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CAD: Promotional Funds by the Federal Government, Aims - Basic CAD-Conception - Present Situation, Trends

Fonds de promotion du government fédéral, objectifs - Conception de base du CAD (computer-aided design) - Situation actuelle, tendances

Entwicklungsprogramm der Bundesregieurung, Ziele - Grundkonzept CAD - Heutige Lage, Tendenzen

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Summary

The paper deals with computer Aided-Design-Activities in the German Federal Republic. By these activities a set of programme chains has been developed for the use of civil and structural engineers. In order to gain a wide application all the publicly funded programme developments must follow the CAD-Guidelines which contain regulations for programming and documentation. So by producing standardized user manuals the interface between the EDP and the engineer will be more easily accepted by the profession. The paper also gives information about the present situation in CAD and discusses trends for the future.

Résumé

L'article traite du projet à l'aide de l' ordinateur en République Fédérale d'Allemagne. Les activités avec l'ordinateur sont concentrées sur le développement de chaînes de programmes qui peuvent être utilisés en génie civil. Afin de garantir une large utilisation, il a été décidé de ne promuovoir que les programmes répondant aux règles CAD de programmation et de documentation. Ainsi l'utilisation de programmes par l'ingénieur praticien sera facilitée grâce à la réalisation d'un manuel de l'utilisateur, qui permettra également l'interface entre le programmeur et le projeteur. La situation actuelle ainsi que quelques problèmes sont évoqués, les tendances de développment possible sont mentionnées.

Zusammenfassung

Der Beitrag handelt von Computer Aided Design in der Bundesrepublik Deutschland. Die CAD-Arbeiten sind auf die Entwicklung von Programmketten konzentriert, die im Bereich des Bauwesens eingesetzt werden sollen. Um eine breite Anwendung sicherzustellen, werden nur solche Programme öffentlich gefördert, die entsprechend den CAD-Richtlinien (Regeln zur Programmierung und Dokumentation) entwickelt werden. Durch die Schaffung einheitlicher Benutzerhandbücher als Schnittstelle zwischen EDV und Ingenieur soll die Anwendung der Programme in der Praxis erleichtert werden. Darüber hinaus enthält der Bericht einige Information zur gegenwärtigen Situation und diskutiert einige aktuelle Probleme, die für die Weiterentwicklung von Bedeutung sind.

General

The Federal Government of Germany supports the EDP-Development taking place at universities and in industry. The so called Third Data Processing Programme, published by the Federal Ministry for Research and Technology envisages an amount of DM 1,575 million to be spent from 1976 to 1979 on the promotion of research into and development of data processing systems and equipment as well as of selected areas of data processing applications.

Promotial funds by years and sectors (DM million):

	1976	1977	1978	1979	1976-79
o Measures in the higher education and training sector	93.7	64.5	57.o	49.o	264.2
o Applications of data processing	127.6	133.o	144.o	157.o	561.6
CAD (part of application)	(15.o)	(16.o)	(17.o)	(18.o)	(66.o)
o Promotion of industrial R & D	14o.3	133.o	138.o	143.o	554.3
o Gesellschaft für Mathematik und Datenverarbeitung mbH.	43.8	48.3	5o.8	51.9	194.8
Total to be spent under the Third Data Processing Programme	4o5.4	378.8	389.8	4oo.9	1574.9

As a part of the Promotion of the Application the utilization of data processing in technology is gaining particular importance. In general, the following two areas are to be distinguished:

- Computer-aided development, design and manufacturing [1)]

with the two major subjects

-- The utilization of data processing as a tool of the development engineer and designer allows the development of improved products within shorter periods of development.

-- Utilization of data processing in production planning, production scheduling, production engineering and assembling for improved execution of manufacturing.

- Process control by means of data processing systems (PDV)

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1) In the following the abbreviation CAD/CAM (computer aided design/computer aided manufacturing) is used for this application.

An optimum utilization of data processing in technology for the economically neccessary

- increased quality of products,
- improvement of the price/performance ratio of products,
- reduction of the innovation period required for improved products

can only be achieved if data processing is successfully and as completely as possible integrated into the whole production process.

The state of data processing application in technology for the solution of the described problems varies according to sectors and depends on the size of the enterprises. With some rare exceptions, only large firms of civil engineering, electrical engineering, chemical and shipbuilding sectors apply CAD/CAM for calculation, record keeping and process control; these enterprises possess the necessary hardware which has been procured for commercial tasks and is now used or expanded for the solution of technical tasks.

As to the relatively small enterprises, being typical for large areas of civil engineering, general mechanical engineering, machine-tool industry, chemical apparatus industry and precision engineering, data processing has practically not found any access to design or manufacturing. There are only a few data processing applications which usually refer to small, limited problem solving areas (e. g. structural analysis of parts). [1)]

On the whole, the software supply is not complete, in particular programs are lacking which can be used in the first stage of the construction process, i. e. in design. Furthermore, there are lacking efficient and economical programs for the important dialogue in development, design and manufacturing and programs for production and modification of construction drawings. Only a few projects are underway in the field of production engineering and process control.

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1) Rechnerunterstütztes Entwickeln und Konstruieren im Maschinenbau, Forschungshefte Forschungskuratorium Maschinenbau e. V., Heft 28, 1974.

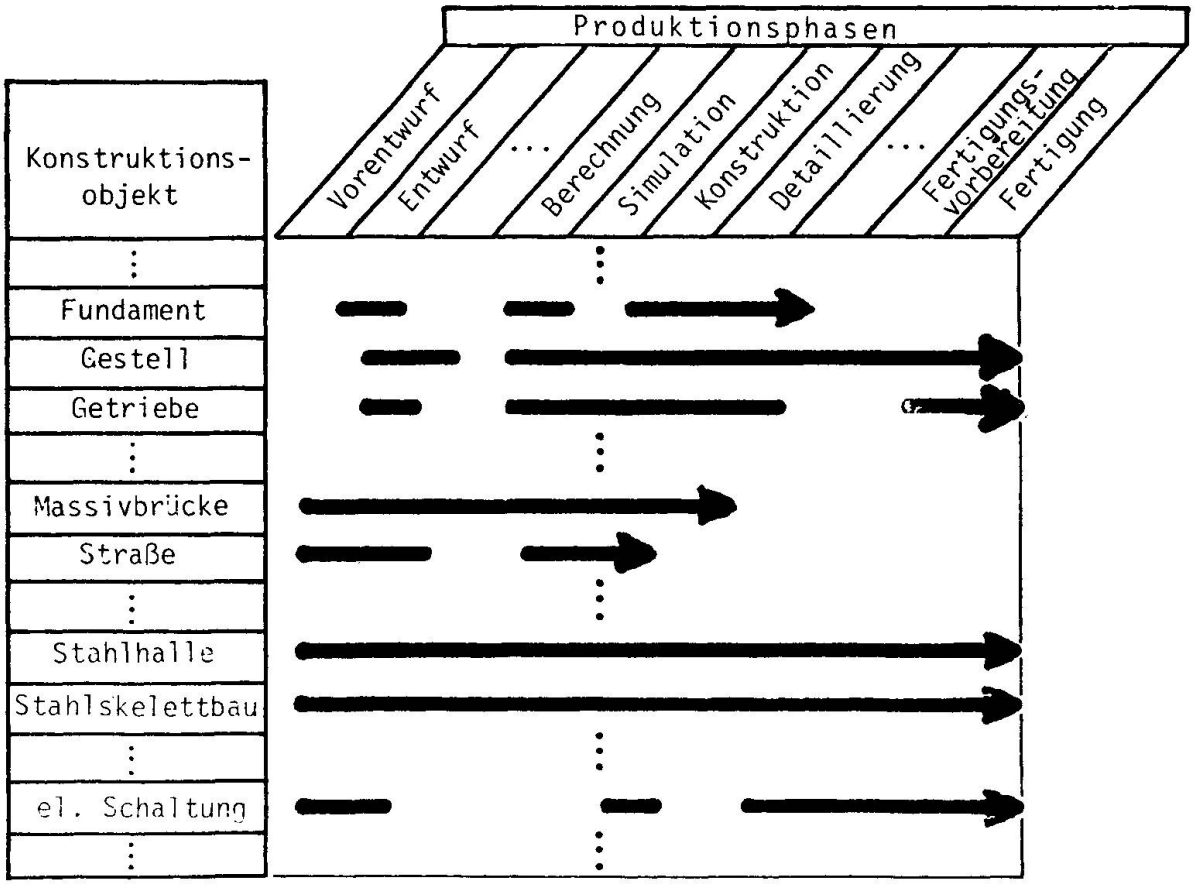
Aims

The following aims shall be pursued by the exploitation of data processing application in technology:

- increased efficiency and competitiveness of industry,
- long-term safeguarding of employment and humanization of working environment,
- rationalization and improvement of public and private services in transportation, communications and energy supply,
- economization in energy and raw materials, improved control and maximum reduction of impairing environmental influences, increased safety of technical equipment,
- securing new potential markets and new export prospects to the European computer industry.

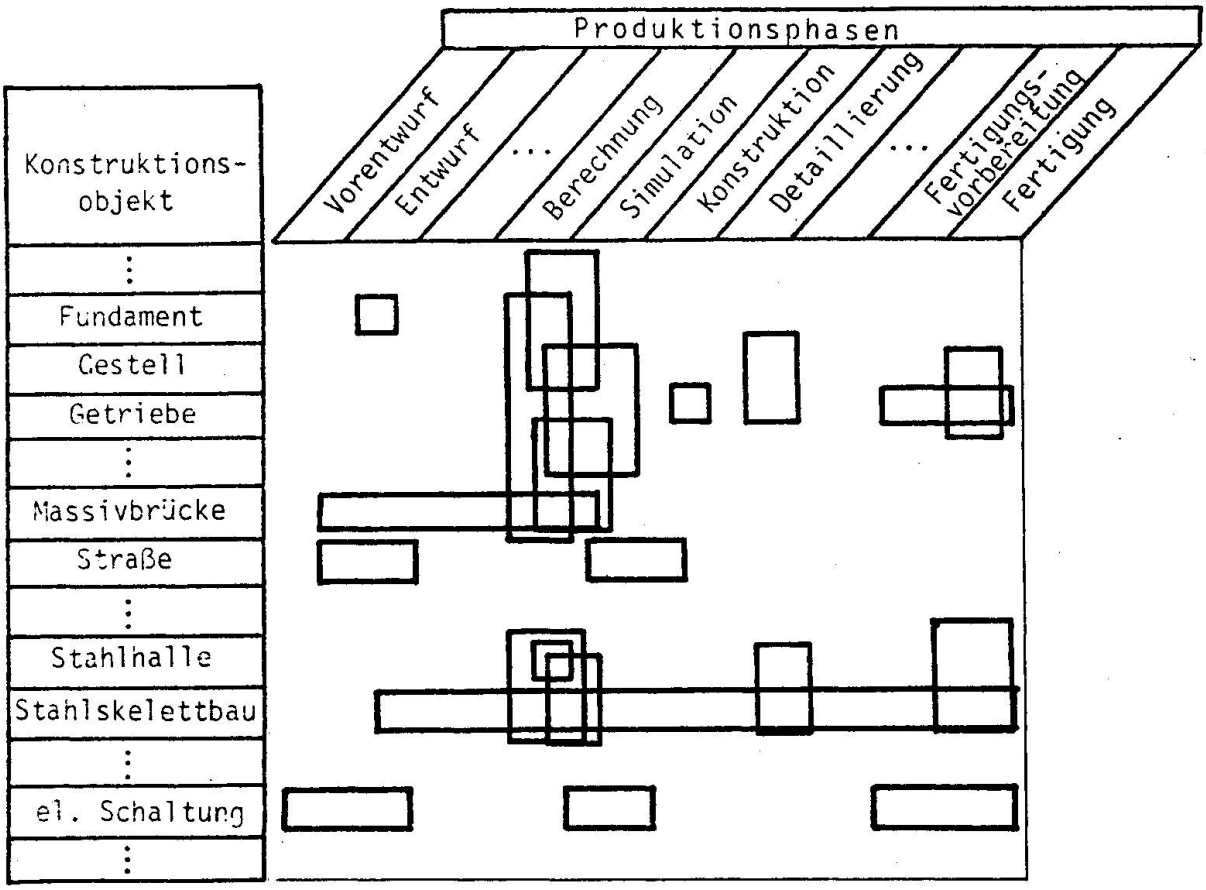
Basic CAD-Conception

CAD-Programmes are to be specified by the different tasks which must be done by the engineer. The "Solution Space" for development of CAD-application programmes is shown in figure 1; within this space the technical scope of performance of such programmes can be depicted and delineated.



The horizontal axis shows the various phases, which must be passed through in design, calculation and manufacture; typical engineering subjects are listed vertically. The tasks to be dealt within production are plotted in fig. 1 as horizontal lines, each associated with the related subject. Depending upon the engineering aspects or the particular features of the firm, there may be breaks in a line, since all the phases are not relevant to every case.

The performance profile of existing application programmes for computer use in production are shown - qualitatively only - in fig. 2 in the solution space corresponding to fig. 1.



In the main, fairly small programm packages, (so called "islands") closely tailored to specific applications, are available; Considerable "densities" of solutions exist in some areas for the calculation or simulation of technical subjects by DP systems, whereas other areas are almost completely empty. In general, the islands cannot in practice be linked together to form larger packages which would make possible a continous flow of information.

In addition there are some major programme systems which appear as vertically oriented fields. This species of programmes are able to solve a very special step in the engineers activity e. g. calculation of stresses and deformations by the Finite-Element-Method, production of a NC-tape for manufacturing etc. The advantage of the systems consists in their broad applicability, which is not limited to only one subject.

And finally there are a few horizontal bars which represent subject-oriented programmes. We call this type of CAD programmes "CAD-Chains". The CAD-chains only allow a continuos information flow through all relevant production stages and thus avoid data adaptations and linking up which are both expensive and liable to error. So the CAD-chain as a whole must be subject-dependent. It is however composed in large parts of modules, which can be in corporated as "standard modules" unchanged into further CAD chains. Typical standard modules in this respect can be the above mentioned finite element programmes, packages for processing geometrical design data or numerically controlled processors. If standard modules of this type are available as tools in sufficient quality and quantity, it is possible to extend them relatively simply and flexibly by subject-specific or firm-specific modules to give useful CAD application programmes.

We can regard such CAD-chains, which are simply produced by a few modifications, as "Flexible CAD-Chain".
The main efforts in future developments are to offer a set of standard modules which enables the engineer to achieve Flexible CAD Chains as described above.

Discussion of the present situation, Trends.

The number of the existing or now beeing developed CAD-chains is very different in the various fields of applications. The present CAD-applications have to use the available island-solutions with all disadvantages connected with them. At present about 2o developments are on the way, which will establish flexible CAD-chains. Further developments are to be tackled if a measurable success may be reached.

For development the following criteria have to be given preference:

a) conception of the data base.

The different modules of the CAD-chain are to be linked by using a standardized data base as an interface.

b) Standard - Modules

The development of general applicable, problemoriented standard-modules has to be intensified. A typical example because needed by each CAD-chain is the standard module geometry, by which it is possible to store, retrieve and manipulate geometric bodies and their attributes, so drawings, etc. may easily be produced.

c) Applicability

In the past the most successful CAD-programmes have been written by the applying engineers them-selves. In future a permanent supervision by the profession has to be garanteed. So the development of sometimes theoreticaly interesting but in practice not su much needed programmes has to be prevented for the sake of real demand.

d) Programming as a craft

The writing of programmes should be less comprehended as an art or even as research instead of a craftmanlike work (which one nevertheless must be able of)- So we have to learn to specify the software-product very exactly before its realisation starts and also a precise documentation of the programme has to be established during its realisation phase. Also extensive tests as well as pilot applications are necessary.

e) Maintainance, Marceting

Already during the development meintainance (=debugging and actualisation) and marceting of the programme has to be guaranteed. This is a particular problem of at universities produced programmes.

f) Standardization

The standardization of the different interfaces (I-/O, calls for the Data Base, grafics, Fortran, Fortran '77, geometry, etc.) has to be enforced. On the other hand there must remain enough room to move for decisions to be taken for adequate development, for instance in order to adapt existing hardware or software or other specific demands.

g) Development of the Hardware

The structure of the programme must be as modular as possible in order to adapt new environments. The demand for portability ramains valid, although its meaning may change in future.

h) Cooperation between EDP-Specialists and the profession

Until now the results of the Research- and Developmentwork (R & D) of the EDP-specialists have been scarcely recoquized by the engineers of the profession. This is regrattable, because in the profession there is a great lack of knowledge for instance at the definition of data structures of a data base. On the other hand the EDP-specialists must produce less philosophy and more concrete results formulated in a language the user can easily understand.

i) Education

Also the just mentioned item h) makes clear that the education of the user must be intensified in the universities and industry as well.