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A Software System for the Workstation in Structural Engineering

Un système logiciel adapté à la station de travail européenne

Ein Software-System für den EDV-Arbeitsplatz im Bauingenieurwesen

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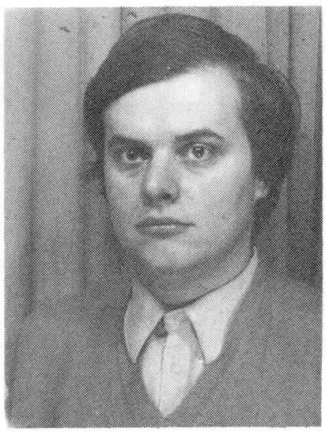

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SUMMARY

Description of the software system SYRAKUS and its aims:
1. Uniform, but user specific man-machine dialogue
2. Use of structural engineering software that has been successful hitherto
3. Software tools for more cost effective development of CAD-Systems that respond to increasing user requirements.

RESUME

L'article décrit le système logiciel SYRAKUS et ses buts principaux de réalisation. Il comprend:
1. Un dialogue homme-machine uniforme mais spécifique à l'utilisateur
2. L'utilisation de logiciels éprouvés dans le domaine du génie civil
3. Des outils de développement de systèmes CAO permettant de répondre aux exigences croissantes des utilisateurs de façon plus efficace.

ZUSAMMENFASSUNG

Es wird das Software-System SYRAKUS mit folgender Zielsetzung beschrieben:
1. Einheitlicher, jedoch benutzerspezifischer Mensch-Maschine-Dialog,
2. Einsatz bisher erfolgreicher Programme des konstruktiven Ingenieurbaus,
3. Softwarehilfen zur Minderung des Aufwandes für künftige CAD-Lösungen, die den steigenden Benutzeranforderungen gerecht werden.

1. INTRODUCTION

In the last few years desktop computers have been increasingly used in engineering practices. The computer at the individual workdesk has proved the most effective way of using data processing in day to day design work. The increasing use of this type of equipment has led to a substantial demand for design supporting software /4/.

Many good programs are now available in this area. They have proved to be operative through several years and many installations. On the other hand they follow such different principles in man-machine interaction, that programs from various sources can hardly be used in parallel.

Software houses thus try to provide complete program libraries for microcomputers. They do not only have to develop means for the management of construction data and their relationship but also do provide programs again that have already been made elsewhere.

The German Ministry for Research and Technology has sponsored the development of a software concept for the use of the structural engineer. This project takes the situation depicted above into account: on one hand, it attempts to exploit the existing software in the structural engineering area, on the other hand, the dialogue between man and computer is standardised.

This system is called SYRAKUS. It will be able to manage all of the information needed for one engineering project. It will supervise data interdependencies in order to make shure, that the data representation of a structure always remains consistent with the user's views.

2. HARDWARE DEVELOPMENTS

The concept of a software system for the desk of the structural engineer must take the hardware situation of the next 4-5 years as a reference. Trends of hardware development must be analysed. The functions available in future are to be considered, not the actual spectrum of hardware items.

SYRAKUS relies on the following functions of a workstation:

2.1 Input devices

The keyboard as it is used today will continue to be the main device for data input. Speech and character recognition are not of great significance. Touch sensitive tablets and key-pads are increasingly used for graphical and also non-graphical applications.

2.2 Displays

The 24 row by 80 column screen will remain widely in use. For text processing A4 upright screens have growing importance. For graphical purposes the raster technology 19 inch 1024 x 780 pixel screen will be most widely accepted.

2.3 Output devices

High speed dot matrix printers are likely to be the most versatile and cost effective means of output for some time. They are also capable to reproduce graphics and will be used for intermixed text and graphics output. For real letter quality output, low speed daisy wheel printers will remain in use. Plotters are not expected to reduce significantly in price. Bigger buffers and increasing intelligence will increase online throughput.

2.4 Local intelligence

Local intelligence stands for the capabilities of the programmable devices available at an individual workplace in addition to some intelligence, which might be available at a remote place. There must be sufficient local intelligence to handle all functions which are critical in response time (key servicing).

2.5 Local storage

Where complex file and data management tools are not available, a manually driven management in form of libraries of floppy discs will remain in use.

2.6 Distributed intelligence

Distributed intelligence is going to play an essential role in future CAD Systems. Three forms are already in use today:

- Use of programmable intelligence in peripheral devices,
- Use of a common system backplane bus in which additional intelligence can be added in the form of wired boards,
- Local area networks, where one participant can take advantage of what ever intelligence is on the net.

The advantages of distributed intelligence are obvious:

- Short respone time due to the local processor managing the dialogue,
- high modularity because new requirements can be met adding new intelligence,
- common acces of several users to expensive peripherals.

2.7 Communication

In the design process, communication between the involved people is essential. Workstation software must therefore look closely to the emerging technology:

- several workstations must have access to common utilities and devices (i.e. Database management, plotter, high speed processing)
- data exchange between the workstations envolved in one project greatly enhances throughput and management efficiency.
- access to public databases keeps the designer well informed and allows quick reactions to market changes.

3. SOFTWARE DEVELOPMENT

Increasing software prices and decreasing hardware prices yield rationalisation in the field of software development. A good approach for this is the use of application independent software tools. As these tools are widely used, they can be highly sophisticated and low priced at the same time. Today, such tools mainly exist in the area of systems software, data base management and graphics.

CP/M and UNIX are becoming de facto standards. Future developments in operating systems will tend to stay close to one of them. Distributed operating systems are under development, but will not have great impact on the near future.

For data base management the MDBS system finds increasing acceptance as it operates under various environments. The UNIX file management system is well adapted to tree-like data access mechanisms.

For graphical data processing the GKS ('graphical kernel system') /3/ has become an international standard. The American CORE system is just becoming important in the US.

In the area of man-machine interfaces there is up to now little consensus about input/output conventions. Mask generators like in commercial dp are not commonly usable in the technical field. A study commissioned by the European Communities /2/ and SYRAKUS try to show possible solutions.

4. REQUIREMENTS FOR THE WORKSTATION

Under contract by the Commission of the European Communities a study aimed at 'The Specification of a Building Industry Computer Workstation' was carried out. Final results were available by May '82 /1/.

In this study, the workstation is defined as the computer facilities needed at an individual workplace to aid design, construction and costing of buildings. The study specifies configurations for three levels of workstation:

Level 1 provides simple design calculations, information retrieval, small office management, word processing and data preparation and checking.

Level 2 provides complex analysis and data base management and uses graphical output.

Level 3 provides interactive graphics for conceptual design, space planning, production drawings and 3D modelling. Figure 1 shows the potential market in the European Communities for the three levels.

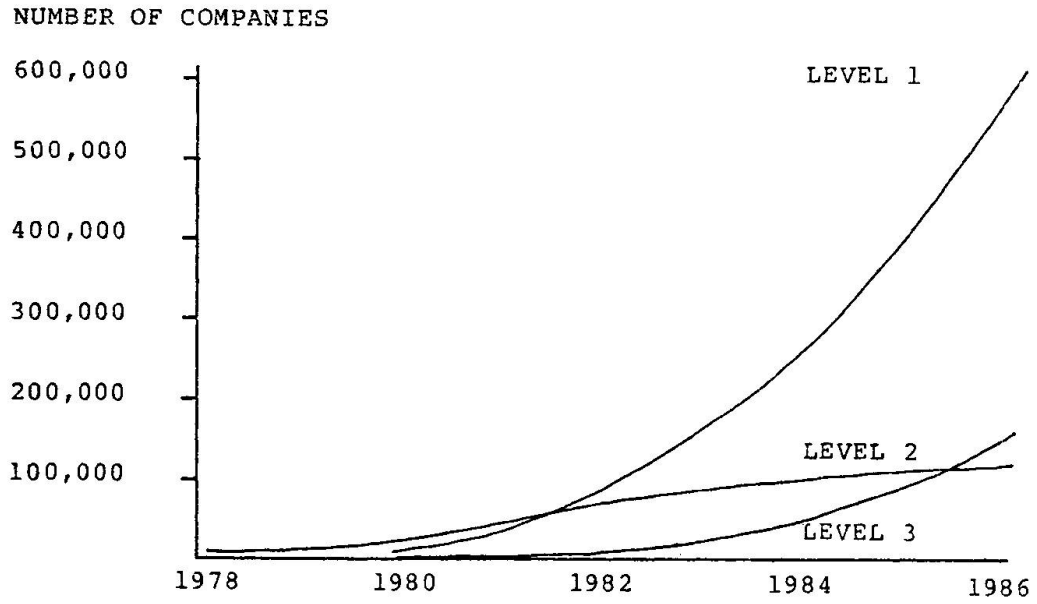

Fig. 1: Potential market in building for the workstations

5. THE SOFTWARE SYSTEM SYRAKUS

On the basis of the expected hardware developments exposed in chapter 2 the software system SYRAKUS is currently beeing developed at the Technical University of Munich in the F.R. of Germany /5/.

SYRAKUS also takes into account, that application independent software modules have to be carefully separated from application specific ones as is exposed in chapter 3.

SYRAKUS will be a powerfull tool for system houses to aid them in the development of specific application programs. These houses have to provide interface modules to:

- the required type of dialogue with the user (User),
- existing application programs, that will be integrated to the system because of their well proved quality and reliability (Methods Base),
- the required types of output forms and devices (Output),
- the data base management system to be used.

These interface layers are very small in the overall system, and skeleton interfaces are provided with SYRAKUS.

SYRAKUS suits the level 2 workstation of the European study well, smaller versions of it could run on level 1 equipment but it is aimed at systems with distributed intelligence. Most parts of SYRAKUS could be integrated into level 3 workstation software.

5.1 Interfaces to the system environment

The environment is composed of the four major components of civil engineering specific design processes:

- the user,
- the methods base,
- the database management system and
- the output.

5.1.1 User

The interface between user and computer is the man-machine dialogue. This dialogue must be conceived for minimum user load and minimum error rate by using

- adequate input devices and
- adequate forms of dialogue.

User load can be kept down by using uniform input structures for all programs to be used independently.

5.1.2 Methods base

The methods base contains good quality programs for a variety of engineering applications. It therefore inevitably contains programs from different sources. The interface between methods base and system is conceived in such a manner that adaptation work is kept to a minimum. The main condition for this is, that a program has a line oriented type of input.

This gives the engineer the opportunity to take advantage of the availability of a big number of programs, without beeing limited to one software source. This also is one step towards stabilisation of the software market, as only really good programs will then be adopted by the user community.

5.1.3 Data base management

For todays computers there always is a database management system (DBMS) available which is well adapted to the specific hardware environment. This is why SYRAKUS does not incorporate a data base management system. It merely takes advantage of an existing system if some minimal requirements are met. There are aids for the construction of interfaces to DBMS, but the interface is to be established for any DBMS to be used.

5.1.4 Output

The usual types of output from engineering work are texts (technical calculations, bills of quantities etc.), and line drawings (sketches, graphical representations of results, production drawings). The output environment is composed of plotters for drawings, daisy wheel printers for printing, matrix printers for text and graphics, all possibly of different manufacturers. Output is to be organised for the whole environment.

5.2 System structure

SYRAKUS is the management system that controls all the environment components named above. This task is shared by four communication modules (Fig. 2):

- USERCOM at the users side
- PROCCOM at the methods base side
- DATACOM for the data base management system
- OUTCOM for output.

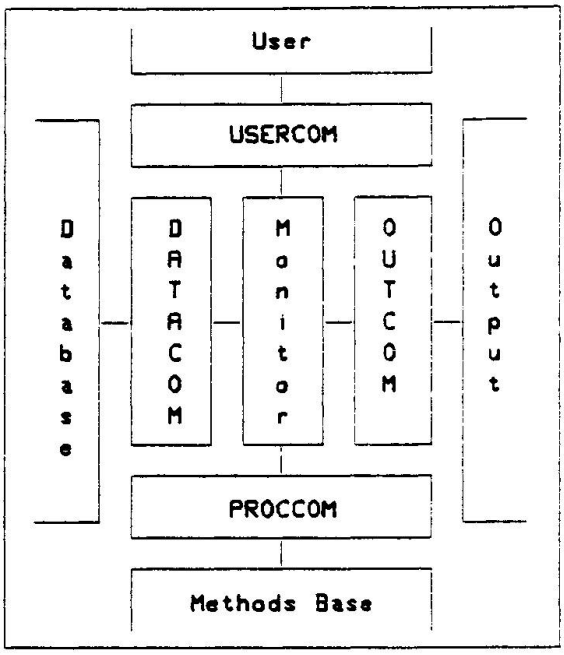

Fig. 2: Structure of the system SYRAKUS

These communication modules keep their independency as far as possible. For adapting SYRAKUS to special user requirements, special application programs, to a special DBMS or specific forms of output, special interfaces must be written.

Communication between modules takes place on the basis of standardised messages. These messages are processed by the modules in order to influence their specific environment. Interaction from the environment are processed and coded into messages to other modules if necessary.

Message routing is done through the central monitor. This module synchronises message transfer. In a single processor multitask system it stands for the physical network in multiprocessor systems. The monitor is not a system kernel as one can find it in some software systems, it does not have any control functions.

The following paragraphs describe the functions of the communication modules more in detail.

5.2.1 User communication (USERCOM)

USERCOM is in charge of the dialogue with the user (Fig. 3)

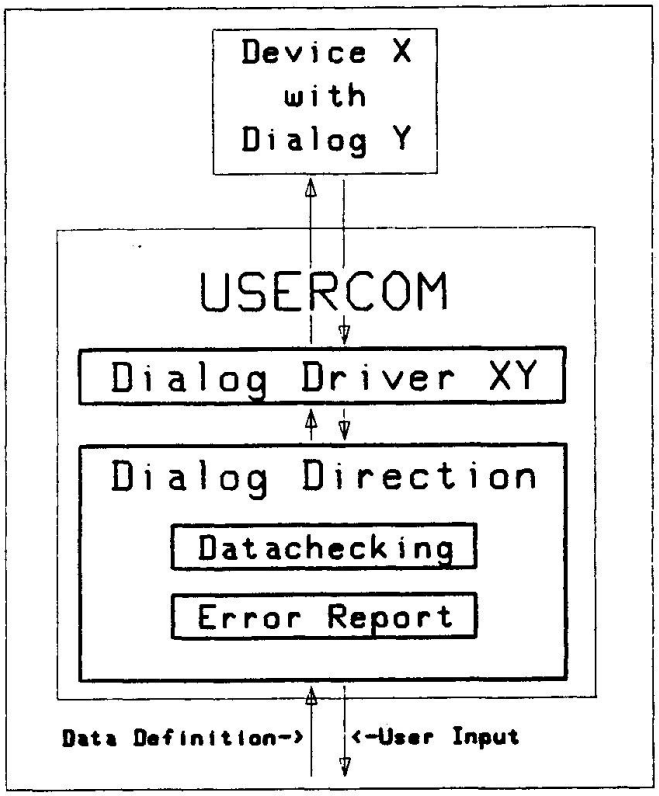

Fig. 3: Structure of the USERCOM

USERCOM accepts messages for the management of input from the keyboard. It is capable of doing a certain amount of data checking in order to give quick response to input errors. These messages contain the following:

- information about the data to be input,
- information about checks for completeness and consistency of data,
- error report mechanisms,
- user information mechanisms.

The parts of USERCOM are:

- dialogue driver XY, drives a dialogue of form X (Masks) on equipment of type Y (a certain VDU with keyboard),
- dialogue controller for data checking and error reporting.

Fig. 4a shows the message which directs USERCOM to provide a section number SNR. USERCOM processes the message and displays the text 'S-NUMBER' at the display row 4, first column. The value to be provided by the user must be in the range of 1 to 99. If the user gives an allowed value, a message indicated in Fig. 4b is returned.

```
a)
BI MO US SNR --- 10 ------ I3 01 04 BZ 08 S-NUMBER B1 01 99 01
EN

BI          Message is data input description
MO          Message is sent by MONITOR
US          Message is received by USERCOM
SNR ---     Short name is SNR (6 characters)
10          Prompt takes 10 positions on screen
------      Unit
I3          Type integer, 3 digits
01          Prompt starts in column 1
04          row 4
BZ          Prompt followes
08          8 characters long
S-NUMBER    Prompt
B1          Range specification type 1 followes
01          from 1
99          to 99
01          step 1
EN          End of message.

b)
WE US MO SNR--- 5

WE          Message is a value transfer
US          Message is sent by USERCOM
MO          Message is received by MONITOR
SNR---      Short name is SNR (6 characters)
5           Value is 5

Interspersed blanks are not transmitted, they are inserted for better readabili-
ty. Underlined parts are binary coded, all others are ASCII code. Hyphens
indicate obligatory blanks.
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Fig. 4: Example of messages: a) to USERCOM, b) from USERCOM

5.2.2 Process communication (PROCCOM)

This subsystem is in charge of the data flow from and to application programs. Overall system activity is loosely controlled by PROCCOM because the requirements of individual application programs yield control of input, output and data storage activities. PROCCOM initiates input for one application program. All data input by the user is stored into the data base. As soon as the information is complete, it is converted into the input form for the specific program and the program is started. Information relevant to the relationship of the individual calculation run to the whole engineering system is put in front of the output (i.e. name of position, table of loads etc.).

After a successfull run of the program, output data relevant to future decisions is transferred back to the data base, the output files are routed to OUTCOM.

5.2.3 Data base communication (DATACOM)

This subsystem is in charge of the data flow to and from the data base. On request it provides all information needed by the other subsystems (i.e. input item descriptions for USERCOM, values for PROCCOM, tables of contents for OUTCOM). DATACOM manages the underlying data structures and is therefore able to determine the amount of information to be provided following a request itself.

Other subsystems can put forward such questions as 'what do you know about xxxx

DATACOM also handles data dependencies and is therefore able to determine which values are to be deleted, once an amendment is made to a specific data item.

DATACOM is in charge of the consistency of units of measurement.
Database drivers are the modules for communication between DATACOM and the underlying data base management system. Any installation will contain one such driver for the DBMS in use on that system.

5.2.4 Output communication (OUTCOM)

OUTCOM is in charge of the data flow to the output devices. PROCCOM routes output files to OUTCOM. Here, they are processed in order to standardize the page layout. Then, the filename is incorporated to an OUTCOM file directory. The user is given the opportunity to process a file with a text system prior to starting output.

Graphical output is treated much the same way as is alphanumerical output. Graphical data is routed in the form of text files containing plot macro calls in textform. The skilled user is able to process these with a text system too. For output, the macros are resolved into calls to GKS primitives /3/ and output using the GKS software available on the computer (Level OB required).

For installations without GKS implementation, a raw version without the whole processing spectrum is provided.

6. SUMMARY AND CONCLUSIONS

In the future, the effective use of computers will essentially depend on the availability of appropriate software. Our capacities for software development will soon be exhausted if software is continued to be developed for individual users, on individual processors and with individual peripherals.

The software system SYRAKUS which is currently beeing developed at the Technical University of Munich aims at several purposes:

- The user communicates with the system in a program independent manner.
- The form of dialogue (mask, prompt, keyword etc.) can be chosen by the user with respect to his skills and experience.
- Any form of dialogue can be achieved on any input device as far as physically possible.
- Existing experienced software in the area of structural engineering can be used with a minimum of adaptation.
- All relevant information is stored in a program independent manner yet consistent with an overall model.
- Output is standardised for an individual installation and highly independent from specific applications programs. The system is open for a variety of available and coming output devices.
- New software developments can rely on the powerfull software tools developed for SYRAKUS. They can use them for establishing an entirely new system or for easy adding of specific applications to the existing system.

As SYRAKUS is more a method, based on a range of readily available software development tools for a wide variety of hardware items, than a closed system, it has a wide basis for application.

SYRAKUS was developed with the coming generation of distributed intelligence systems in mind.

The support of the German Ministry of Research and Technology in this future oriented project is gratefully acknowleged.

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