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The Introduction of CALS-Technologies in Russia

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Abstract. The article presents an analysis of the development of CALS-technology. CALS technology allows to reduce costs during the entire product life cycle and improve its quality and competitiveness. As a result of the introduction of these technologies, there is an increase in the efficiency and competitiveness of the enterprises themselves. Efficiency improvement is achieved through the integration and continuity of information based on information systems. This result is achieved by significantly reducing the time of development of new products, improving the quality of these products and technical documentation (submitted electronically), providing a high level of service and logistics support at all stages of the product life cycle. The characteristics of many parts of previously created products, descriptions of systems, processes, machines and equipment involved in the manufacture of this product are stored in a unified electronic form and are available to any user regardless of its location.

1. Introduction

In Russia, the introduction of CALS-technologies is at an early stage and occurs without a systematic study of the issue, separately, and often with the use of local policy across the country. However, at the turn of the century at the Gosstandart Committee № 431 was established coordinating the work on CALS-technologies; research center of CALS-technologies "Applied logistics" was established; the program of standardization in the field of CALS-technologies was developed in 2000 - 2003; pilot projects on the introduction of CALS-technologies are implemented in aircraft, shipbuilding, defense industry. In our country among pioneers of introduction of CALS – AVPK "Sukhoi", JSC Tupolev, Design Bureau of instrument making in Tula, the Voronezh mechanical plant, Russian aircraft Corporation "MiG». These projects are supported by the Ministries of Industry, Education and Science of the Russian Federation, «Minatom» of the Russian Federation. The country has developed basic documents in the field of CALS. Introduction of CALS-technologies in production is engaged in a number of the specialized organizations.

In addition, in the leading engineering Universities of Russia (MAI (TU), MATI, MSTU. N. E. Bauman, MSTU "STANKIN", MADI, RSATU named after P. A. Soloviev, USATU, etc. training of specialists in the field of CALS-technologies is carried out, textbooks on CALS-technologies are published, conferences devoted to CALS-technologies are held.

2. Implementation of CALS in industry and education

For the implementation of CALS-technologies in industry and education in Russia should:

- First, to overcome the barrier of awareness of the need for the introduction of CALS-technologies, based on the concept of "Reengineering of Business Processes" (Business

Process Reengineering, BPR), which implies a fundamental rethinking and redesign of business processes of the enterprise in order to improve its efficiency.

- Secondly, to carry out training of highly qualified personnel, based on the ideology that promotes a collective style of work, modern methods of information management and the creation of information infrastructure to support the life cycle of the product (product), as support for the Life Cycle of the Product (SLP) includes several stages (starting from the need with its creative concept and ending with the utilization), therefore integrates specialists of different profiles.
- Third, to attract investments and financial resources (possibly significant) both for the restructuring of individual physical enterprises and for the creation of integrated corporate "virtual enterprises" in order to improve their efficiency;
- Fourth, given that the Foundation of CALS-technologies is standardized representation, storage and transmission of information, quickly create a regulatory framework that will be the basis for solving production problems. Therefore, it is necessary to combine resources for the development and implementation of standards and other regulatory documents in the field of CALS-technologies.

CALS (or in the Russian interpretation of the ISP – Information Support of Product life cycle) covers and brings together the tools, tools and methods used to improve, support and ensure the economic activity of the enterprise. Therefore, the introduction of CALS/ISP in the organizational structure of the enterprise should be considered as part of the overall strategy of economic activity of the country. The application of CALS/ISP cannot be considered purely technical issues affecting only information technology specialists, but should be based on the economic needs and nature of the enterprise, take into account the main activities, the needs of customers and suppliers [1].

3. Appearance and evolution of CALS

In the origin and evolution of CALS-technologies there are several periods:

- 11 point Times or Times New Roman. Originated CALS-technologies in the Ministry of Defence of the USA in the mid 80-ies. Then this abbreviation stands for (Computer-Aided of Logistics Support) "Computer Support of Logistics Systems." At first CALS-technologies were associated only with large-scale projects of the American military-industrial complex, later in order to increase productivity, the principles of CALS-technologies began to be applied in civil industry.
- In 1988, in the semantic content of CALS-technologies were removed typically military restrictions and they became known (Computer-Aided Acquisition and Support) "Computerized supply and support". In this embodiment, has been strengthened organizational focus CALS.
- In 1993 the reduction of CALS became known as (Computer-Aided Acquisition and Lifecycle Support) "Support for continuous supply and life cycle". The new name took into account the methodology of parallel design, integrated logistics support, configuration management and document management. This allowed the integration of processes throughout the life cycle of the product, from the expression of the need for it to its disposal. In 1995, CALS began to decipher as (Commerce at Light Speed) "Business at a high rate", which emphasized the reorientation of these technologies in the direction of information highways and e-Commerce.

Currently, CALS-technologies (English. Continuous Acquisition and Lifecycle Support) – continuous information support of supply and product life cycle) or ISP (Information Support of Product life cycle) – an approach to the design and production of high-tech and knowledge-intensive products, consisting in the use of computer technology and information technology at all stages of the product life cycle [2,3].

Due to the continuous information support is provided by uniform ways of process control and interaction of all participants of this cycle: customers, products, suppliers/producers, operating and maintenance personnel. Information support is implemented in accordance with the requirements of the system of international standards governing the rules of this interaction mainly through electronic data exchange. To ensure information integration, CALS uses the IGES and STEP standards as

formats. CALs also includes standards for electronic data interchange, electronic technical documentation and guidance for process improvement [4,5].

The use of CALS-technologies can significantly reduce the volume of design work, as the description of many components of equipment, machines and systems, designed earlier, are stored in unified formats of data network servers, available to any user of CALS technologies. It is much easier to solve the problems of maintainability, integration of products into various types of systems and environments, adaptation to changing operating conditions, specialization of design organizations, etc. it is Assumed that success in the market of complex technical products will be

The development of CALS-technologies should lead to the emergence of so-called virtual production, in which the process of creating specifications with information for software-controlled process equipment, sufficient for the manufacture of the product, can be distributed in time and space between many organizational and Autonomous design studios. Among the achievements of CALS-technologies – ease of distribution of advanced design solutions, the ability to repeatedly reproduce parts of the project in new developments, etc.

Construction of open distributed automated systems for design and control in the industry is the basis of modern CALS-technologies. The main problem of their construction is to ensure a uniform description and interpretation of the data, regardless of the place and time of their receipt in the common system, which has a scale up to global. The structure of design, technological and operational documentation, languages of its presentation should be standardized. Then it becomes a real successful work on a common project of different teams, separated in time and space and using different CAD/CAM/CAE-systems. The same design documentation can be used many times in different projects, and the same process documentation – adapted to different production conditions, which can significantly reduce and reduce the cost of the overall design and production cycle. In addition, the operation of the systems is simplified.

Development of national CALS standards in Russia is carried out under the auspices of Rosstandart: to this end, a Technical Committee TC459 "Information support of the product life cycle", which developed a number of standards ISO 10303 series, which are authentic translations of relevant international standards (STEP).

CALS is a set of techniques that allows you to find ways to find a systematic approach to the process of bringing new products to the market – from research and development (R & d) and production organization to the implementation of a complex of marketing, sales and after-sales service of finished products up to disposal. This method includes the provisions of the quality system and is implemented in the form of a project [6,7].

The further development of the CALS method (2000) led to the expansion of the original meaning of the abbreviation CALS: Continuous Acquisition and Life Circle Support – support for the continuous product life cycle as a method of improving the competitiveness of the product through effective information management. The task of the CALS method is to transform the product life cycle into an automated process by reengineering (restructuring) the processes included in it. The CALS method provides for a single data entry, storage in standard formats, standardization of interfaces and electronic exchange of information between all organizations and their units – participants of the project [8].

In the definition of CALS, the concept of "continuous development" involves the constant acquisition of new properties of products through its continuous modernization, which requires effective contact between the supplier and the consumer. The term CALS implies the organization of interaction between the process participants on the basis of new information and telecommunication technologies. The CALS strategy provides for the creation of an enterprise information space that allows information to be stored electronically and acts as a single data source for all participants in the product life cycle. The CALS method defines The Information Space (IP) of the enterprise as the accumulator of all information about the product, as the only source of data about it (direct data exchange between the participants of the life cycle is excluded), formed on the basis of international, state and industry standards.

4. The CALS strategy and methods

The CALS strategy involves two stages of creating a single information space:

• automation of separate processes in the life cycle of the product and the reporting of them in electronic format according to international standards;

• integration of automated processes and related data into a single information space.

The following methods are used to implement the CALS strategy [8].

1. Technologies of analysis and reengineering of business processes – methods of restructuring the functioning of the enterprise. These technologies allow the correct transition from paper to electronic document flow and introduce new methods of product development (parallel design, interdisciplinary working groups, etc.) in the automation process.

2. Methods of presentation of the product data – methods for standardized representation in the electronic form of data relating to individual processes of life cycle of the product.

3. Product data integration technologies – methods for integrating automated product life cycle processes and related data.

Product data management systems are used to integrate all data within CALS. Their task is to accumulate all the information created by application systems into a single model. The process of interaction between these systems and application systems is based on standard interfaces, which can be divided into four groups.

1. Functional standards monitor the organizational procedure of interaction of computer systems. For example, in the standard IDEF (Integrated Computer Automated Manufacturing DEFinition – a family of methods and technologies for creating complex systems and designing computer systems), IDEF0 – modeling functions. This is a whole family of IDEF standards that originated on the basis of SADT standards.

2. Information standards offer a data model that is used by all participants in the life cycle. For example, ISO 10303 STEP.

3. Standards for software architecture define the architecture of software systems necessary for the organization of interaction without human intervention. For example, COBRA.

4. Communication standards indicate how data is physically transmitted over local and global networks. For example, Internet standards.

CALS-methodology regardless of the subject area and is actively used in the creation of complex science-intensive products for both military and civil purposes, the life of which, taking into account various upgrades, is decades. As a rule, it is developed with the involvement of numerous subcontractors, and the philosophy of CALS implies transparent and easy communication of performers with each other and buyers [4,6].

5. Problems of implementation of CALS-technologies

Despite the great attention to CALS-technologies there is a problem on introduction of this technology connected with stages of Life Cycle of the Product (SLP). The Life Cycle (LC) of high-tech equipment includes the following main stages: fundamental and exploratory research; marketing research; design; production of prototypes and debugging; Technological Preparation of Production (TPP); batch production; operation and after-sales service; disposal. The GCS involves the integration of all these stages. However, in Russia, the greatest attention is traditionally paid to the automation of product design, and therefore, in a wide range of specialists and managers of enterprises, the terms "CALS" and "CAD" (computer-aided design system) are perceived almost as synonyms, which is fundamentally wrong. Already at the next stage of the product life cycle – at the stage of technological preparation of serial production, scientific developments can fail. If we consider the stage of operation and after-sales service of the technical product, it is the least investigated in our country stage of the LC. And the problem of recycling has practically no solution in our country [7].

The whole process of implementation of CALS-technologies can be divided into three stages.

The first stage is the Informatization of each individual process of the product LC and the presentation of data in them in a standardized electronic form for further integration. Previously, for

the successful completion of this stage, the enterprise should create a single information space (EIP) and an Integrated Information Work Environment (IIWE), where the integration of electronic data of individual processes should take place. Here is a revision of the organizational structure of the business process of the enterprise, appointed "owners" of the process. At this stage, it is important to choose promising innovative relevance, optimal in terms of price-quality basic information technology (IT), taking into account the ease of their integration within the framework of CALS. An important role is played by industry, regional and corporate cooperation, unification and standardization, allowing much faster and cheaper creation of IIWE.

The second stage, consists of the following components: analysis of existing business processes in the enterprise and their information support, i.e. creating a model as is "AS-IS". Next, there is the formation and training of the working group for a radical redesign and rethinking of the business process. Then there is a direct development of the concept of information integration, redesign (reengineering) of business processes and the construction of a new model of the enterprise "TO-BE". Within the framework of this model, corporate classifiers of objects, operations, documents are developed; development of strategy of introduction of CALS-technologies in the enterprise with innovative actualization; the selection, purchase, setup and adaptation of PDM-system; development of corporate standards; the filling of the PDM-system; the formation and adaptation of the IIWE. At this stage, the key factors are the development of a strategy that affects the basic it of the first stage, and the choice of a promising innovative update, the optimal price-quality PDM-system.

In the third stage, the main role will be played by the organization of users ' work in the IIWE and the process of innovative updating of basic it and applied information support. Implementation of PLM-system. PLM (Product Lifecycle Management) is a product lifecycle management concept that manages all product information and related processes throughout the product lifecycle, from design and production to decommissioning. The main components of which are: PDM-system– product data management system, is the basis of PLM, designed for data storage and management; CAD-system– product design; CAE-system– engineering calculations; CAPP-system– development of technological processes; CAM-system– development of control programs for CNC machines; MPM-system– modeling and analysis of product production. Innovative updating should be necessarily incorporated in the strategy of implementation of CALS-technologies.

The basis of CALS is the use of a set of unified information models, standardization of methods of access to information and its correct interpretation, information security, legal issues of information sharing (including intellectual property), the use of automated software systems (CAD/CAM/CAE, PDM, PLM, MRP/ERP, etc.) at various stages of the LC, allowing to produce and exchange information in the CALS format.

6. Conclusion

The introduction of CALS technologies is fundamentally wrong to perceive only as a total automation of traditional stages. CALS is not so much technical as organizational processes, based on the reengineering of business processes (Business Process Reengineering, BPR), which involves the fundamental rethinking and redesigning business processes of an enterprise with the purpose of increase of efficiency of its work. It should also be emphasized that CALS technologies support a broad end-to-end business process. The lag with the introduction of CALS will make it impossible for enterprises to participate in international cooperation, will negatively affect the competitiveness and attractiveness of products, will cause the loss of certain market segments.

Thus, the development of the LSP model is no less difficult than the development of a science-intensive innovative product. Training of specialists at the University is aimed primarily at the development of software and hardware design phase CALS. At the same time, a serious methodological problem in the way of implementation of CALS-technologies is the need to create a single product model throughout the life cycle. Therefore, the training course at the University on CALS-technologies should be integration and include a program of training of specialists in engineering, management and engineering-economic profile, and not only specialists of IT-services

for enterprises (as is traditionally believed), which will be engaged in the management of the life cycle of products of the technical industry.

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