

**AN EXPERT SYSTEM FOR NEW APPROACHES FOR
DEVELOPMENT CONCURRENT DESIGN FOR ASSEMBLY
AND MANUFACTURING PROCESSES**

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Abstract

An expert System construction on technological operations of machine parts processing is from the area of the information systems for the technology of the machine building. The important question in such a system construction is the collection and presentation of the information from different areas of science and technology in the multimedia format. The application of this information will be directed on the users from one area of the technology, i.e. for engineers-technologists of the machine-building profile. Main principles of expert system development and software realization have been stated. The possibilities of the system offered to users by teaching tools have been given. Short descriptions of methods used for the info-system organization and models of the information presentation have been formed.

The main objective of the current research work is to construct an expert system to develop the theoretical bases that support new approaches for design for assembly and manufacture within a concurrent engineering environment.

The system gives users the possibility to assess and reduce the total production cost at an early stage during the design process. The system enables designers to select the most economic assembly and manufacture techniques and appropriate tools.

The system help designers to minimize the number of components of product and estimate assembly cost, assembly time and efficiency design.

Keywords

Technological process, Concurrent engineering, Design for assembly, Design for manufacture, Info-system, Internet-technology, Multimedia, Teaching tool, Computer-aided design, Expert system, Object-oriented programming.

Introduction

In today's increasing of competitiveness of products released by competitive product market the reduction of product manufacturing costs is of a great significant. Products become more complex and highly integrated.

There is no doubt of impact of product and process design on manufacturing cost, therefore, decisions made at this stage have direct impact on the product's manufacturing costs. Researchers estimate that more than 70% of product cost is defined during design stage [1].

Designers or design team find it increasingly necessary to have a system with a common language, independent of traditional engineering disciplines. The system should provide quick results and be simple and easy to implement. It should also allow free association of ideas, enable easy comparison of alternate design, ensure that solutions are evaluated logically, identify assembly and manufacture problems areas and suggest alternate approaches for improving the manufacturing and assembly of product.

Therefore, it is expedient to carry out search of new ways and methods of development of manufacturing and assembly methods in view of the opportunities given by the high-productivity tool and the equipment. However cost of the modern equipments and tools sometimes exceeds ten times than traditional cost. Without the detailed economic calculation which is taking into account all costs of the factory on a wages, cost of working areas, the electric power, capital investments and other parameters to calculate economic efficiency of a heading of the simplified approach at choice the tool when are oriented only on its cost, does not justify itself and can considerably reduce economic efficiency of used production engineering.

The objective of the present research it is to construct an expert system using Kappa-PC to develop and support the new approaches of design for assembly and manufacture which gives its users the possibility to asses and reduce the total production cost at early stage of the design process. Design for assembly and manufacture (DFAM) are now an accepted techniques and used widely throughout many large industries including Lucas, Mercedes Benz, Nissan motors, etc.

Experiences have shown that DFAM analysis provides much greater benefit than simply a reduction in assembly costs. Many examples are now available which show that the product simplification brought about by DFA analysis often leads to parts cost reductions that are significantly greater than the reduction in assembly costs [2]. In addition, to other cost reductions which are difficult to quantify. Examples of these would be reduction in inventory, reduction in record keeping, improvements in material flow and production flow and other benefits.

Problem situation

The simplified approach at sampling the tool when are oriented only on its cost without taking into account productivity, durability and other parameters, does not justify itself and can considerably reduce economic efficiency of used production engineering. It conducts to rise in price of released products and accordingly to decrease of its competitiveness.

The increasing of techniques for assembly and manufacturing process, and increase the different estimation of efficiency economy for such process.

Solution of the above-stated tasks requires operating with the large volume of information, that is difficult for the designer because of the width and the variety of the existing data. The creation of the concentrated structured information as an expert system (teaching tool) with the sufficient volume for correct understanding and the possibility of easy operating with the presented data will allow technological personnel develop optimum technological processes and equipment satisfying given requirements.

The goal of the system construction is the increasing of the design effectiveness of the technological processes in the machine-building by optimum choice of the method of processing under given conditions.

There is a scientific and practical interest in forming expert system with multimedia elements of assembly and manufacturing processes. The important question in such a system construction is the collection and the presentation of the information from different areas of science and technology in multimedia format (video-films, pictures, description, etc.) with the use of the Internet-technologies [1]. The application of this information will be directed on the users from one area of technology, i.e. for engineers-technologists of machine-building profile. The ground for compiling the database on the methods of the machine parts processing is the world patent and research information, processed by experts for using in the determined area - the technology of the machine building [4].

The development of the expert system as teaching tool with multimedia elements about assembly and manufacturing processes with concentrated information on patents and research literature from different areas of science and technology will allow increasing the knowledge level of the technological personnel, the speed of the application of the advanced methods in the production, the new technological process development. Tasks have been solved by the system:

- decrease of the time expenses for the search of the technological methods for the given conditions;
- teaching the users (help in understanding) how to use the technological operations from different areas of science with the help of the multimedia and Internet-technologies;
- taking into account all possible methods of processing of the machine parts, including those from other areas of the science and technology;
- using a suitable dialogue interface;
- development of the detailed concentrated information on methods of processing with the graph- and video- explanation of the technological operation realization;

- the use of the expert and reference information on methods of processing functioning (including on equipment, technological modes and etc).

System capabilities

The system has capability to help designer and user to quantify the following:

- Select methods of manufacture and assembly with the best technical and economical indexes.

- Select the right manufacturing tools and equipment.
- Reducing the number of parts of the designing product.
- Determine the design efficiency.
- Determine the manufacturing and assembly operations cost.
- Determine the manufacturing and assembly operations time.

Conclusions

Developed new methods will allow:

1. To estimate the cost price of products at a stage of adoption of design solutions.
2. To lower expenses of production by development and introduction of new production engineering at the machine-building factories.
3. To facilitates communication between manufacturing, design engineering, decision-makers and others during design process.

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