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THE APPLICATION OF THE MODERN INFORMATION TECHNOLOGY IN THE HIGH-END SCIENTIFIC MANUFACTURE MANAGEMENT

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Abstract: The problems of CALS - technologies application for management of a product life cycle processes are considered. A uniform object of management submits the set of life cycle processes. The model of a small-lot manufacture process of manufacture is constructed, for which the analysis of known ways of the optimum time-table finding is given, and the automated approach to the decision of the optimum time-table finding is described.

The modern stage of the manufacture development is characterised by new information technologies usage. The regulation of the mutual relations between structures of the enterprise at the level of information interchange is undertaken by **CALS** (Continuous Acquisition and Life Cycle Support) technology [1].

Basis of CALS concept is the increase of a product life-cycle (**LC**) efficiency processes at the expense of management increase efficiency by the information on a product. The purpose of CALS is the transformation of a product LC in the automated process by re-structuring of included business-processes.

The central point of CALS is the concept of a product LC (Fig. 1). The product is represented as virtual object (model of a product), having all properties of a real one.

The product LC, as defined by the standard ISO 9004 - 1, is a set of the processes which are carried out from the moment of a society needs revealing in certain production up to satisfaction their needs and up to a product reclaiming.

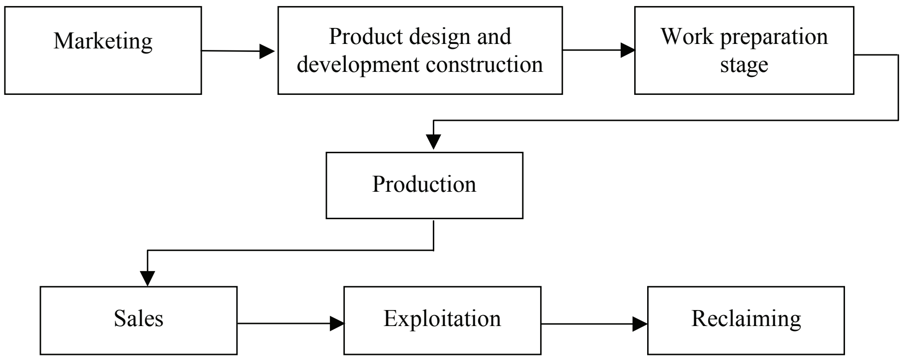

Fig. 1 The product LC and it's components

The purpose of the CALS concept is achievement of the product quality and the manufacture flexibility (fast reaction to changes of the market), at the expense of complex consideration of all industrial services through «prism» of those or other product properties. In this case the properties of a virtual product display not one direction of attributes (technological or technical and so on), but all in complex. Thus, it is possible to achieve an optimality in not only parameters of the product, but also optimality of processes: management planning and production, marketing, purchase of raw material, management and planning at a stage of research, etc.

At the expense of the complex analysis of LC processes, and all of its stages, the CALS method should lead manufacture to a new cultural and production level [2].

The CALS concept assumes the control and management in ensemble LC with processes of a product. It is characteristic of Russian industry that the stages of the LC are realized on the territorial shared areas and enterprises. In this case, for CALS policy realization, it is necessary to create virtual enterprises [3]. Hereby, on the basis of the modern telecommunication means there is a uniform information space storing the product's data during its LC, despite territorial unintegrity, the management of stages of the process manufacture as a single unit is carried out.

The world practice shows, that the investments in the virtual enterprises creation, give profit and provide improvement of a product quality [4]. Nevertheless, at the present stage of development of market relations in Russia the enterprise carrying out a part of LC product is not ready to associate in the virtual enterprises. This fact is explained that the majority of the industrial enterprises pass crisis, and don't have means for long-term investments in organization of the virtual enterprises. At the given stage of the capital accumulation, it is necessary for them to be engaged in activity, which demands short-term investment.

Therefore, we shall consider the implementation of the modern CALS technologies on the example of the enterprise carrying out all stages of LC. The creation of the uniform information space according to the CALS policy now is possible only at such enterprise. The product passes all LC from research of the market, the scientific research work, the design work, technological preparation of manufacture, manufacture, selling ready production, support, repair and up to reclamation.

Manufacture at the enterprise, which is carrying out complete products LC, is high-assortment and high-end technology one. From the point of management view, it has some advantages and disadvantages. The advantage is that the manufacture becomes more flexible: the updating of technology and technical decisions parallel with the stages of manufacture is possible. The disadvantage is plenty of information accompanying a product on an extent LC. First: high-end manufacture has large assortment production with small parties. Secondly: the information about LC is stored within the framework of one enterprise.

The basis of CALS forms the complex of the integrated information models, standard ways of access to the information, correct interpretation, information safety, legality of information sharing (including intellectual property) [5].

The information interaction of the subjects participating in support LC, should be carried out in uniform information space (**UIS**). The basis of the concept of UIS forms the use of open architecture, international standards and approved commercial products of data exchange. Data formats representation, methods of data access and their correct interpretation are subject of standardization.

UIS represents a set of information models appropriate to various stages of LC.

(« The Integrated information model of a product. Complete, all-round description both of a product, and technological receptions of its manufacture, features of its functioning and modes of operation, etc.» [6])

Information models classification and their communication with stages of a product LC are given in the table.

The integrated information models of all stages LC are united on integrated information environment (**IIE**).

(«IIE. – A set of the distributed databases containing the items of information on products, industrial environment, resources and processes of the enterprise ensuring correctness, urgency, safety and availability of the given themes to the subjects of production - economic activity participating in realization LC of a product, for which it is necessary and it is authorized. All items of information in IIE are stored as an information objects». [6])

Table 1

Information models classification and their communication with stages of a product LC [5]

Stages of LC	Information model		
	Product	Business-process in LC	Manufacturing and exploitation environment
Marketing	Marketing (concept)	Model of the marketing process of a product	Model of the marketing environment
Product design and construction	Designing	Model of a product design and construction processes	Model of the design and construction environment
Manufacture	Technological	Model of a product manufacture process	Model of the technological environment
Sales	Sale (price, sale)	Model of the sale process	Model of the sale environment
Installation, breaking-in, technical help and service, exploitation, reclamation	Exploitation	Model of the sale process	Model of the exploitation environment

The character is that the integrated model of a product has large volume and includes fragments concerning various subject domains. Therefore, the process of the integrated model creation is discrete from the point of LC view - separate fragments are formed and included in the integrated model at different stages of a product LC. Thus storage of all fragments of a product model is necessary, irrespective of the stage of a product LC at which the fragment was created. For example, «the Outline project» is not cancelled with the occurrence of «the Technical project», and changes in a product design don't mean, that the description of the previous design should not be kept.

The information integration in CALS frameworks is based on the application of the following base integrated models:

– Model 1 - product; contains the information on a product generated at all stages LC;

– Model 2 – product LC, and business-process carried out in its course; describes processes occurring within the framework of the enterprises in ensuring output;

– Model 3 - industry and environment; describes organizational structure of the enterprise.

From the positions of system architecture the basic information models are the base, on which the automated control systems of a various level can be constructed. On the basis of the same model of LC and business-process the tasks of the efficiency business-process analysis and maintenance of production quality [2] are solved. The integrated model of a product provides an exchange of the design data between the designer and manufacturer, it is the source of information for calculating requirements in materials and creation of the electronic directories on operation of a product and so on.

We shall consider construction of the specified models for multi-assortment enterprise carrying out complete product LC more in detail. We shall consider model of industrial environment of a management for management task formalization (model 3).

In fig. 2 the basic circuit of management scientific enterprise displaying information flows of process of development and output is submitted.

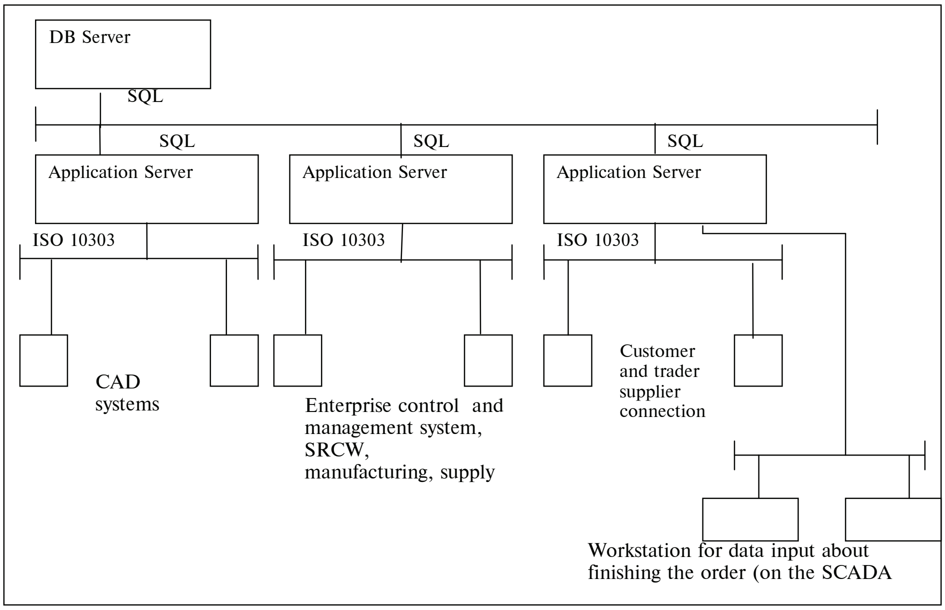

Fig. 2 Logic structure of a corporate network

Four contours of management here are allocated: the contour of business operation, contour of research management (scientific research development and the work), contour of production management, contour of purchases management.

Four tasks of management are accordingly formulated:

– Business Operation;
– Research Process Management;
– Production Management;
– Management of Purchases.

There is the task of finance management, but this task is independent and is not considered in this paper.

We shall consider the problems of management of one business-process manufacture on the example of solving calendar planning task for one or several kinds of products in terms of scientific enterprise.

The task of calendar planning (on a long-term period) represents the task of optimum industrial resources (equipment, attendants, raw material) distribution in time, on a scheduled period, for one or several kinds of production [7].

So, it's necessary to develop a plan, according to which we have to produce N_k (pieces) of products of the k 's order for a T_k period. N_k – quantity of a product set, T_k – time of output of the k-order, according to contractual obligations. The received calendar plan should satisfy to the given material and time criteria. The amount of orders on a scheduled period in manufacture is equal K . The initial moment of a scheduled period T_0 = 0. The output of the k-order (product) means consecutive performance of technological operations. The sequence of operations is strictly regulated by technology (technological circuit). The technological circuit for each product is described in the document, under the name «Technological Process». This document contains the detailed description of each technology operation. The description consists: volume of a necessary material; the equipment, on which it is necessary to carry out the given operation; time of operation performance; qualifying characteristics and expenditures of the experts labor, who are carrying out an operation.

With the use of Boolean variable for each technological process the relations of the consequent operations are set:

$$D_{ij} = \begin{cases} 1, \\ 0, \end{cases} \quad (1)$$

1 – if the j-operation follows directly for i, 0 – otherwise.

Matrix D makes a sequence of operations performance for all technologies. If $d_{ij} = 1$ $(i \in [1..G]; j \in [1..G])$, operation, under number j follows operation under number i; otherwise, the element should be equal to zero. Some properties of a D matrix:

1) If the column doesn't have individual elements $(d_{ij} = 0, i \in [1..G])$, for j-operation performance it is not required to perform any other operations, hence, it should be carried out, from the very beginning of the performance order.

2) If the line doesn't have individual elements $(d_{ij} = 0, j \in [1..G])$, the i-operation will finish technological process. The result of this operation performance is the final product, subject of the order.

Some constraints on a matrix D:

Let's consider the any k-order $(k \in [1, G_k])$, the site of a D matrix appropriate to this order will be defined as:

$$d_{ij}, \begin{cases} k = 1; \; i, j \in [1, Gk_1] \\ k > 1; \; i, j \in [Gk_{k-1} + 1, \sum_{n=1}^{k} Gk_n] \end{cases} \quad (2)$$

The change i and j lays in the specified limits.

1) In the specified limits the matrix D can and should have only one empty line. It is explained that the technology has treelike structure, and one operation can precede only one operation, and it can be preceded by some operations. The result of technological process is the result of the last operation included in it. The absence of a zero line within the framework of technology testifies to a mistake of a database filling to correct it, it is necessary to look after correctness of the technology entering with the report using, which created by the calculate module at a technology load stage.

2) All matrix elements, behind the specified limits should have zero meaning, as the technological processes among themselves are not connected in any way, at the sequence of operations filling stage. The operations of one technology cannot be required for performance of other technology operations. The existence of unzero elements connecting technologies testifies to a mistake in the subroutine of the sequence operations definition.

On the basis of the document «Technological Process» the formalized operation representation will look as follows: p_i – time of operation performance under the schedule; m_m – norm of the required material charge; o_o – the unit of equipment, on which an operation should be carried out; z_z – expert required qualification; t_i^0 – time of i-operation in manufacture start.

The index i – corresponds to a number of operation in k-technology $(i \in [1; G_k])$, where G_k set of operations in k-technology, $(G_k \in [1; G])$; G – set of all operations,

$$G = \sum_{K} G_k . \quad (3)$$

The index m corresponds to an account material number ($m \in [1; M]$, M – total volume of a material for all technological processes). Index O corresponds to an equipment unit number (further in text – workplace) ($o \in [1; O]$, where O park of the enterprise equipment: machine tools, tools, adaptation etc.).

The index z corresponds to the expert ($z \in [1; Z]$, where Z - aggregate number of the enterprise personnel).

To establish conformity between operation and the equipment, material and personnel it is necessary to enter following Boolean variable:

$$A_{io} = \begin{cases} 1, \\ 0, \end{cases} \quad (4)$$

1 – if j -operation is carried out on the o -workplace, 0 – if i -operation is not carried out on the o -workplace.

$$B_{iz} = \begin{cases} 1, \\ 0, \end{cases} \quad (5)$$

1 – if i -operation is carried out by z -worker, 0 – if i -operation is not carried out by z -worker.

$$C_{im} = \begin{cases} 1, \\ 0, \end{cases} \quad (6)$$

1 – if for i -operation is used m -material, 0 - if i -operation is not used m -material.

Thus, the initial data of a task are following: matrixes A, B, C, D (4)-(6), $\{G_k\}$ (3), $\{T_k\}$, $\{N_k\}$, $\{p_i\}$, $\{o_o\}$, $\{z_z\}$, $\{m_m\}$ specify production process.

The decision of a calendar planning task is the matrix $\{t_i^{\,0}\}$. The calendar plan is considered as developed, if determined $\{t_i^{\,0}\}$ for $i \in [1; G_k]$, and $k \in [1; K]$.

The load diagram of the production capacities are estimated on economic parameters [8]. The estimation criterion of the time-table can be divided into two types: regular criteria concerning the time-table, and criteria concerning an estimation of the service system. The regular criteria (7) are connected in course of work performance in the system:

– total time of output of each product (time of the each work termination in system), by results of model work - $\{T^0_{G_k}\}$;

– rough cost of a products set:

$$F_k = \sum_{G_k} \left(\sum_{O} f\left(A_{io} o_o\right) + \sum_{M} f\left(C_{im} m_m\right) + \sum_{Z} f\left(B_{iz} z_z\right) \right), \quad (7)$$

where *f* – function of cost depends on number of the equipment, material, work.

The second type of criteria (8) estimates system of service. The most important of them:

– operating equipment ratio –

$$\overline{U} = \frac{\sum_{K} N_k \sum_{G_k} p_i}{\max_{K} \{T_k\}}. \quad (8)$$

Average volume of work, contained in system, for an interval of time –

$$\overline{P}\left(t_1, t_2\right) = \frac{1}{t_2 - t_1} \int_{t_1}^{t_2} P(t)\, dt, \quad (9)$$

Where $P(t) = \sum_{G(t)} p_i$ – total duration of all operations in system to the moment of time t, $G(t) \in G$ a subset of operations executed to the moment of time t.

In the beginning we shall consider the task of drawing up the calendar plan for one order $K = 1$.

There is a set of theories describing algorithms to account the calendar plan. Let's consider algorithm, which belongs to a class of unitary algorithms named scheduling [8]. Characteristic of this class is that the consistently nominated moments of operations beginning for each machine will form a strictly growing sequence. In other words, the decisions on inclusion in the time-table are accepted in the same order, in which they will be resulted in execution performance. The process of drawing up of the time-table can be stretched (dragged out) in time, accepting each decision before it should be executed. The class of scheduling is sufficient for drawing up time-tables. So for any time-table exists a unitary algorithm, realizing it. In spite of this fact it is impossible to be limited only to algorithm of this class. For various industrial tasks there is no universal, effective algorithm of scheduling. Automatization allows the operator to make a dynamic changing principles of the time-table construction depending on an industrial situation. One of construction principles of the time-table is applied in the algorithm described below.

This implies, that there can be two reasons for the equipment downtimes: in connection with costs of the time-table, and with the given sequence of technological processing (the operation cannot begin, the operation on technological process will not be executed before previous one).

The idle times caused by technological features of the process are caused by difference of operations performance time in one technological chain. It is not possible to avoid such idle times.

With the rigid task of a technological sequence of operations and standart-charges for output of a product (as in this case) algorithm gives optimum by the chosen criteria or rather close to optimum variant of the diagram.

Thus task of calendar planning of one product output is reduced to process construction in time, strict under the rules. It is necessary only to watch duly delivery of materials.

It was marked, that peculiarity of the scientific manufacture is large assortment of production (5-20 products) under its small (1000-2000 pieces) sets. Besides serial production the internal order constantly takes place, where quantity in set is small (up to 50 pieces), and it is impossible to plan the internal order sometimes. For example, after tests of an experimental set it was found out, that some serial part does not pass control, then it is necessary to reduce the same set of products, but with the changed part or method of its manufacturing, in the shortest time. In this situation we have to make optimum decision for the limited period of time.

So, it is necessary to define optimum start time in manufacture of each product. We can vary set G and N_k to simulate and estimate process with any sequence of the order performance.

For formalization of the task it is possible to use the above-mentioned model of manufacture for one product.

Let's present, that the order, which consists of one operation, is carried out by one device. The device, in this case, represents all manufacture.

Then the task, within the framework of the time-tables theory, is formulated as follows: define optimum sequence of service K - requirements for one device. In condition, that all orders put in service system simultaneously, the interruptions in processing are not admitted, the simultaneous service of the requirements is authorized.

Let: $O = 1$ – there is only one machine, $G_{ki} = 1$ – the performance of the order consists of service of one requirement, P_k – time of k-order performance, W_k – waiting time k- requirement, $t_k^0 = W_k$ – beginning of service k- requirement, $T_k^o = t_k^0 + P_k$ -

moment of the termination of the k-work, where $k \in K$. Define an optimum sequence of service K of the requirements on one device, concerning of criteria (7) and (9).

The time-table of works introduction in service system is considered if the matrixes $\left\{t_k^0\right\}$, $\left\{T_k^0\right\}$ and $\left\{W_k^0\right\}$, for $k \in K$ are given.

The required diagram should satisfy following restriction: $T_k^0 \le T_k \forall k \in K$. The time of output of each order $\left\{T_k^0\right\}$ should not exceed time $\left\{T_k\right\}$ allocated for it in the contract with the customer.

The processes of different products manufacturing are crossed, i.e. they have common resource (equipment). In this case there is a task concerning integer class of combinatorial optimization.

The set $\left\{t_k^0\right\} \in T$ is not discrete size. Therefore, the decision will belong to set to an equal combination from $\frac{T}{\Delta t}$ on K. In this case, Δt - step splitting of set T with $\Delta t \to \infty$, set of possible variants $\to \infty$ - search is impossible (as a guarantee of optimum result).

To solve such class tasks the following groups of methods [9] are known:

1. The methods, which split the task into subtasks, considerably reduce dimension, and simplify search of an optimum, but at the same time, the result received as set of the subtasks decisions, not always is the decision of an initial task. The proof of legitimacy of splitting becomes a problem with the equal complexity.

2. The combinatorial methods. The optimum decision (global extremum of criterion function) is found by means of complete ordered search. However, dimension of the task does not give an opportunity to consider this way as really applicable in practice.

3. The combinatorial methods and heuristic rules. The sense of such methods consists in the following: with the help of introduction of heuristic rules the dimension of a task is reduced, so, the subset of the obviously non-optimum decisions are removed from consideration. The heuristic rules are based on intuitive reasons of one or commission of experts in a subject domain of the task [10].

Thus, the optimal account requires large expenses of time and material for development, introduction of both mathematical models and algorithms.

In real industrial conditions the application of expensive computing algorithms is not obviously possible and is not expedient, as the cost price of production sharply grows. The development and introduction of the mathematical device of the task operative calendar planning decision and management requires significant, in scales of the enterprise, material expenses.

Any optimization algorithm provides movement to extremum on a direction. It is not possible in the given task to define this direction. For such sort of tasks there is a class of algorithms called heuristic. The algorithms are based on some assumptions of a direction on extremum. If we use such algorithms, it is impossible to guarantee an optimality of the result. In this case, to solve a task some heuristic rules for searching extremum are put forward. Thus, comparison of several (10-20) results allows to choose «quite good» variant of the plan. It will be necessary for each case, to construct technological process in time for each order on given for reception model of the calendar plan for one product.

The hand-operated recalculation of even 20 variants in real industrial conditions is not possible. The strategy of CALS provides integration of applied packages of special purpose in the whole control system of the enterprise.

The input data for system, with the decision of a calendar planning task, is the information on a current industrial situation: the items of information on the equipment $\{O\}$, stocks of raw material $\{M\}$, current industrial orders $\{K\}$, and personnel $\{Z\}$. On the basis of the input data, the system should give out the managing decision, using mathematical models business-process of the enterprise. The user of system (person accepting the decision) should receive some variants of «not worse» decisions, which he has an opportunity to compare with the model estimated parameters: volume of output, energy consumption, load of capacities, idle times, cost price of production, raw material expenses and so on.

«Not worse» - means that an optimality of the received result cannot be approved, because we use heuristic algorithms of optimization, which have a deviation from the optimum decision. The optimum decision in such tasks is the only one we can find by method of direct search, which is not applicable in real conditions of industrial planning, taking into account large dimension of a task. The deviation of the decision depends on an optimum, with search by one or another algorithm, from the input data. In some situations one heuristic algorithm brings a smaller deviation, in others a bigger one. As it is impossible to define, which algorithm will be better in particular conditions, the automated system carries out search of the plan on several algorithms at once.

So, the operator receives an opportunity to make a calendar plan taking into account his personal experience and parameters interesting for him. The variation of the ways of the equipment load will help to find the most successful compromise. Thus, the user is released from routine hand-search of the capacities load plan, by specifying only principle portofolio of the orders accommodation, he receives the calendar plan with necessary estimated criteria.

If a successful plan is found using personal experience the automated system should transform this principle of construction of the plan into heuristic rule, with the purpose of its application in the further work. Thus, the system should be improved. The opportunity for development is caused by characteristics of the manufacture mathematical model and the way of heuristic rules record.

The strategy of CALS provides association means of automation, processes connected with output at the enterprise, in uniform system. Standardization of applied software packages, in frameworks of CALS-standards provides the uniform interface of the programs used for automation various business-process in current product LC. In aggregate applied packages of general purpose («1C», «SCADA», «AUTOCAD», etc.) with special packages, such as a package of operative calendar planning and the manufacture management and SRCW will form the automated system.

The automated system must solve the following tasks:

Modeling business-process of the enterprise;

– Reception of the charge materials and material resources plans;
– Granting to the user an opportunity of an estimation of the managing decisions;
– Reveal the real industrial situation;
– Provide an opportunity for the decisions check, received on the basis of personal experience;
– Accumulation of «experience» (self-training) during acceptance of the decision.

The automated system should provide the user with the authentic information at the moment of the decision acceptance. The interface of system should allow to carry out operatively the centralized collection of the information from «workplaces», that is from producing units (warehouses, shop, workplaces). The information support of the automated system should correspond to the modern international standards (CALS - standards - standards of information support of a product during all life cycle), being reference rules with creation of any information systems of the enterprise [11].

For an effective utilization of UIP strategy CALS provides the distributed processing of the information [12]. Such approach provides parallel work with the data, that in turn accelerates process of calculation and allows to share workstations to a functional attribute: «Warehouse», «Accounts Department», «Scheduled Department» etc. For realization of the distributed work with the data the association of personal computers in a corporate local network is used. The possible logic circuit of such association is submitted in a fig. 2.

In fig. 2 the example of association of personal computers in the local computer network is given.

Storehouse of the information is database server representing an applied package of SMDB, such as, for example, Oracle, or Microsoft SQL Server. Server provides parallel access to information space to other workstations - clients. «Clients» are the workstations taking place in a network and which are carrying out the functions, for example, such as data input, task of management etc. The communication is carried out under the protocols of an exchange according to normative base of CALS. Each workstation functions parallel each other, «and does not know» about existence others. The interaction of stations is carried out only in change of the information.

In this work the basic principles of strategy CALS of automation business - process LC on an example of scientific product are stated for enterprise with a big assortment of goods. The use principles provide complex automation of manufacture processes and allow to increase quality and to reduce production cost price on the base of improvement of business operation level.

References

1. А. Кабанов, А.Давыдов, В.Баранов, Е.Судов "CALS-технологии для военной продукции" // Стандарты и качество, №3, 2000. – С. 28-31.
2. Судов Е.В. "CALS-технологии или Информационная поддержка жизненного цикла изделия" // PCWeek/RE, № 45(169) (17-23 ноября) 1998 – С. 16-19.
3. Дмитров В.И. CALS как основа для проектирования виртуальных предприятий // Автоматизация проектирования 1997, №5 .- С. 35-37.
4. Дмитров В.И. Опыт внедрения CALS за рубежом // Автоматизация проектирования 1997, №1. – С. 21-23.
5. CALS (Поддержка жизненного цикла продукции): Руководство по применению / Министерство экономики РФ; НИЦ CALS-технологий "Прикладная логистика"; ГУП "ВИМИ", 1999. – 44 с.
6. Госстандарт России. Рекомендации по стандартизации Р 50.1 – 2000 «CALS – технологии. Терминологический словарь». Част 1. «Терминология, относящаяся к стадиям жизненного цикла изделия». – М., 2000. – 57 с.
7. Федоренко Н.П. Математика и кибернетика в экономике. Словарь – справочник. – Экономика, 1975. – 605 с.
8. Конвей Р.В., Максвел В.Л., Миллер Л.В. Теория расписаний. – М.: Наука, 1975. – 360 с.
9. Иванов В.В., Березовский А.И., Задирака В.К., Здоренкой Л.Д., Н.П. Лепеха. Методы алгоритмизации непрерывных производственных процессов. –М.: Наука, 1975. – 305 с.
10. Норенков И.П. Эвристики их комбинации в генетических методах дискретной оптимизации // Информационные технологии, №1, 1999. - С. 2-7.
11. Материалы www.cals.ru «Сервер CALS в России».
12. Подколзин В.Г. ,Судов Е.В. "Применение STEP-технологии при построении корпоративной системы "КБ - завод" // Проблемы продвижения продукций и технологий на внешний рынок, специальный выпуск, 1997.- С. 41-44.

Применение современных информационных технологий в управлении наукоемким предприятием

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Ключевые слова и фразы: жизненный цикл изделия, виртуальное изделие, процессы жизненного цикла изделия, единое информационное пространство, много ас-

сортиментное производство, наукоемкое производство, информационная интеграция, контур управления, целочисленные переменные, календарный план, суточные задания.

Аннотация: Рассмотрены вопросы применения CALS – технологий для управления процессами жизненного цикла изделия. Совокупность процессов жизненного цикла представлена как единый объект управления. Построена модель процесса мелкосерийного производства, для которой приведен анализ известных способов нахождения оптимального расписания, и описан автоматизированный подход к решению задачи нахождения оптимального расписания.

Anwendung der modernen Informationstechnologien in der Verwaltung vom wissenschaftsgeräumigen Betrieb

Zusammenfassung: Es sind die Fragen der Anwendung der CALS-Technologien für die Steuerung von Prozessen der Lebensdauer des Erzeugnisses betrachtet. Die Gesamtheit der Prozesse der Lebensdauer ist als Einheitsobjekt der Steuerung dargestellt. Es ist das Modell des Prozesses der Kleinserienfertigung geschaffen. Dazu ist es die Analyse der bekannten Verfahren des Findens des Optimalplans angeführt. Es ist auch die automatisierte Behandlung zur Lösung der Aufgabe des Findens des Optimalplans beschrieben.

Application de modernes technologies d'information dans la gestion de l'entreprise utilisant la science d'avant garde

Résumé: On a examiné le problème de l'application des technologies CALS pour la gestion des processus du cycle vital du produit. L'ensemble du processus du cycle vital est présenté comme un objet unique de la gestion. On a construit le modèle de la petite série pour lequel on a fait l'analyse des moyens connus de la définition des horraires optimaux et l'on a décrit l'approche automatisée pour la résolution du problème de la définition des horraires optimaux.
