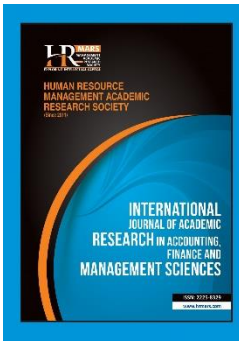

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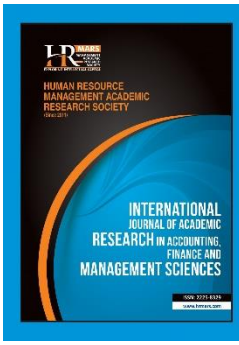
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Management Information Systems for Computer Aided Design

Cezarina Adina Tofan
Spiru Haret University, Faculty of Accounting and Finance, 223 Traian Street, Campulung, Arges, Romania
Email: adina.tofan@spiruharet.ro

Abstract
Methods and production means of the mechanical industry are disturbed by the presence of computers, robots, programmable controllers, numerical controls, etc. After the appearance of the numerically controlled machine tools, the main developments were marked by an accelerated development of the computational techniques, the processing centers, the group technology, sensors, the geometric modeling techniques and graphical data processing, simulation, CAD/CAM systems, systems and diagnostic techniques, high-level programming languages and the artificial intelligence. Informatics found the first place at the administrative functions of the company: accounting and management, then it enabled the automation of the control and the production processes. However, the "classical" techniques of mechanical, electrical engineering and electronics have evolved, enabling the development of the new performance parts and adjusting the digital signal treatment. Adding the computer techniques to the high established techniques allowed the access to the flexible automation of the manufacturing processes.
Keywords: Aided Design, Geometric Modeling and Graphics Data Processing, Simulation, CAD/CAM

Introduction

CAD - Computer Aided Design (Computer Aided Constructive Concept) is the term used for IT tools in the product design. In the figure 1 is presented the general mechanism for designing and projection and it is distinguished the place where the artificial intelligence comes. The role of the computer-aided constructive concept is that based on the functional requirements, esthetical and constructive to be determined by the computer, the form properties, the material and the quality of the object.

The design process is considered as an activity based on the induction, deduction, intuition, experience and creativity. Through the information technology it is possible to gradually transfer the experience, deduction and induction from the design engineer to the CAD system, so, to become an intelligent system.

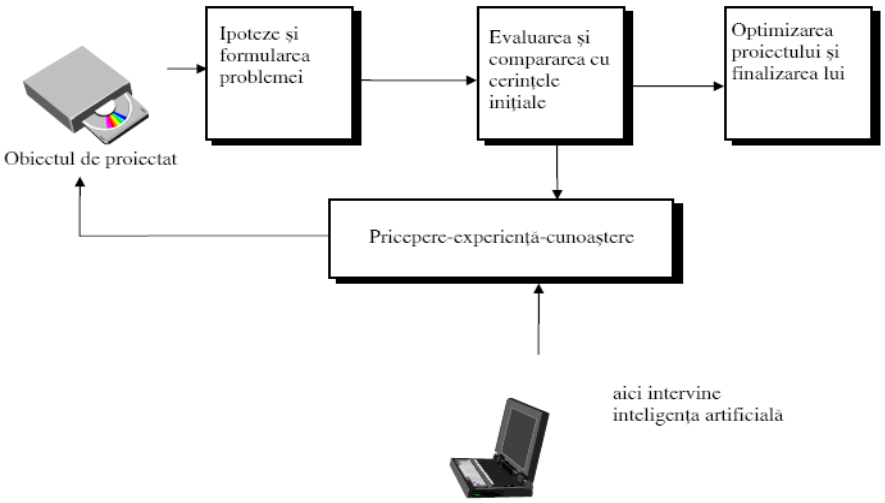

Figure 1. The designing and projection process in the CAD subsystem

A CAD system, with the general scheme shown in the figure 2, involves continuous dialogue through the design screen, between the technical and general data base on the one hand, and algorithms based on the other side.

As man-machine system, the CAD system is based on the creative-intelligent human capacity and the computing power of the computer; it possesses the operating speed and high capacity storage and retrieval of the information.

CAD systems represent integration of the computer science methods and engineering, including: databases, banks of the fundamental and algorithms methods, the communication systems, graphics systems and the application programs.

A CAD system must have the capacity for decision including the assignment of the design requirements and the design specifications. These features include the natural language processing, transforming and refining through the user query (interactive) over the degree of the detail design.

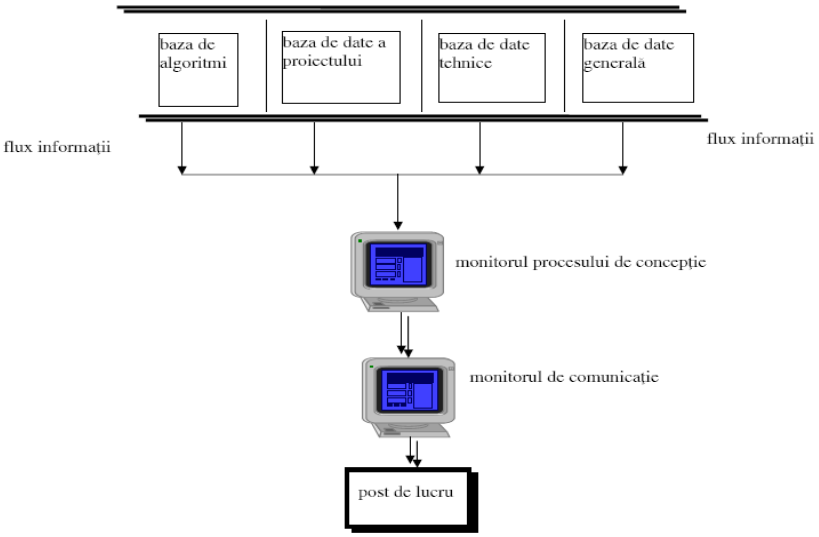

Figure 2. The general structure of a CAD system

An intelligent system for the computer aided design will be to provide the capacity for archiving in a symbolical logic for the users, which would allow him to make his expressions about the computer design knowledge and to access the computer for an adequate representation of their meaning.

Materials and Methods

Creating a CAD system requires the integration of the un-geometrical and technical-administrative information in a database and knowledge, thus incorporating the "reality" of any product designed.

The transition from the classical analytic geometry, Euclidean, to the axonometric geometry, which lend themselves to the logical interfaces on many abstract properties of the geometric entities can be the solution for the integration of the three types of information.

Thus, it was necessary to develop more intelligent CAD systems in the graphics and geometric modelling field.

CAM - Computer Aided Manufacturing is a term that has no a clear consistency. Some use the term to define computer-assisted processing and others include in CAM the control functions of the production. Most commonly, CAM means assisting with the computer of the manufacturing process. In essence, this involves developing the NC programs, the processing and assembly technologies.

The transition from a manufacturing economy to a market economy emphasizes the difficulties of the enterprises to adapt to this new environment through the appearance of the following factors:

- The continued growth of the products complexity, the diversity and their quality, and lower their selling price, the latter factor leads to a fierce competition, to produce timely, quality and at a lower price, which demonstrates hostile environment in today's evolving enterprise.
- The continued growth of the product availability (short-term, split time demand) and their progressive character.

The information system treats information flows on the one hand with the decision system and that operational and on the other hand with the environment. The information flows with the customers' poles and suppliers are represented of the physical and financial flows handled by the decision system and the operational systems.

The concept of the information system covers two concepts:

- Evolving the business reality, movement, communication and information storage, information system concept which is close to a natural object;
- The system, an artificial object built by the human, so that to represent the business, communication and storage organization.

A built information system is an integral part of the business organization, being its performance support.

The issues of the enterprise information system are generally considered from two points of view:

- Development on the levels in order to formalize the future system in its various aspects (contribution to the company strategy, management rules, organizational and technical aspects). There are used the modelling techniques (logical models, conceptual models, etc.) and separation of the activities and data which allow a validation of implementations descriptions and dialogue between different actors in the process of the enterprise (users, decisions makers, IT organizers)

- The phased development (guidelines scheme, studies, etc.) selling hierarchy decisions need to be taken during the design, development and commissioning of the new information system as well as its future development.

This dual approach helps the risks manage (cost, terms, influence over the staff) and the failures of the new system over the company (management efficiency, improve the performance, increase the commercial impact). It promotes the introduction of the new technologies (relational databases, communication networks, etc.), and the development of the information system based on the changes within the business or in the environment as it evolves.

The IMS program (Intelligent Manufacturing System) provides a technology of the future design of production systems that allow this approach. IMS is a Japanese acronym corresponding to a research and development program in Japan and is accompanied by FGMS - Future Generation of Manufacturing Systems.

The role of this program is to develop an industrial system prototype for the future. This focus is on the consumption and on the consumer rapport beside the product. Usually the product has a limited lifespan; it is consumed, used and then destroyed in general, without to be recycled adding rejections already accumulated. For the replacement of the product, the consumer takes advantage of the progress and innovation developments in time.

The consequences of this consume pattern are: environmental destruction, depletion of manpower, etc. This situation cannot last forever and cannot be generalized to the scale of the planet.

Analysis of the consumer products shows that only the functions chosen to satisfy the demand have an increasing value, the physically object disappeared for the benefit of its functions. Adding the additional features to the renewed product will evolve the consumer requirements that will also be satisfied.

This approach led to the concept of "smart products" (Software Product) produced by intelligent machines (Soft Machinery) composed by the autonomous systems, automated, highly standardized and able to be reconfigured.

The IMS concepts treat more particularly the various markets structure, implementation and dissemination of the new technologies, human factors and environment, etc.

There are two interpretations of the IMS, which are frequently cited in the speciality literature:

a) depending by the accumulated experience in businesses and research centres, IMS can be defined as: systematization of the industrial experiences into knowledge, organization based on these normalized production knowledge of some research on the intelligent manufacturing systems where machines and systems are capable to think, to judge and make decisions for themselves.

b) A second interpretation is: the development of the next technologies generation and the regulations on the manufacturing industry experience, experience gained by humanity, through organizing and systematizing, organizing the normalized knowledge for the future production systems with 5-10 years in advance; beginning the research and development of the technologies manufacturing that it is thought to be used at the beginning of XXI century.

IMS can be perceived as an overall research on the transition from the current system of production to the future production system that will replace it. Under these conditions some elements allow to define the IMS very well: globalism technical (technology without borders), applications to organize technical knowledge and interpret of what is meant by smart.

The IMS concepts are related by the current reality and supplied the future reality research being found in the diversification market structure (increasing the flexibility of manufacturing

systems, upgrade the base technologies, development of the fundamental information technologies), implementation and dissemination of the new technologies (normalized have to advance the marketing, publication of the competitive technologies, organizing the mechanisms for the technology transfer), human factors (improving the working environment, creating the adapted technologists for the low-skilled workers, integration the workforce qualification and the automation, taking into account the cultural and ethnic factors), industrial globalization (collaboration in research and development, normalization, development of the integrated information systems) protection and conservation the natural environment (saving the natural resources and energy, recycling the natural resources that develop the closed-loop systems, reusing the effective waste, systematic and assessment the environment).

The aim of IMS is to establish the future generations of the industrial systems, and wanted to have a universal character and assuming the following characteristics: to be adaptable to the market, to be cantered on man, to be open and universal, to be adaptable to the human nature and its social environment, to be effective (a low rapport cost/performance). It must links between the concepts and features through the technology and the technological research programs. The IMS research programs have been the result of five preliminary feasibility studies that correspond to the technology areas able to link between concepts and features.

These studies have focused on the following areas: intelligent devices, automatic control and systems integration, systems design, systems architecture, information integration. Enterprise is the IMS research centre, the themes of ongoing technological interest as categorized by the following manner: enterprise integration, global production, technology of system components, organic production.

IMS is essentially a general idea of showing up where it is possible to predict the future based on the most advanced technologies of these days, an open enterprise, international, for the benefit of all who seek to establish universal standards for systematization and organization the technological knowledge to be available to all, an ecological approach designed to preserve natural resources and the company itself, but in the same time it shows the distances that are sometimes insurmountable between the attention and reality such as for example the interests of the big countries that are not always in harmony.

Near the simultaneous engineering approach, re-engineering proposes to reconfigure the business organization at the operational processes level, more than adaptation of the enterprise at the business processes level, more than adaptation of what exists, it takes the fundamental nature of business, replaces the established rules and made all aspects of the organization to evolve to a transverse structure of the business. While the parallel engineering influence the design and management project, the re-engineering actions involve a complete remodelling of the company. Activity are considered in an overall process no longer isolated tasks, objectives are fundamentally driven by the customer satisfaction, the role of information technology is fundamental, and all these actions will require an intense involvement of the general directions for a long time. The concept of "reengineering" in relation to a firm, company or the new economic conditions, technological and social, specific in the 21st century, when it is made the transition from the industrial society, with the beginnings of the 19th century, to the new type of society: the global information society.

How the new organizations buy, make, sell and distribute products and services is very different from the present situation. Compared to the decomposition proposed by Adam Smith, until the

simple basic operations (tasks), the new guidance is based on the need to unify these simple operations into a coherent system.

Reengineering begins from the current and future requirements and characteristics of the market, from the current technologies power, based on the process, which is defined as an activity that, taken together, lead to a result with a value on the market for a client / consumer, so to a new product or service.

Procedures for such an orientation approach and redefining the activities of an organization were called reengineering the organization. This orientation and redefinition is required by the three forces, **c**ustomers, **c**ompetition and **c**hange, three C, with new definitions and characteristics in relation to what they represented so far:

- **Customers** are the ones who decide beside the suppliers: what they want, when they want, how they want and how they will pay. This is different than what the market is called "mass produced" (mass market), especially the industrial market where the customers are professionals.
- **Competition** is intensifying in terms of the customs barriers fall, so the market globalization. The performance which is required that the standard is represented by the low price, high quality and best services. Any firm that does not rise to the level of these standards required internationally is in danger of disappearing.
- **Change** is accelerating like rhythm with market and economy globalization, when companies are faced with several customers competitors, each of them may introduce innovative products and services market, especially in the technology development condition. It was reduced life cycle from years to months even for a large part of the goods. Firms cannot enter the market in time, in this new rhythm, with innovative products and services, so the companies which do not "moving fast" almost certainly will disappear (no longer move at all).
- The "three C" to which I referred have created a new world of market and business, where are imposed the stringent requirements on the flexibility and the response time to meet a demand for innovative products and services that for the implementation of which should be a responsibility accompanying the process and is triggered by the request of each product or service.

Results

In reengineering, the processes have to be redesigned; a new labour context must be defined, all under the impact of technology, which enables the concept of reengineering. Reengineering a company actually changed very much, if not all in one company, in what is defined as being essential elements " an aces system of a business" (business system diamond) work processes and structures, management and measurement system , organizational culture (values, beliefs).

Problems and challenges of the current period, which require reengineering as a solution to enable fundamental changes can be grouped into four categories:

1. Important changes in the parameters and the rules that define the competition: the economies on the "scale" and mass production have been marked by the absence of the innovation in the product design and manufacturing of low quality products. Now organizations are faced with new requirements: a greater flexibility in their work, introducing the quality products on the market faster than competitors, maximizes revenues from sales of products/services in a lower life cycle of these. These requirements are added a dynamic competition in the global markets, forcing the

organizations to reconsider the fundamental existence, focusing on the cyclical goods introduction on the market and the innovation strategy.

2. Structural and organizational capacity to implement change to "jump type" major, fundamental. In an organization, bureaucracy and mentalities resist to the changes. Often the changes are accepted by consensus, which often leads to the option for the lowest common denominator that, in contrast with the option for innovation, which would correspond to the highest level, according to the new requirements. Under these conditions reach steady state characterized response to changes in place to initiate change, especially for senior management of the organization, which inevitably can only lose to competitors who have an innovative behaviour.

3. Innovative systems are either ineffective, or insufficiently adapted to fundamental changes in the organization. Conservatism in the making or development of the information systems may lead to high operating costs, the duplication of efforts, fragmented solutions, the system's role reducing in automating of the existing processes rather than changing them satisfied the requirements listed.

4. Advanced technologies are not sufficiently well managed to make major changes. Issues of management are to understand how to make a new structure and how to change processes to make the most of IT innovations: distributed and parallel processing network connection, wireless communications of the relational databases, CASE methodologies, etc.

For these basic questions there is not a type answered and not a single model or is not directly intended. In this uncertain world, the companies must be highly mobile and highly receptive to the continual and very rapid developments because a immobility business lead to its disappearance.

The system must allow all those entitled to act according to their assigned privileges (consolation, insertion, correction, modification, etc.) and in the perfect knowledge on the stage where this information is (under the development, under the stage of correction, final, etc.) corollary of these features consists in an organization of the data based on a standard configuration and a normalized of the data exchange. The virtual enterprise (zero defects, zero paper, and zero inventories) is now the ideal that is wanted to be touched.

In the CAM system there is FMS - Flexible Manufacturing System. It is defined differently from a country to another, but in essence it is a manufacturing entity capable to produce a wide (family) of discrete products with a minimal manual intervention. It includes work stations equipped with the capacity of production (numerically controlled machine tools or other equipment assembly or treatment) linked by a material handling system for the purpose of moving parts from one work station to another, serve as a fully integrated system with a complete programmable control.

The rapid advance in the computer industry has led to the wide using computers area, at an acceptable cost, to conduct the machine tools with numerical control - MUCN. This was driven by the trend deeper increasingly to enhance the automation and control of the manufacturing processes and to make processing lines, the auto companies which are led by the computer.

Depending by the capacity of the computer used and the mode of the action there are two types of the control systems by the computer of the machine tools:

1. CNC - Computerized Numerical Control systems that use low-capacity computers to control a single machine tool, or more identical machines that running the same operation through a rigid program;

2. DNC - Direct Numerical Control systems, which use high-capacity computers for centralized control of a group of machine tools through a flexible (interactive) program.

CATIA v5 platform is available both on Windows and UNIX. Together with ten new products incorporated in this new version (released in Paris on 17/11/2000). CATIA reaches a total of 60 programs. These applications can be used in the mechanical design, analysis of the parts conduct, equipment design, simulation of the various movement processes, studying the comportment of the parts in the different environmental factors.

With these new facilities, CATIA v5 covers all stages of design and manufacture of the equipment. Providing a maximum of productivity, this product with unique capabilities modelling can integrate the related applications. For these reasons CATIA is used as a standard platform in many areas.

In CATIA and ENOVIA, the aerospace industry, are considered a standard, with over 22,000 workstations. IBM is a consultant, providing the service or providing a full system for the first 12 companies producing by the commercial airplanes in the world. Among these can be mentioned Airbus, Boing, Bombardier, Eurocopter and Lockheed Martin.

CATIA solutions of IBM PLM (Product Lifecycle Management), figure 3, provide a very rapid development in the automotive industry, by reducing the time when it is created a new model. Thus CATIA was chosen by 20 of the 30 top global producers of automobiles. The three beneficiary segments of the new CATIA v5r5 product are: the 1st formula, automobile manufacturers, manufacturers of buses and trucks.

In the 1st Formula CATIA is used by Ferrari, McLaren, Honda, Mercedes and others. This product is used for making locomotives, wagons and other railway equipment, in the ship industry and for the navigation equipment. Also, it is considered the ideal solution for the production the electrical and electronic equipment being used by companies like IBM, Panasonic, Sony, Samsonite, Lore, Grunding and others. It is an ideal product for the construction and optimization of the moulds, dies and tools in the automobile industry field.

Each of the beneficiary companies have one big advantage with CATIA V5 because it is very easy to use, has an increased flexibility and scalability, and capture and reuse the knowledge leading to increase the productivity, cost reduction and, finally, at the increased competitiveness of the company.

ENOVIA is an Internet portal that is part of e-business solutions of the Product Lifecycle Management. With this portal there is possibility of collaboration during the product development in the design phase. Thus, the production of the equipment can take less because the participation of the engineers and beneficiaries at the new product. Because all information is conveyed through the Internet, the time decision and transport are dramatically reduced.

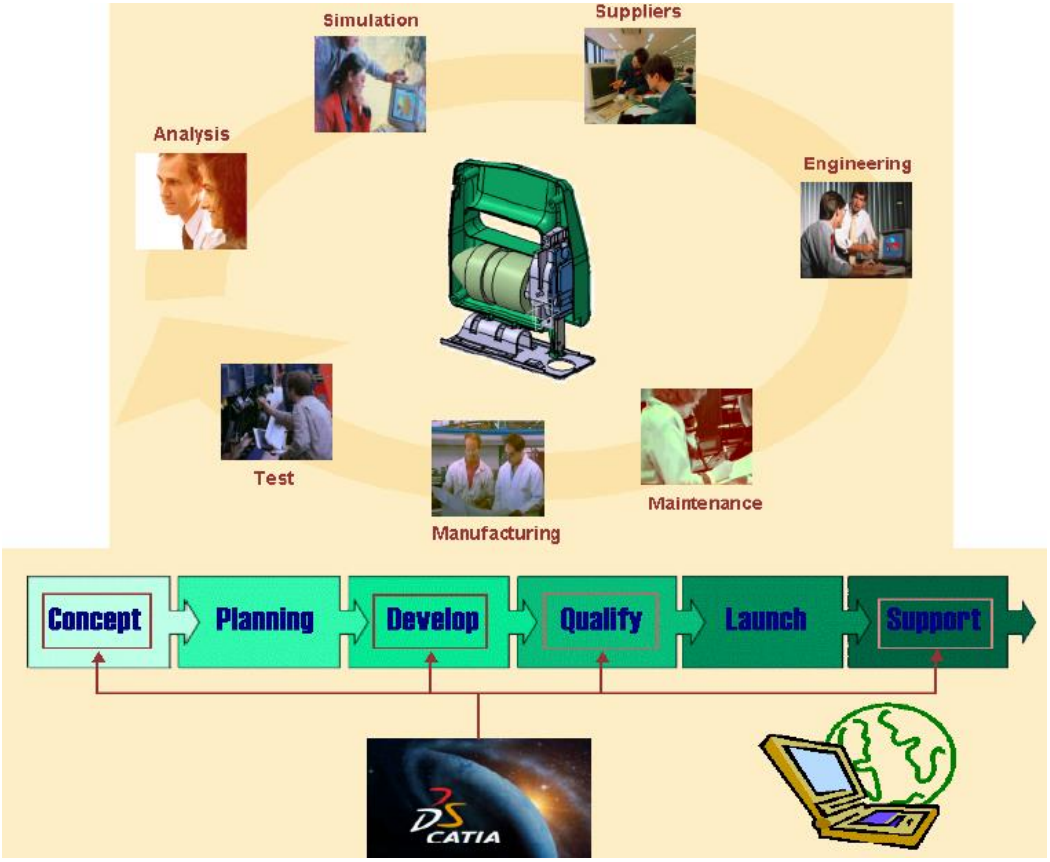

Figure 3. The concept of PLM (Product Lifecycle Management) of CATIA V5

Developing the CAD techniques (Computer Aided Design) and CAE (Computer Aided Engineering) creates new opportunities for a significant integration of the reliability considerations from the beginning of the design process of the dies and moulds.

The spread of computer stations and networks, of the advanced methods of computer simulation, provides to the design engineers and specialists from the reliability the possibility to use the data and the analysis methods during design, to:

• Evaluate the different characteristics of reliability, as dies or moulds are created in a CAD modelling environment;

• Identify the failure modes and failure analysis for reliability prediction using the computer simulation before to prototype manufacture and testing of moulds or dies;

• Simulation of the manufacturing process together with the anticipated effect of the design changes on cost and efficiency of production;

• Finding and rules that help the design engineers in the efforts for optimizing the reliability characteristics with other performance characteristics of dies and moulds.

Although the mechanical systems data are relatively low, by adapting the methods of simulation and the CAD packages available, it can be created a working environment so that they become part of the mechanical design for reliability.

Conclusions

For the design of dies and moulds can use advanced methods for simulation and CAD packages for geometric modelling, structural analysis, dynamic analysis, thermal analysis, precision design analysis, etc.

Currently, some of these methods are used in the design departments, but it is necessary to adapt, integrate and implement these methods as the design engineers and experts in reliability.

Using the new methods of CAD/CAE design leads to improvements in dies and moulds, involving specialists in the design of reliability, which provides:

- Use the results of reliability analysis and optimization by the design engineers;
- Use of simulation techniques from the beginning of the design;
- Increase the capacity of organizes the data flow, reducing the feedback time and providing the automatic updating of the database embedded;
- Improved the design by involving the reliability specialists in the design process, both directly and through the implementation of algorithms for reliability design used by designers;
- Significant improvement of the communication and data transmission between designers and reliability specialists.

The immediate potential for applying the CAD/CAE methods for the reliability design of dies and moulds, depends on the use:

- Graphics-based on the workstation that allows interaction the CAD design with the simulation methods at the moderate cost;
- Powerful workstations, equipped with the latest generation capabilities of computer at the affordable cost;
- Networks of computers equipped with software to allow the using of the full workstations and servers, as well as decreased time access to the central databases;
- The CAD industry transition to producing the design systems aided by the computer which can create the geometrical patterns that support analysis and design simulation.

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