Assoc. Prof. Ing. Jozef Novak-Marcincin, PhD.
Faculty of Production Technologies TU, Presov, Slovakia

INTEGRATION OF CAPE SYSTEMS (COMPUTER AIDED PRODUCTION ENGINEERING) TO CIM STRUCTURE

Computer technology equipped with suitable software is advantageously used in various branches of practise at present time. It is difficult to imagine the development and production of new products in modern enterprise without exploitation of appropriate computer aided systems. Most of present CA systems are mainly determined and used in the area of computer design of new products, but only complete application of these modern computer technologies to all periods of product manufacturing, can bring the maximum profit for the enterprise.

1. INTRODUCTION

Main area of CAM (Computer Aided Manufacturing) systems application is creating of computer aided programme for CNC production devices. However, CAM systems do not sufficiently cover all periods of production process and due to this, the necessity to define the systems of Computer Aided Production Engineering - CAPE. CAPE is a subsystem of the system CIM including the computer aided systems of all activities connected with realization of product. CAM systems are used only in the area of CNC production technique programmes creation. There are also others processes of product manufacturing process for example: automated work-in-process transport and product storing, automated handling with the products, performing the measurements in automated inspection stands, etc. Following these facts, CAM systems do not sufficiently cover all stages of production process and so it is neccessary to define the systems of Computer Aided Production Engineering - CAPE [2, 8].

2. HISTORY OF COMPUTER AIDED PRODUCTION ENGINEERING

In the early 1990s, due to the economic recession, more industrial firms worldwide suffered a severe downturn in bussines. Most important factor for surviving was ability to reduce costs. In the mid-'90s, with a renewed and booming, customer-driven market, business success is contingent upon coming to market faster with new products and building up output to meet the increasing demand. The automotive industry was one of the first industries to respond quickly to consumers diverse tastes and products shorter life cycles. On example the average development cycle of a vehicle was reduced from seven to five years, with three years as the current goal. But this goal cannot be achieved by compromising on quality. Quality is no longer only a selling feature but also a basic element of any product - this is one of the rule in todays competitive market. Thus, manufacturers have begun to look closely at their current methods and examine how they can increase their products offering while meeting three major challenges: shorter time of product from production to market, increased quality, lower manufacturing costs [3].
Shorter time of product from production to market requires more efficient and productive development tools. Increased quality means verification and analysis of the manufacturing processes to check that they comply with design intent. Cost savings can be generated through productivity gains, reduced capital investment, better allocation of manpower, efficient management of design changes and reduced overheads.

We have to study the impact of each investment on the complete development and manufacturing process when we want to make right decision where to invest. Over the past few years, manufaturers invested heavily in the two ends of the industrial process:

- the product design phase by install CAD systems (CAD - Computer Aided Design),
- the production phase by application of automated devices.

CAPE started as an off-line programming tool for automated manufacturing equipment. Its prime purpose was [10]:

- to program robots off the shop floor,
- to provide the operators a safer working environment,
- an efficient tool to perform trial-and-error routines,
- a reduction in maintenance and troubleshooting efforts,
- better use of the production equipment for real manufacturing purposes rather than preparation work.

Soon the advantages of using CAPE tools upstream became clear. It was neccessary not to use CAPE only for programming equipment, but also use it up-front, for designing the whole workcell. Enhanced CAPE tools enabled manufacturing engineers to design the complete workcell in a faster, optimized and error-free fashion. The ability to view the equipment working in a manufacturing enironment allowed for much tighter designs with less error margins, as well as more accurate time and flow calculations. Thus, CAPE took a significant step forward.

3. THEORY OF COMPUTER AIDED PRODUCTION ENGINEERING

CIM (Computer Integrated Manufacturing) represents the integration of traditional production technologies with the computer technology. This enable the automation all activities from product design to their expedition (design of products, creation of technological procedures, production planning, operative control, manufacturing of products, quality control, assembly, packaging, expedition, etc.) [1, 9]. The strategy of complex computer integration is not only goal, but in many firms it is also reality. Slump of prices of computer components and increase of computer power in connection with modern software technologies, new progresive technologies condition bring orientation on modern information technologies are using in many firms. The CIM systems is not represented by complex wholes, or they are compile by integration of Computer Aided Systems, composition which is shown on Fig. 1.

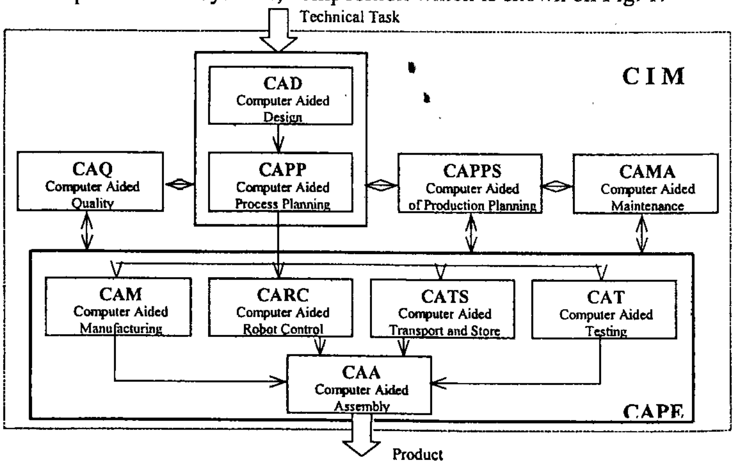

Fig. 1 Organization of CA systems in CIM

Computer Aided Production Engineering (CAPE) is a subsystem of the system CIM including the computer aided systems of all activities connected with realization of product (programming of manipulation, machine tools, transport and store devices, measuring, testing and diagnose of parts and assembled product). This stage of computer aided systems in complex CIM fluently establish on applicaton of computer aided systems in technical (construction and technological) preparing of production and is inevitable for secure of concurrent engineering conditions.

Main subsystems of Computer Aided Production Engineering can be [11]:

a) *CAM (Computer Aided Manufacturing)* - these are systems enabling data and programme preparation for controlling of CNC machines in automated production of mechanical parts which use geometry and other data acquired during period of CAD design.

b) *CARC - Computer Aided Robot Control* - it is a part of off-line robot and manipulator programming, when programme of robot activities is prepared apart from working-place, in computer. After simulation and optimising of activities of the model of automated working-place with robot, the system creates controlling programme, which is possible to be used for concrete robot control system after postprocessing.

c) *CATS - Computer Aided Transport and Store* - these systems enable computer programming of activities of automated work-in-process transport performed mainly by inductive transport, but also by portal transport systems, by cylindrical and other conveyors and also by automated way of storage using high-shelf automated systems.

d) *CAT - Computer Aided Testing* - mainly, it is controlling and manipulating with 3-axis measurement machines by computer, programming of automated measurement stands, computer evaluation of measured data, etc.

e) *CAA - Computer Aided Assembly* - it represents last period in process of completely automated realisation of the product composed from several parts and it includes such areas of computer support as, for example, programming of automated assembly machines, flexible assembly equipment, etc.

All of the above considerations lead to the conclusion that graphic computerized process planning holds huge potential for improvements on all fronts. This is even more so considering the fact that changing a product design is almost always less costly than changing the manufacturing process. The enabling technologies for CAPE (Computer Aided Production Engineering) emerged only in the mid-'80s. Simulation, advanced graphics, motion emulation and powerful computers to support them all matured to the extent that CAPE technology could be brought into economically justifiable use [12].

A typical task is to design a complete manufacturing process of a production engineer by using a CAPE tool. He creates a graphical representation of a factory workcell in his computer. Then he imports the products geometric 3-D CAD data. He selects the appropriate production tools from electronic reference libraries, where all the capabilities and features of these tools are kept together with their respective geometric data. Then he designs the process in this virtual manufacturing environment. It was beginning to several new terms in the industrial world: digital mock-up, master model, electronic prototype - all names for the same concept - refer to a single database that contains all the product data, and is consistently updated with the latest changes. This database will allow all departments involved in the same project to work on the most recent data. CAD integration technology allows CAPE to create the production master model by directly accessing the CAD master model at the front end of the industrial process. It actually facilitates a CAPE database that both complements the CAD database and holds all production-related data. At the back end of the development process, CAPE has to provide a smooth transition to the manufacturing equipment. Fallowing this aim, a European forum was established consisting of automated equipment vendors, CAPE and computer-aided robotics vendors, and their customers [16].

4. CONCLUSION

CAPE technologies has evolved from a simulation and offline programming tool to a mainstream production engineering tool. It is tightly integrated with the other computerized and automated tools in the industrial development cycle. The challenge industrial concerns are facing now is to keep abreast of this evolution, and to build their organization in such a way as to fully capitalize on the benefits of CAPE. There is already a severe shortage of trained CAPE users, and turnover rate of personnel can reach 50 percent. Colleges and dedicated technical centers are falling short of demand.

ACKNOWLEDGEMENT
This work was supported by Research Grant Agency of the Slovak Minister of Education, contract No. 1/7290/20 „The Analyses of the Virtual Projecting Methods and their Syntheses in Techniques of Computer Aided Production Systems Design".

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Reviewed by K. Vasilko