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INTEGRATION OF KNOWLEDGE BASED PROGRAMS IN CAD-APPLICATIONS

Summary: The paper presents possibilities linking knowledge based programs to CAD-Software

Introduction

The engineering design department is one of the most important data producer and user within a company. When starting with electronic data processing often hardware for the commercial tasks and after that a CAD-system for the engineering tasks are invested. This investment aims primarily at fast drawings, data exchange to MRP-sytems and NC-manufacturing.

The terms "integration" refer within data processing mostly to the complete concept for different departments and of different computer systems. The long-term target is a total integration of all CA-systems including MRP, they are comprehended under the term "CIM".

Because of the big variety of computer systems for different purposes complete integrated hardware and software concepts can be found only very seldom in practice. Problems exist already when using hardware from different producers between the operating system and data format. There are standards for the data transfer between and within CAD-systems available like IGES, VDA, DXF, GKS etc.

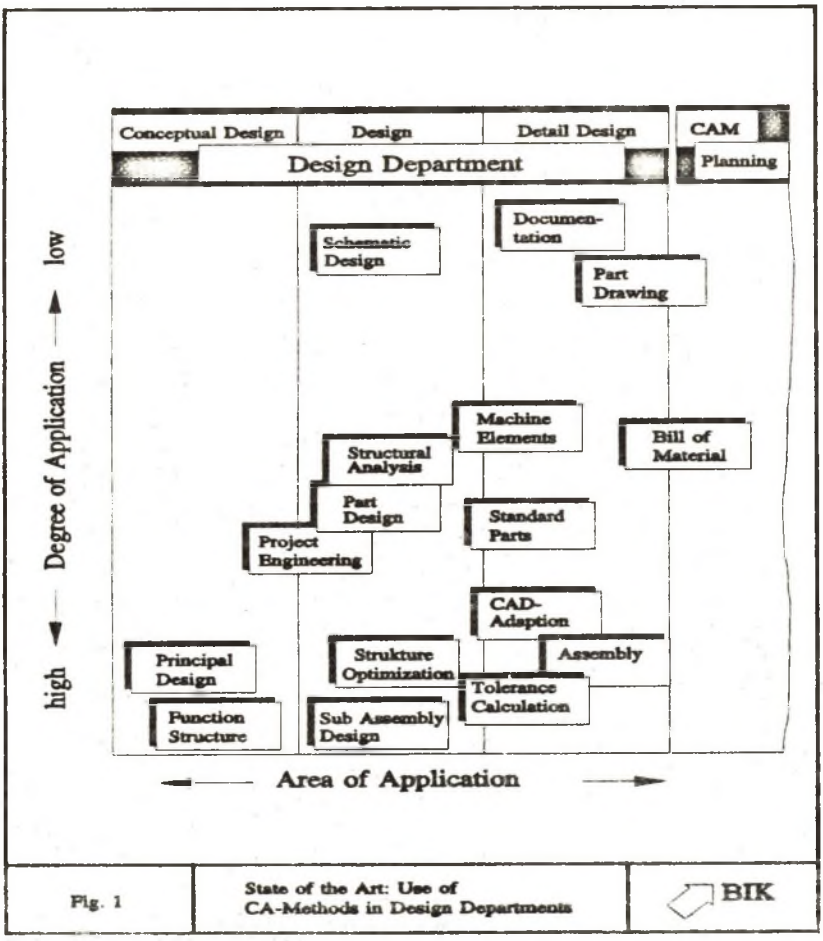
Computer aid during engineering design

Analyzing the activities in an engineering department using CAD demonstrates that the main task is furthermore the geometric description of the parts and assemblies. Therefore

the essential development for CAD-systems are straigthened to fasten the necessary time when designing the geometrics and it is aimed to improve the CAD/CAM-integration in the respect that the geometric data like tolerances and surface roughness.

The second important activity of the engineers is the procurement of informations.

The state of the art concerning computer aid in the engineering design is shown in fig.1. The focal point is within the phase of drafting.



During the conceptual phase which is more straigthened with fundamental problems more basic informations are needed. This phase is not or only a few supported by computer systems.

In the phase following the concept finding more computer applications are available, for example for dimensioning purposes or for structure analyzis (FEM, BEM). But the engineers only accept this computer systems partially, again because of missing data exchange or because of too complicated theory like at FEM or BEM.

CAD-interfaces

The interfaces have to guarantee a completely accurate data transfer as a basic for a workable data exchange. There are system-specific and neutral interfaces.

IGES has not the possibility to transfer technology data. SET claims to allow the data transfer for all CIM-data but it did not put through in the international industry. VDA-FS was developed for the transfer of curved surfaces. The system is limited in geometrical data. The interface STEP is just in the stage of developemt or better of definition. With this interace all data appearing during the products' life cycle shall be transferred. This development is a long-term task, therefore IGES will be the most important tool for the transfer of geometry data for the next future.

Some examples shall prove what can be done already today without the STEP interface.

Similar parts identification, Part of CAD-systems

There are different statistical data which prove the necessity to check the possibility of using already designed parts and subassemblies in new designed products. These statistics are:

- ca. 70 % of the products costs are determined in the design office;
- ca. 50 % of the time in the design office is used for information purposes;
- ca. 80 % of a new designed machine consists out of similar or equal parts or by combining existing solutions, only
  20 % are new designed parts;
- the risk is higher with completely new designed machines.

The use of repeated parts and of standard parts offers big economical advantages not only in the designing office. But the engineer has to have simple working and geometry based systems to classify similar parts or to design new parts based for example on elements which were already designed.

Fig. 2 demonstrates only possibility to design variant parts. Based on shaft-segments which were classified due to their functions and to the geometry the system allows to design new shafts by combining these elements. With this system the

stan-dardized geometry has not to be defined by the user, the system itself combines the elements due to logical conditions and a complete part is offered by the system.

Since the shaft is connected out of existing elements also the manufacturing, material, drilling machinery, tools and NC-programming are exactly determined.

The technical drawing is produced automatically by the system, that means dimensions, surfaces and tolerances are specified directly after the combinations.

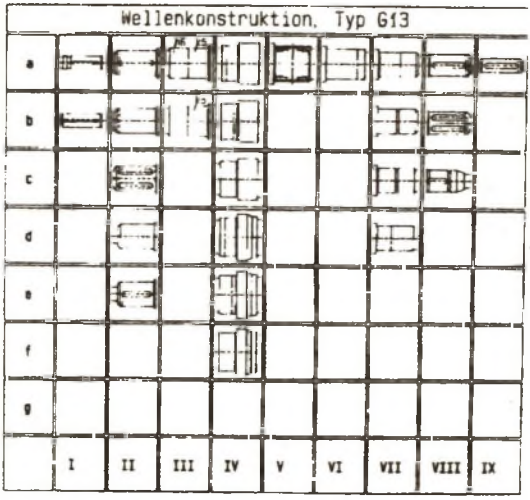
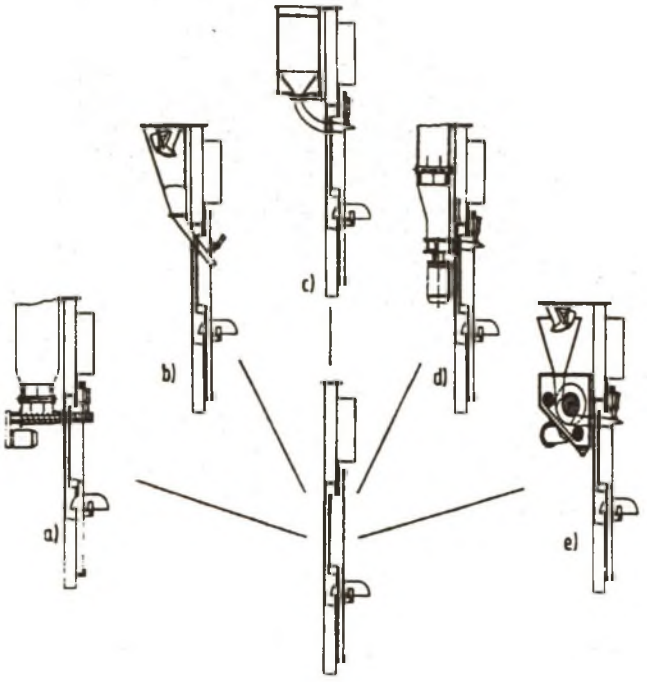


Fig. 2 System for Shaft Design Based on Parametrics BIK

Similar systems can also be conceived for assemblies. Fig. 3 presents such an example. The shown machines were analyzed and similar geometric structures could be defined for the necessary functions. After developing a structure which allowed to specify the general usable geometry by means of conceptual design methods a similar system as described for the shaft elements could be built up.

Moduls for dimensioning

One of the main tasks of the industrial designers is the dimensioning of machine parts. Most of the time they can be calculated by analytical methods or simplified FEM-methods. Very seldom those calculation rules where integrated in CAD-systems. FEM-moduls often include pre- and postprocessors to build up the necessary net. Of course, FEM-moduls have big



a) Screw Type
b) Gravity Type
c) Pneumatic Type
d) Turbine Type
e) Centrifugal Type

Fig. 3	Similar Geometry for Bagging Automatics	BIK

advantages in comparison to analytical methods and also dynamical or thermical problems can be solved with this method. On the other hand specific knowledge is necessary and due to costs and time the possibilites are not often used in practice.

Further possibilites exist in combining the numerical and analytical methods. This can be done for product specific solutions, this is especially helpful for designing variants. For example, FEM-methods or BEM-methods are used to calculate stress concentration factors for specific notches. With this factor then structures can be often calculated by analytical methods.

Existing CAD-systems offer the possibility for the calculation of areas, moments of inertia etc.

The use of data files about standard parts like screws, bearing etc. are available for easing the desing task. But it is necessary to present in addition the possibility for dimensioning these standard parts due to stress analyzis, costs volume and other criteria.

Only some of those dimensioning programs are joint to CAD-systems. Most of them are stand alone moduls and therefore they gained a minor acceptance in practice.

The user must have the possibility to start a dimensioning program out of the CAD-system to transfer either a drawn geometry to the dimensioning modul, to add technological data and to retransfer the calculated data to the CAD-system.

Fig. 4 demonstrated such a program which can be used either stand alone or in combination with CAD-systems and which offers both paths of data transfer. Specific files for material data, stress concentration factors, factors of safety etc. are integrated.

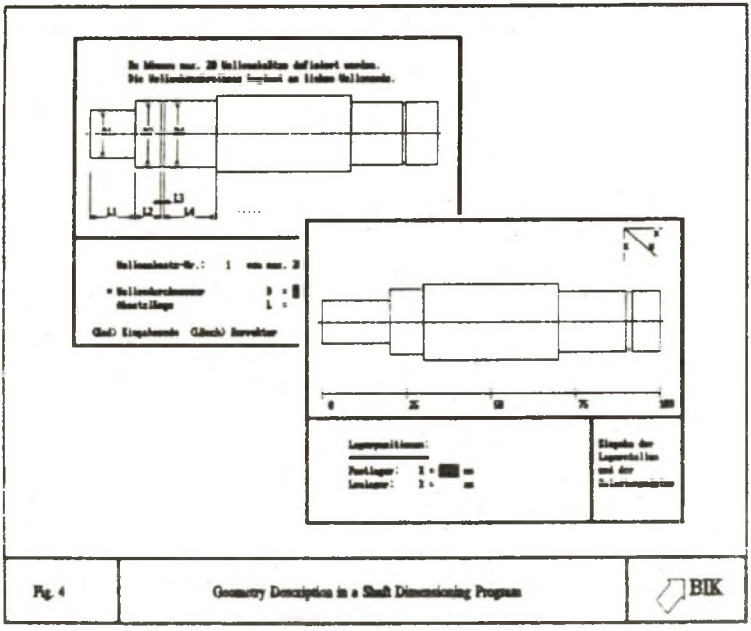
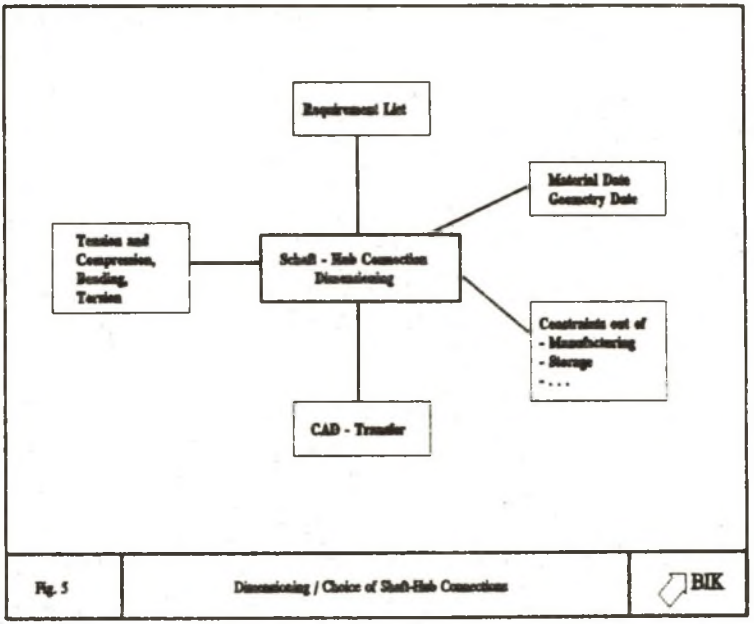


Fig. 4 Geometry Description in a Shaft Dimensioning Program

Similar programs are available or have to be developed for the different standard machine parts. Fig. 5 presents the scheme for the program of dimensioning and selection for shaft-hub connections. Ideas from the conceptual design

methodology are used to enter the program. Based on the requirement list the program selects possible solutions and offers these to the user. Connected to this selection modul are the different calculation programs for the shaft-hub connections. This is based on material data information by the suppliers etc. The calculated element is the transferred with all necessary data to the CAD-system.



Summary

The industrial design should be performed on one screen with one computer system. Of course, the basic system is CAD. Therefore additional moduls should be in close connection to the CAD-system.

The STEP-development is a very fundamental work. Until first interfaces are available other moduls should help the designer to fulfill especially his main tasks like getting the information, finding already designed similar parts and dimensioning. The engineer will by this be suuported by brought knowledge, on the other hand he should be not limitted within his creativity and within his experience by these moduls. The existing additional moduls were mainly developed at Universities, practical acceptance is seldom. Therefore, already before having the STEP-interface those programs should be added to CAD-systems and there are at the time being unused potentials which could be used for the above mentioned purposes.

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INTEGRATION WISSENSBASIERTER PROGRAMME IN CAD-ANWENDUNGEN

Zusammenfassung

In der Arbeit werden Möglichkeiten zur Integration von wissensbasierten Systemen in CAD-Software aufgezeigt.

INTEGRACJA PROGRAMÓW BAZ WIEDZY W APLIKACJACH CAD

Streszczenie

Artykuł przedstawia możliwość powiązań programów baz wiedzy z oprogramowaniem CAD.

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