordination in a distributed decision-making environment, which is typical for adaptive and self-organizing automatic and automated systems of new generation.

The ***stage of visualization of information resources*** is the most important stage of the evolution to adaptive enterprises and the corresponding automated systems. By means of virtualization, logical functions of servers, storage devices and other system components become separated from their physical functions (processors, RAM, disk drives, input-output systems, switchboards and so on); further on, they are transferred to general pool of resources, which are convenient to control in automatic and/or automated mode of operation. By now, for instance, HP proposed and realized several variants and directions of virtualization for information resources, namely ([HP, 2001], [HP, 2003], [IBM, 2004]): server virtualization, virtualization of telecommunication network, virtualization of data storage systems, virtualization of applications.

According to the idea of HP, utility data centers (UDC), created by the company, builds the basis for a transition to Darwin reference architecture. This architecture ([Chernyak, 2003b], [HP, 2001], [HP, 2003], [IBM, 2004]) is a tool for creating and developing hierarchical-and-network information structures, which makes it possible to adapt IS and IT to changing goals and objectives of business-systems. It is proposed to establish three control levels, namely ([Chernyak, 2004], [Chernyak, 2003a], [HP, 2001], [HP, 2003], [IBM, 2004]): *component level* that controls data processing center, *service level* that controls aggregated components and delivers applied servers, and *business level* that controls users and permissions to access applications.

On the whole, future Darwin reference architecture is to provide for permanent balance between business queries for services and infrastructure resources delivering these services in FMAF.

Fig. 4 presents information technologies that, together with SOA, provide for realization of the adaptive enterprise concept ([Gorodetskii, 2000], [Dmitrov, 2006], [Zatsarinnyi, Ionenkov, 2007], [Chernyak, 2003a]). On the whole, by expert estimates, creation and development of flexible adaptive integrated ACS for controlling enterprise make it possible to reach the following goals ([Kozlovskii, 1985], [Mertens, 2007], [Sovetov, 2006]): enhance productivity of labor at future industrial enterprises 8-10 times; increase production output per unit area 1.5–2 times; decrease the period of production cycle 2-10 times; increase machine utilization by 30–40%.

In conclusion of the report we shall consider, as an example of the above ideas, the influence of modern space-based information technologies on operating benefits of ACS for space-based facilities (SF). Hereinafter, by space-based information technology (SIT) we mean information technologies that provide for gathering, storage, transmission (importation), representation, processing and analysis of data at various stages of life-cycle of SF. The basic features of SIT are determined by:

- essential influence of numerous factors of space and related specific space-and-time, technical and technological restrictions that prevent direct usage of standard information-and-telecommunication methods and tools for effective solution of fundamental and applied tasks of cosmonautics;
- multilevel and cyclic nature of solving targeting and maintenance problems by SF;
- complex integration of space-based information technologies with technologies of automated (automatic) control of SF in the frameworks of the corresponding automated systems (AS).

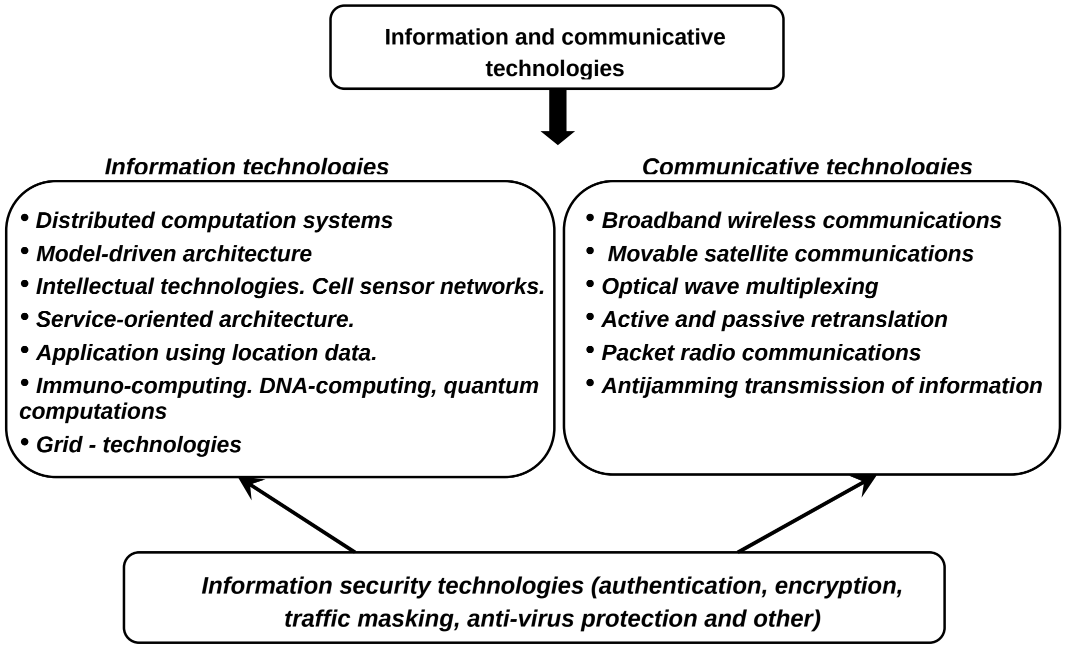

Fig. 4 Perspective information technologies (Zatsarinnyi, Ionenkov, 2007).

The influence of SIT on the essence of modern ACS for SF is apparent in the framework of the following directions [Military-space activity…, 2005]:

- Increase of globality and continuity of control of SF on the basis of creating network structures for information interchange with spacecrafts (SC) of various classes.
- Distribution of methods of situation packet telemetry, which makes it possible to form flexible telemetry programs directly on spacecraft-board.
- Substantial reduction of amount of measurements of current navigation parameters (MCNP) performed by means of ground control complex (GCC) on the basis of comprehensive utilization of navigation and time-and-frequency field produced by domestic "GLONASS" space navigation system and foreign systems.
- Creation of SF of new generation (modernization of existing SF) in order to enhance the level of their unification and multi-functionality that provides for required conditions for adaptation and self-organization of the processes of automated (automatic) control for SIT in various conditions of dynamically changed environment.
- Decentralization (space-time distribution) of the processes of gathering, representation, decision-making, storage and access to information circulating inside the control loops of SIT; it is realized by means of creating integrated distributed databases and knowledge bases with necessary level of information security and information safety.

Speaking about intrinsic efficiency indices of SIT, we restrict ourselves by a single example, which is a result of joint works performed by SPIIRAS and a special design bureau during the period from 2003 to 2008 [Okhtilev et al, 2006]. As a result of comprehensive investigations performed in the specified period, methodological and methodic basis was developed and realized for solving problems of structural and functional synthesis of intellectual information technologies (IIT) and systems for monitoring multi-structure macro-states (MS) of complex technical objects (CTP). These methods are based on their poly-model multiobjective description obtained in the frameworks of the theory of underdetermined calculations and control of structural dynamics ([Kalinin, Sokolov, 2005], [Okhtilev et al., 2006], [Sokolov, Yusupov, 2008a]).

The proposed IIT makes it possible for a user, who is not a programmer, to perform, using a professionally-oriented language in interactive or automatic mode, intellectual processing of multi-type data and knowledge on the state of both CTP and MS using incorrect, incomplete and contradictory measurement information. This IIT is oriented to development of applications for objects that are especially difficult to control under the conditions of arising emergency and extraordinary situations and time trouble (including power consumptions, cosmonautics, petrochemical industry and transportation).

Preliminary analysis have shown that realization of the developed intellectual information technology of state monitoring (SM) for space-based facilities makes it possible to obtain the following effect for dataware systems in ACS SF [Okhtilev et al, 2006]:

- reduce time expenses spent for performing SM providing for obtaining results in real-time according to the transfer rate of measurement information (MI) with sufficient level of authenticity;
- enhance flexibility, reliability and information capacity of software used for SM; on the whole, this improves effectiveness of usage of the corresponding ACS SF;
- formalize (by means of a knowledge representation language and appropriate systems of initial data preparation) up to 90-95% of data about performing SM;
- reduce at least twice the time needed for preparation of initial data and knowledge for SM regarding SF that are being taken to information maintenance;
- reduce the period of the cycle of development and realization of information system for SM from 10 to 15 times;
- provide for saving resources spent for development of special software (SS) for the corresponding ACS SF that incorporate the SM system at hand;
- exclude up to 60-80% of all errors encountered in developing software for SM owing to the usage of verification tools for SS;
- exclude up to 80-95% of corrupted data received from CTP.

Thus, summarizing the aforesaid, it should be noted, first of all, that one of the main tendencies of development of information technologies and systems (IT and IS) in XXI century will be connected, in our opinion, with solution of the problem of comprehensive integration of these technologies and systems with existing and future industrial and socio-economical structures and the corresponding control systems. To solve successfully this interdisciplinary problem, it is necessary to solve a number of scientific-and-methodological and applied problems.

Conclusion

Today influence of computer science and IT on the progress in control theory and systems has a global nature. Specialists note that recently the second turn of convergence between general control theory (cybernetics) and computer science take place; we are observing revolutionary progress in control systems caused by the influence of IT.

In this connection, the problem under discussion deals with formation of a new interdisciplinary direction at the turn of cybernetics, telecommunication theory and general systems theory. This direction was conditionally called *neocybernetics* by the authors of the report ([Sokolov, Yusupov, 2008b], [Yusupov, 2005]).

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