This paper reports on the experience gained during two years of activities in educational measures in connection with the introduction of CAD/CAM technologies in various areas of a car manufacturing firm.

Some 120 employees from different areas have been trained so far. The training of direct users such as development and design engineers has been in the foreground of these internal educational measures, but measures of training their superiors or the management have also been taken.

Training Concept

In the course of the educational measures taken so far, a multi-stage, modular training concept has been developed for the users for various reasons. This permits to account for the fact that the various CAD users (design engineer, detail engineer, draughtsman) coming from different areas of application (product development, design of jigs and fixtures, equipment and tools, forging, process and layout planning, architecture, electrical engineering, etc.) make different demands on the CAD system.

A multi-stage, modular training programme permits the necessary system knowledge to be taught in a user-specific manner, so that both a deficient coverage ("gap in knowledge") and an excessive coverage ("ballast of knowledge") can be avoided in the teaching process.

The knowledge of the requirements profiles of the individual employees regarding the CAD system on the one hand, and the fact that the employees of the same requirements profile can be combined to make up homogeneous groups of trainees on the other hand, are a prerequisite for such a tailor-made training programme.

The finding out of the requirements profile poses difficulties, at least at the beginning of the introduction to CAD, since for this purpose detailed knowledge is required both on the potential and limitations of the CAD system used and on the individual areas of application.

But even if the requirements of the individual users are known, the making up of homogenous groups of trainees remains problematic, if this results in an impermissible reduction of the available manpower in individual areas during the training phase.

A graded training programme may e.g. look as follows: An introduction to the hardware and software components of the CAD system and an outline of CAD/CAM applications are given in a basic course. This basic course confines itself to the preparation of two-dimensional components.

The method of preparing three-dimensional models and further basic commands will be taught in a continuation course. The goal of this continuation course is the capability of preparing three-dimensional components of simple to medium complexity.

The further courses are primarily intended to teach special knowledge regarding the various fields of application, e.g. generation of surfaces and intersections, preparation and use of macros, editing of menu-field definitions, data handling, and the like.

Moreover, the basic subject already taught will be reinforced, and special techniques and aids for improving the handling of the system will be demonstrated. This special course aims at increasing the user-specific efficiency by getting to know the relevant system commands.
Regarding an intensive exchange of information and experience among the users, it is e.g. advantageous to have a central arrangement of the workstations at the start of the introduction to CAD, and to wait with the decentral arrangement of the workstations until more progress has been made in the training.

Apart from this, the earliest possible availability of specialists from the most varied fields of application for answering special questions, will promote a mutual progress and accelerate the increase of the effectiveness of the individual users.

Possibilities of further training

The measures to be taken for further training aiming at increasing the efficiency and widening the fields of application can be most different in nature.

So, e.g. user meetings organized at reasonable intervals or also follow-up training measures serve to show the limitations of the system and to work out, collect "tricks" and impart them to others.

In addition, suitable written material or video films can be prepared and used for further training by self-teaching.

An very decisive influence on the increase of efficiency can be exercised by an user attendant, if he is in a position to do so on account of his technical and personal capabilities and the time available for this purpose. The possible tasks of such a user attendant can be listed as follows:

- User assistance (acting and reacting);
- collection, working out and giving tips to users; contact in the event of software faults; definition of standards and system defaults; working out of standard menus; coordination of user meetings; cooperation with the trainer and last not least design work of his own.

Measures for superiors/management

In conclusion, the necessity and the kind of training or information measures to be taken for superiors/management are to be dealt with briefly. The necessity for such measures is due to the fact that this group of persons mostly did not get to know the CAD/CAM technologies available today in their own education.

The available know-how mostly results from visits to fairs, the attendance at seminars and/or contact with manufacturers, but rarely goes back to their own experience.

This may lead to an excessive expectancy level with respect to the degree and period of an increase in efficiency. The scope of the necessary training expenditure for the users is also often underestimated or there are generally difficulties in estimating the volume of work involved. Further problems may lie in the selection of "likely" CAD applications.

For these reasons, the measures to be taken for superiors include a condensed training at the CAD workstation on the one hand, and the demonstration of the potential and, above all, of the limitations of the CAD system with selected examples on the other hand.