1TH INTERNATIONAL WORKSHOP "ADVANCED METHODS AND TRENDS IN PRODUCTION ENGINEERING"

THE PLACE OF CAPP SYSTEMS IN AREA OF COMPUTER AIDED PRODUCTION ENGINEERING

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Abstract: *Computer-Aided Process Planning (CAPP) or automated process planning is an approach that uses computers to generate a process plan. When constructed properly, such a system can satisfy the above mentioned needs. However, the task of automating the process planning function is not a simple one. No single algorithm can model the complexity of the thinking process of an experienced human planner. The development of CAPP started in the late sixties.*
Key words: *computer aided process planning, computer aided production engineering, CA systems*

1. INTRODUCTION

The manual process planning is often a tedious and time demanding engineering process and it is one of the labour activities in the preparatory stage of manufacturing. There are many routine, heuristic, deciding and intuitive activities used by a engineer. There is an effort for these activities to be supported by computer.

Computer support can markedly help to solve some planning activities. Computer aided process planning (CAPP) system is software for the automated design of route sheet. A number of reasons can be identified for the advance of CAPP systems. There are amount of process planning departments in small batches where a skilled workforce is scarce. Many companies have different process planners make different process plans for the same parts, resulting in inconsistencies and extra paper work. CAPP systems can help in overcoming these inconsistencies. Computer Aided Process Planning aids in creation of process plans for manufacturing and increases the flexibility of manufacturing. Process planning is a task which requires a significant amount of both time and experience. Computer support or computerised process planning systems can help reduce a process planning time and increase plan consistency and efficiency.

2. COMPUTER AIDED PROCESS PLANNING (CAPP)

The computer aided process planning (CAPP) represents the implemented methodology of process planning in the software package. The CAPP includes all process planning activities needful to realize of the design of the process plan. The CAPP system has to solve the planning activities such as selection of machining operations, selection of machine and cutting tools etc.

The CAPP is concerned with the preparation of a route sheet for the engineering drawing. The part must be interpreted in terms of manufacturing process to be used. The route sheet is a listing of the sequence of operations. Closely related to the process planning are the functions of determining appropriate cutting conditions for the machining operations and setting the time standards for the operations [1].

The CAPP is often a heart of the CA systems in the engineering enterprise. Input for the CAPP system is output from the CAD system. Output from the CAPP system is at the same time especially the input for the CAM system. One can often to meet the integrated the CAD/CAPP and the CAPP/CAM.

Early attempts to automate process planning consisted primarily of building computer aided systems for report generation, storage, and retrieval of plans. A database system with a standard form editor is what many early systems encompassed. Formatting of plans was performed automatically by the system. Process planners simply filled in the details. The storage and retrieval of plans are based on part number, part name, or project ID. When used effectively, these systems can save up to 40% of a process planner's time. Recent developments in computer-aided process planning have focused on eliminating the process planner from the entire planning function. Computer-aided process planning can reduce some of the decision making required during a planning process. It has the following advantages:

1. It can reduce the skill required of a planner.
2. It can reduce process-planning time.
3. It can reduce both process-planning and manufacturing costs.
4. It can create more consistent plans.
5. It can produce more accurate plans.
6. It can increase productivity.

The benefits of computer-aided process-planning systems have been documented.

Two approaches for computer-aided process planning have been pursued: variant and generative. The variant approach uses library retrieval procedures to find standard plans for

similar components. The standard plans are created manually by process planners. The generative approach is considered more advanced as well as more difficult to develop. In a generative process-planning system, process plans are generated automatically for new components without referring to existing plans. The details of these two approaches are discussed in the following sections. Fig. 1 represents the structure of a complete computer-aided process planning system. Although no existing turnkey system integrates all of the functions shown in the figure (or even a goodly portion of them), it illustrates the functional dependencies of a complete process-planning system. It also helps to illustrate some of the constraints imposed on a process-planning system (e.g., available machines, tooling, and jigs).

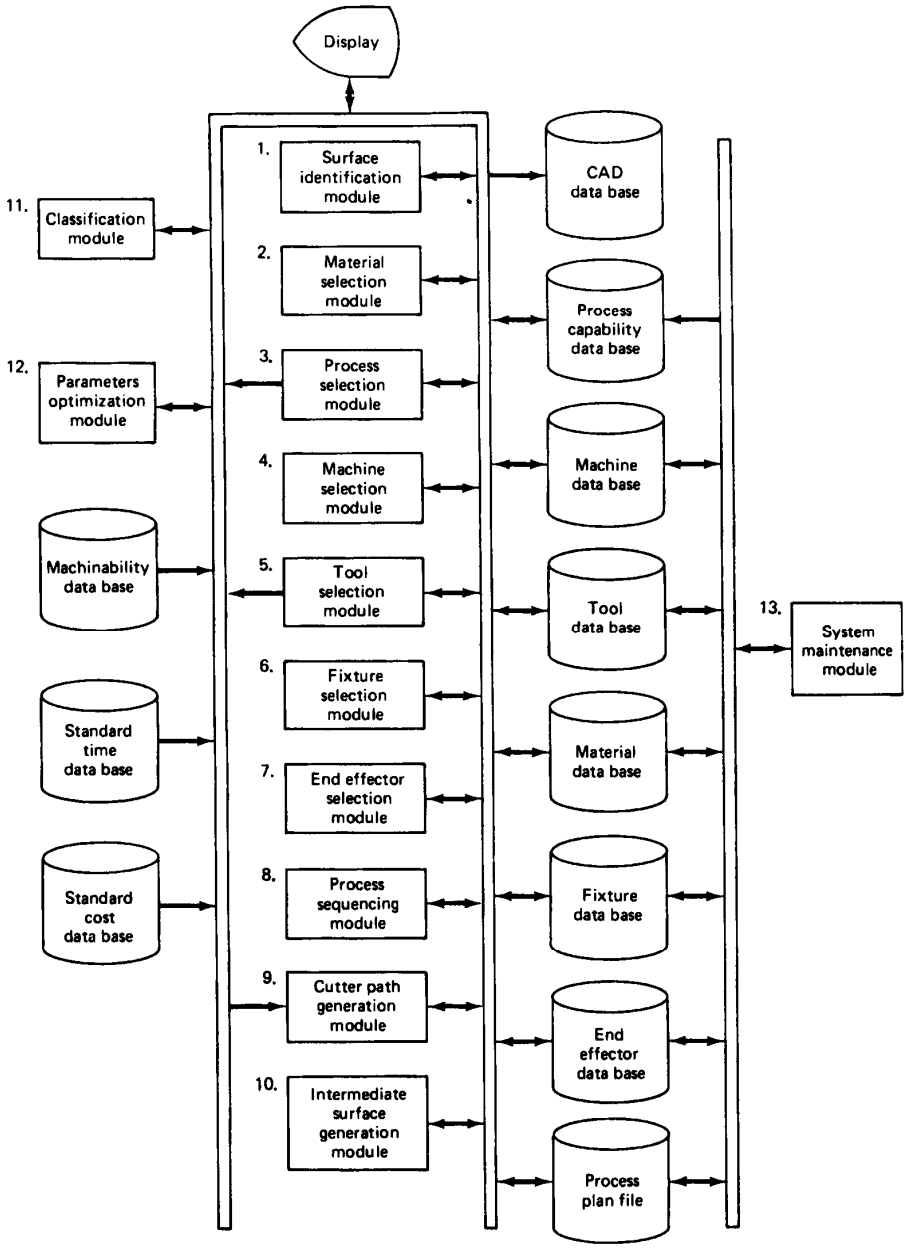

Fig. 1 Process planning modules and databases

In Fig. 1, the modules are not necessarily arranged based on importance or decision sequence. The system monitor controls the execution sequence of the individual modules. Each module may require execution several times in order to obtain an "optimum" process plan. Iterations are required to reach feasibility as well as good economic balance [2].

Process planning is the critical bridge between design and manufacturing. Design information can be translated into manufacturing language only through process planning. Today, both computer-aided design (CAD) and manufacturing (CAM) have been implemented. Integrating, or bridging, these functions requires automated process planning.

3. PLACE OF CAPP IN COMPUTER AIDED PRODUCTION ENGINEERING

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 manufacturing (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 [4]:

1. CAM - Computer Aided Manufacturing.

   These are systems enabling data and programme preparation for controlling of NC machines in automated production of mechanical parts, full assemblies, electronic circuits, etc, which use geometry and other data acquired during period of CAD design.

2. 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.

3. 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.

4. 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.

5. 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, exploitation of special virtual reality systems determined for assembly technology planning, which can verify suitability and optimal composition of assembled components, suitability of manual assembling and ergonomic aspects of manual assembling (for example to ensure enough free space for hand of the worker in order to manipulate with assembled part without problems).

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 [3].

However because these automated tools become industrial standards nowadays, manufacturers have to look elsewhere to maintain improvement and competitive edge. This is the reason why many top manufacturers are increasing their use of Computer Aided Production Engineering (CAPE) tools as part of Computer Integrated Manufacturing (CIM).

Computer Integrated Manufacturing (CIM) represents the integration of traditional production and engineering technologies with the computer technology, which 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.), with goal to bring down of the material and energy pretension, to increase of work productivity, to bring down of supplies, to shorten of development and production time, to increase of time and power utilize of production devices and ti increase of products quality [3, 4]. The strategy of complex computer integration is not only goal, but in many firms it is also reality. The CIM systems in most cases is not represented by complex wholes, or they are compile by integration of partial automated systems - CA systems (Computer Aided Systems), composition which is shown on Fig. 2.

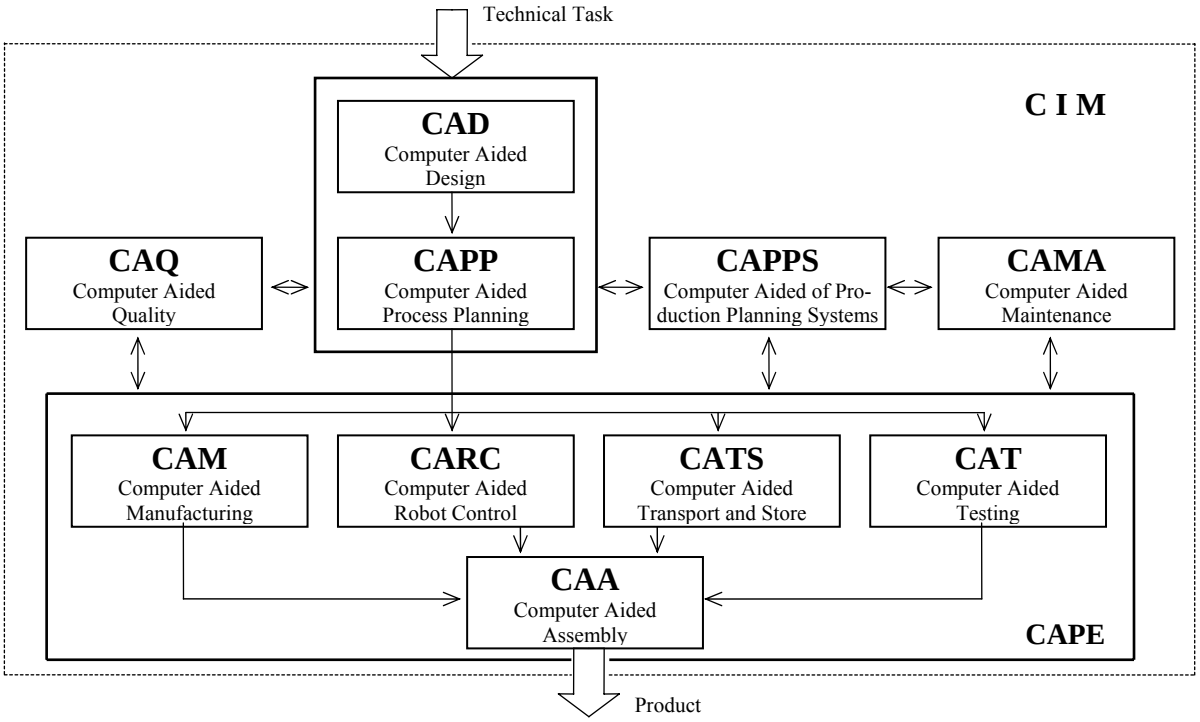

Fig. 2 Organization of partially CA systems in CIM complex

4. CONCLUSION

The development of Computer-Aided Process Planning has been around for more than two decades. At the beginning, the approach was to find optimum machining parameters and cut distribution. Then, the approach evolved into report generation and documentation retrieval. In the later case, Group Technology was used to help locate similar parts, thus becoming process plans. Paper was prepared in time of realization of VEGA project No. 1/0405/03.

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