CHRISTIAN ROVSING A/S

CHRISTIAN ROVSING A/S
Marielundvej 46B
DK 2730 Herlev
Denmark

Phone: (02) 91 88 33
Telex: 3 51 11 cr dk

CONTENTS:

getting to know-how we do it

CHRISTIAN ROVSING A/S
COPENHAGEN · DENMARK

The Company

CR 01

THE COMPANY

Christian Rovsing A/S was founded in 1963 as a computer software house. The company today covers a complete range of systems activities, including:

- the design and production of special purpose computer hardware,
- the definition and implementation of all types of computer software,
- the delivery of complete hardware and software systems, on a turnkey basis.

Today Christian Rovsing A/S stands as one of Denmark's leading computer systems houses, capable of taking responsibility for all parts of a hardware/software project, from conception through implementation to final acceptance.
The company is completely independent and wholly owned by Danish Nationals.

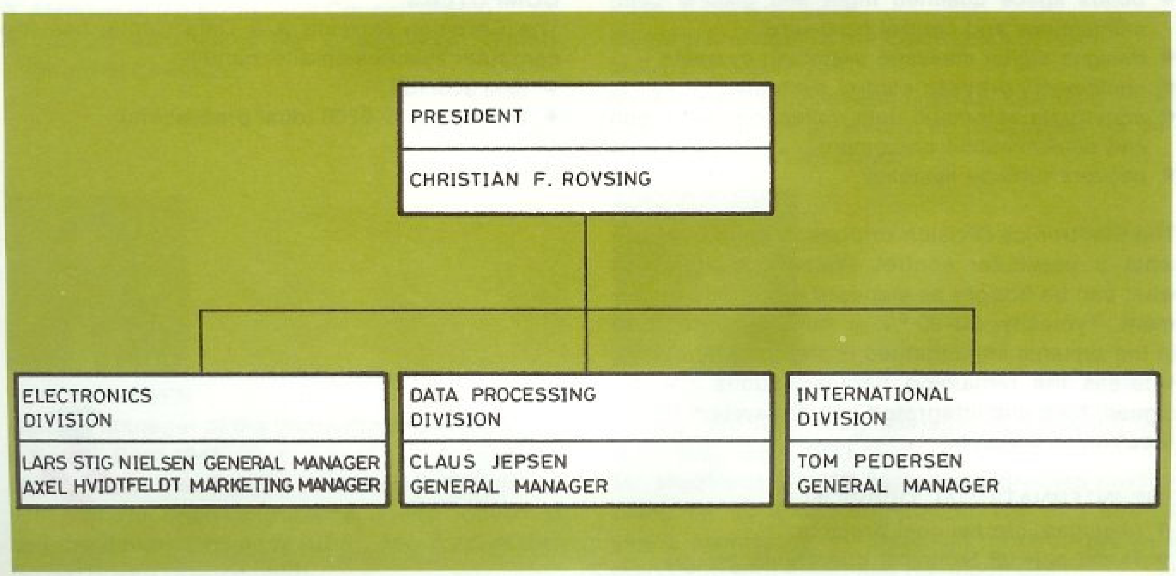
ORGANIZATION

Christian Rovsing A/S is organized into three divisions:

1. Data Processing Division.
2. Electronics Division.
3. International Division.

Within this overall organization the company comprises a number of departments, each of which specialises in particular activities. The structuring is, however, sufficiently loose to enable the formation of an integrated project team of specialists from many fields, capable of tailoring a solution to any particular client requirement.

In many cases accumulated client know-how is integrated into a project through one or more client engineers working as part of the team, ensuring full client contact with the project.



ID 40 1.10.1975 Form 5 prime

CHRISTIAN ROVSING A/S
COPENHAGEN · DENMARK

CR

THE DATA PROCESSING DIVISION:

- *designs* software generators
- *constructs* operations research/mathematical models for engineering and commercial applications
- *provides* complete computer facilities management on contract
- *implements* health service management systems
- *supplies* front-end processors for large scale computer systems

The Data Processing Division also runs the Christian Rovsing A/S Data Center, which offers a wide range of computer services, including terminal services via the telephone network.

THE ELECTRONIC DIVISION:

- *develops* the latest generation of miniprocessors
- *builds* space qualified flight and ground communications and control hardware
- *designs* digital message switching systems
- *implements* process control systems
- *constructs* automatic data collection, extraction and dissemination equipment
- *delivers* turnkey systems

The Electronics Division bridges the gap between what a particular control system requires and what can be bought as standard electronic equipment. Typically, 50–90 % of the hardware used in the systems implemented is standard hardware, whereas the remaining hardware units are designed, built and integrated into the system by the Electronics Division.

THE INTERNATIONAL DIVISION:

- *manages* international projects
- *forms* special technical operations groups
- *supplies* macro economic consultancy
- *transfers* know-how world-wide

The International Division has its own project s and draws upon the manpower and expertise of other two divisions.

TEST FACILITIES

Christian Rovsing A/S has two electronic tes cilities available:

1. One for building and testing space quali hardware, including a »clean room«.
2. One for implementing and testing turnkey stems based on minicomputers.

DRAFTING FACILITIES

Technical drawings and print layouts are pr ced in the company's own drafting offices.

COMPUTERS

The Christian Rovsing A/S Data Center has computer systems on-site, namely:

- IBM 370/158
- Burroughs B–6700 (dual processors)

Key Personnel

CHRISTIAN F. ROVSING
President and co-founder of Christian Rovsing A/S.
M.Sc. E.E. Born 1936.

Mr. Rovsing is engaged in a number of public functions:

- Member of the Danish National Research Board
- Chairman of the Danish Spacelab User Committee
- Member of the Danish Academy of Technical Sciences
- Chairman of the Danish Data Processing Society
- Member of the Eurospace Council (Paris)
- Elected member of the Copenhagen County Board of Directors.

TOM PEDERSEN
General Manager of the International Division.
B.Sc. I.E. Born 1941.
Mr. Pedersen has 6 years commercial experience with Control Data Corporation, Litton Industries and the Boeing Company (USA), and 2 years with Brown Boveri (Switzerland).

CLAUS JEPSEN
General Manager of the Data Processing Division.
M.Sc. E.E., MBA. Born 1940.
Mr. Jepsen has established the Christian Rovsing A/S Data Center, and is a consultant to the Danish government.

LARS STIG NIELSEN
General Manager of the Electronics Division.
M.Sc. E.E. Born 1941.
Mr. Nielsen holds several patents, including world wide patents for an electronic pacemaker for patients with heart diseases.

AXEL HVIDTFELDT
Deputy and Marketing Manager, Electronics Div.
B.Sc. E.E. Born 1933.
Mr. Hvidtfeldt in 1960 designed a process control computer for Elliott-Automation, UK, and has 13 years experience in computer control systems marketing with Elliott and Raytheon Co.

ID 40 1.10.1975 Form 6 prime

CHRISTIAN ROVSING A/S
COPENHAGEN · DENMARK

The International Division

CR 12

ORGANIZATION

The International Division is responsible for:

1. The international software and systems marketing of Christian Rovsing A/S.
2. Undertaking software and systems projects abroad.

The International Division is headed by a general manager who is supported by a sales and project control staff.

While the general management organization remains fixed, the international project organization is relatively loose. It is a matrix organization where staff can be allocated, as required, to different functions.

PROJECTS

The projects undertaken by the division include:

- international project management
- international brokerage
- delivery of turnkey software systems
- engineering software consultancy, including the definition and implementation of simulation and operations research models
- delivery of support software
- formation of special technical operations groups
- execution of software and systems projects abroad
- macro economic consultancy

INTERNATIONAL COOPERATION

Christian Rovsing A/S is a member of several international consortia, formed to undertake projects which will benefit from a joint approach. Christian Rovsing A/S cooperates with the following companies:

- CSC, Computer Sciences Corporation, USA
- Hughes Aircraft, USA
- ICL, International Computers Ltd., England
- MBB, Messerschmitt-Bölkow-Blohm, Germany
- SAAB-Scania AB, Sweden
- Siemens, Germany
- TRW, USA

The International Division has learnt to work in developing countries calling for special consideration to historical, cultural and legal background.

RELATION TO THE DATA PROCESSING AND ELECTRONICS DIVISIONS

The International Division maintains a close cooperation with the Data Processing and the Electronics Divisions. This cooperation covers all phases of the project work, from the preparation of proposals to the implementation of the ultimate design.

ID 40 1.10.1975 Form 6 second

The Electronics Division

CR 21

ORGANIZATION

The Electronics Division comprises two departments:

1. The General Purpose Digital Electronics Department.
2. The Advanced Systems Department.

The organization of the division is flexible. It allows the setting up of a project team to meet the requirements of any specific task, drawing on staff from both departments within the division, and from other divisions of the company.

SKILLS

The Electronics Division designs and implements electronic units and systems for several types of clients, including:

- End users
- Computer hardware manufacturers
- Manufacturers of electronic units.

The electronic units produced are used within the areas of:

- Special purpose interfacing
- The control of large-scale communication systems
- Graphic modules for man/machine interaction
- Micro-processing for scientific purposes, involving 4th generation technology.

Most units are produced within the framework of a systems project. The division undertakes systems projects under total responsibility.

The complete systems delivered by the division include:

- Automatic satellite check-out
- Process control
- Data processing and dissemination.

TECHNICAL EQUIPMENT

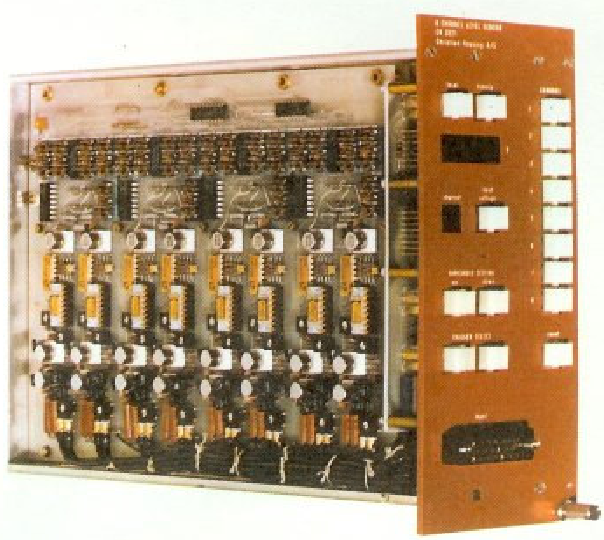
The Electronics Division has the following facilities at its disposal:

1. An advanced test laboratory
2. A »clean room« and facilities to simulate a space environment
3. A mechanical workshop
4. An electronic workshop.

Although the division is not concerned with large scale serial production, it undertakes the production of the units designed, either as prototypes, as single operational units, or as units which form part of a systems project.

The hardware standards applied include:

- Existing commercial and company standards
- Aerospace standards
- Military standards



ID 40 1.10.1975 Form 6 prime

CHRISTIAN ROVSING A/S
COPENHAGEN · DENMARK

The Data Processing Division

CR 22

ORGANIZATION

The Data Processing Division comprises four departments:

1. Software Systems and General Consultancy
2. Technical Computer Applications
3. Bio-medical Engineering
4. The Christian Rovsing A/S Data Center.

SKILLS

The Data Processing Division is engaged in both commercial and technical software development.

The division undertakes the following projects:

- Feasibility studies
- Implementation of commercial systems.
- Assistance in the purchasing of computers and the build up of EDP organizations
- Computer facility management
- Implementation of scientific programs and systems, in any programming language
- Compiler design
- Medico-surgical monitoring and control
- Process control.

CLIENT LIAISON

Software projects are carried out in close cooperation with the client, and in many cases with direct client involvement in the implementation. This ensures that:

- the software product accurately reflects the requirements of the client
- any changes are made subject to a client decision on the cost and time impact of the change
- maintenance and future improvement changes can be performed inhouse by client's own staff
- client better appreciates software impact of hardware upgrading

THE DATA CENTER

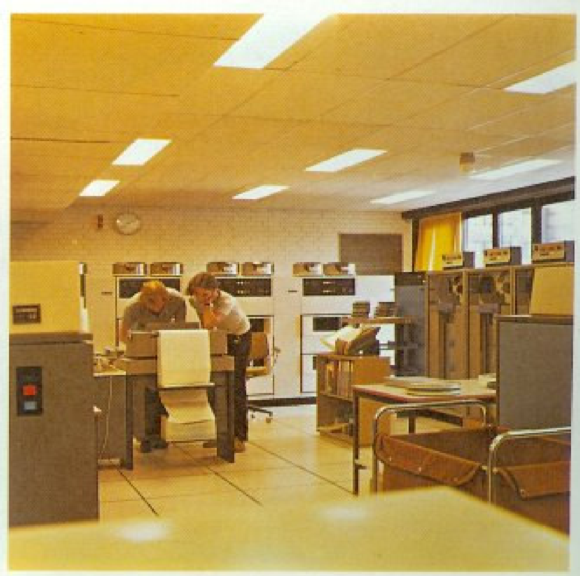
The Christian Rovsing A/S Data Center is a computer service bureau offering:

- computer machine time, either in a batch-mode, or, on a real-time basis, via the public telephone network (both time-sharing and conversational)
- computer machine time and standard computer software (e.g. for invoicing, accounting, or stock control purposes)
- terminal service based on a small computer at the client site, connected to the Data Center's large computers.

DATA CENTER HARDWARE

The Data Center has the following computers on-site:

- Burroughs B–6700 (dual processing).
- IBM System 370/158.



ID 40 1.10.1975 Form 6 second

CHRISTIAN ROVSING A/S
COPENHAGEN · DENMARK

Project Management

MAN 01

MANAGEMENT PROBLEM AREAS

The success of a project – in terms of goals reached and cost-effectiveness of the chosen solution – depends heavily upon the way in which the project is managed.

Although goals vary, all systems projects have a number of management problems in common. These problems arise in:

- Defining the performance of the system to be implemented. In most cases, it becomes clear to the client only during the development phase, exactly what he wants the system to do; this may require changes to be introduced as the system is being developed. The task of estimating the time, cost, and performance impact of such changes, and implementing them into the system, represents a major management problem.
- Ensuring that all systems interfaces work. It is axiomatic that a system will work only if all internal and external interfaces work. Parts implemented by different project team members must be compatible when put together into the system, and the system as such must be able to cope with all situations that may occur, particularly those which occur when the system is no longer working under laboratory conditions.
- Planning and controlling the project activities. Planning is a strategic problem. Initially it presents the project management with the task of determining which activities have to take place to meet the project objectives, and at the same time, accomodate any limitations. During the project, the management will have to define the action to be taken whenever slippages in the time schedule occur.
- Assuring the technical quality of the system design.
- Testing the system.
- Defining and enforcing a documentation standard.

MANAGEMENT ORGANIZATION

The management needed to supervise a project in the most economical faschion depends upon the size of the project. In general, the greater and more complex the project, the greater will be the manpower allocated for management purposes.

Irrespective of size, projects from one man-year and upwards will typically include the following management functions:

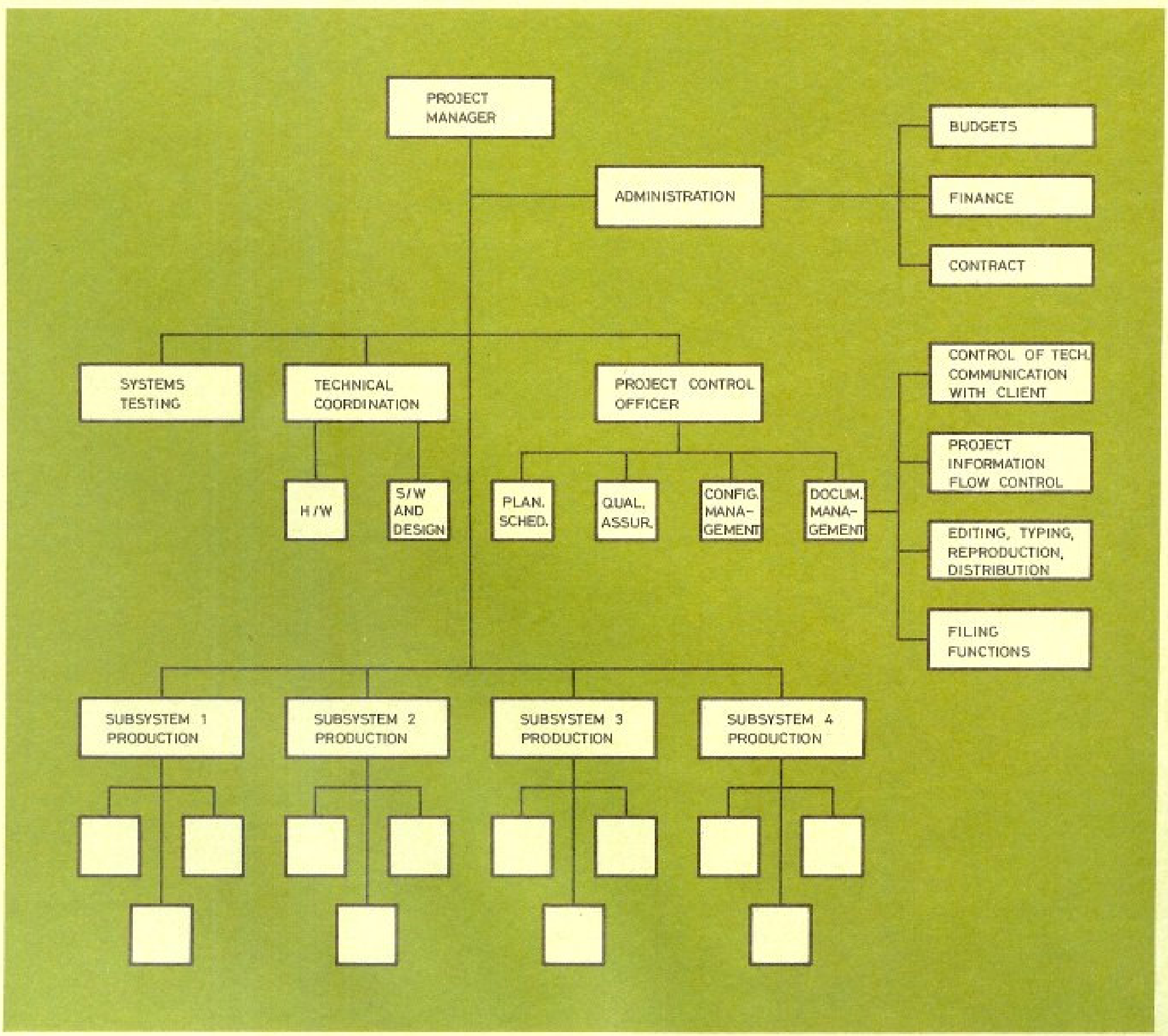
1. A project control function responsible for:
   a) planning and scheduling
   b) quality assurance
   c) configuration management
   d) documentation
2. A technical coordination function, with responsibility for the software/software, the hardware/software, and the hardware/hardware interfaces.
3. An independent support and systems testing function.

MANAGEMENT PROCEDURES

The functions included in the Christian Rovsing approach to project management are enforced by a set of formalized and standardized management procedures, which have been applied successfully to a number of complex projects, and refined in the light of experience.

A brief outline of the Christian Rovsing A/S management standards is given in the following.

ID 40 1.10.1975 Form 2 prime


PROJECT MANAGER
ADMINISTRATION
BUDGETS
FINANCE
CONTRACT
SYSTEMS TESTING
TECHNICAL COORDINATION
PROJECT CONTROL OFFICER
CONTROL OF TECH. COMMUNICATION WITH CLIENT
PROJECT INFORMATION FLOW CONTROL
H/W
S/W AND DESIGN
PLAN. SCHED.
QUAL. ASSUR.
CONFIG. MANA-GEMENT
DOCUM. MANA-GEMENT
EDITING, TYPING, REPRODUCTION, DISTRIBUTION
FILING FUNCTIONS
SUBSYSTEM 1 PRODUCTION
SUBSYSTEM 2 PRODUCTION
SUBSYSTEM 3 PRODUCTION
SUBSYSTEM 4 PRODUCTION

Development Methodology

THE PURPOSE OF THE SYSTEM REQUIREMENTS DEFINITION

Defining the user requirements of a system serves a dual purpose:

1. It helps the client specify exactly what he wants the system to do.
2. It serves as a basis for determining whether or not the system meets the design objectives.

Effective systems development thus depends upon a development methodology capable of translating the requirements into a responsive system.

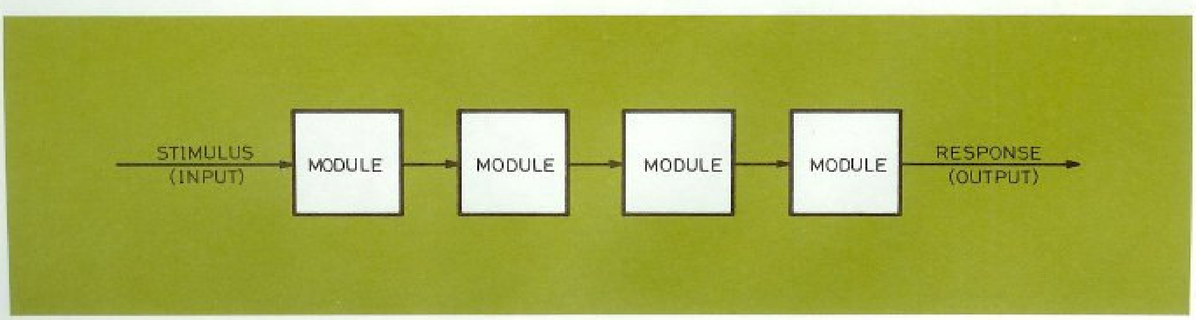
STATEMENT OF THE PROBLEM

Systems development traditionally proceeds from requirement definition through the stages of design, unit implementation and testing, systems integration, and operation. This approach suffers from two serious drawbacks:

1. Deviation from the original specifications and the errors which inevitably creep in as the design work proceeds will in most cases pass the unit testing without being identified as errors. These errors may only be revealed during the integration phase. In practice integration, i.e. making the tested systems parts work together at systems level, may take as much as 40 % of the total effort needed to implement the system. Some aspects of this problem are:
   a) development costs are too high
   b) the progress of the project is obscured because systems capabilities can be demonstrated only very late
   c) the progress of the project cannot be monitored, nor can corrective action be taken early enough.
2. Requirement changes tend to make the project run out of control since there is no built-in mechanism for estimating the impacts of changes in terms of manpower, cost and schedule.

THE PROCESS PATH METHOD

The development methodology adopted by Christian Rovsing A/S tackles precisely these two problems. The principle of the method is to key the required system capabilities to the performance of the single units within the system: For each type of input the system must activate a sequence of hardware and/or software modules to produce the output required. A complex system is then broken up into PROCESS PATHS, each with a precise input and output. Each of these paths requires an identified subset of modules to be activated, in a known sequence.



ID 40 1.10.1975 Form 3 prime

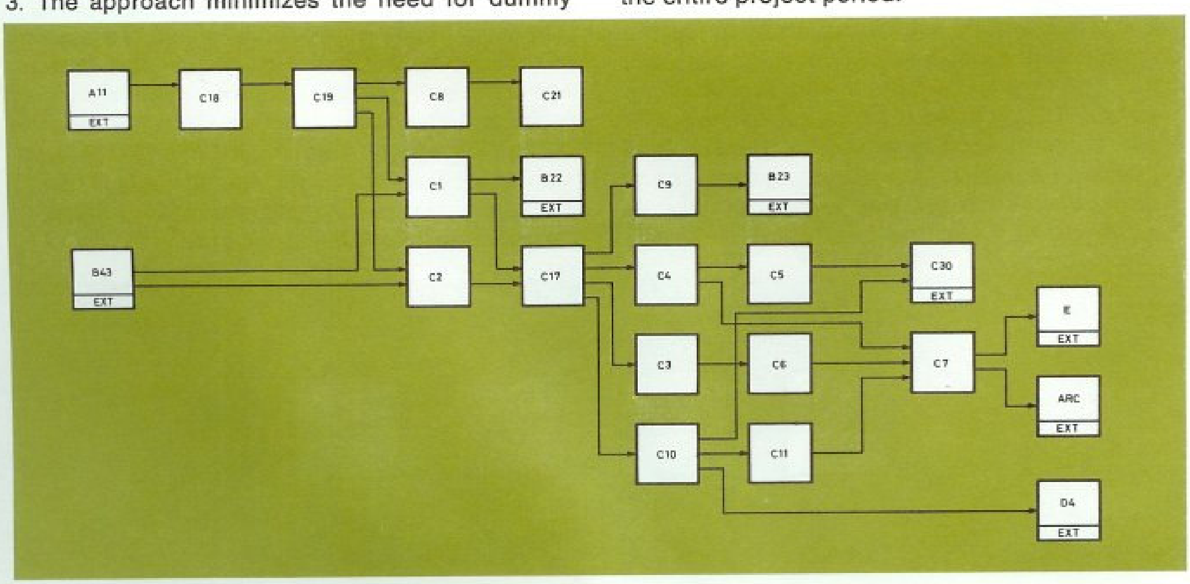
These PROCESS PATHS form the basis for implementing the system: Process paths and the corresponding hardware and/or software modules are grouped into subsets which constitute »work packages«. As soon as the first work package is implemented, some system capabilities can be demonstrated. Each successive work package adds new system capabilities to those already completed, until finally the whole system is operational.

BUILD 'N TEST and BUILD 'N TEST

This approach yields the following advantages:

1. Each process path can be traced to a user (system) requirement it supports, and its status can be measured.
2. The impact of any change in the requirement definition can be estimated from its effect on the process path network.
3. The approach minimizes the need for dummy units to simulate system parts which have not yet been implemented.
4. System parts implemented may be used for production at an early stage. If the development work is terminated before the full system is operational, most of the work done can still be used.
5. Since the units forming part of any process path are tested each time that process path is tested, the system parts most often used will also be the parts most extensively tested.
6. The maintenance is greatly facilitated.

The PROCESS PATH method has proven to be a unique tool in establishing a meaningful communication between the system users and the project team at a very early stage of the project, and to maintain automatic contact between the user requirements and the system implemented during the entire project period.



Planning

PLANNING FUNCTION

The function of the planning of a project is:

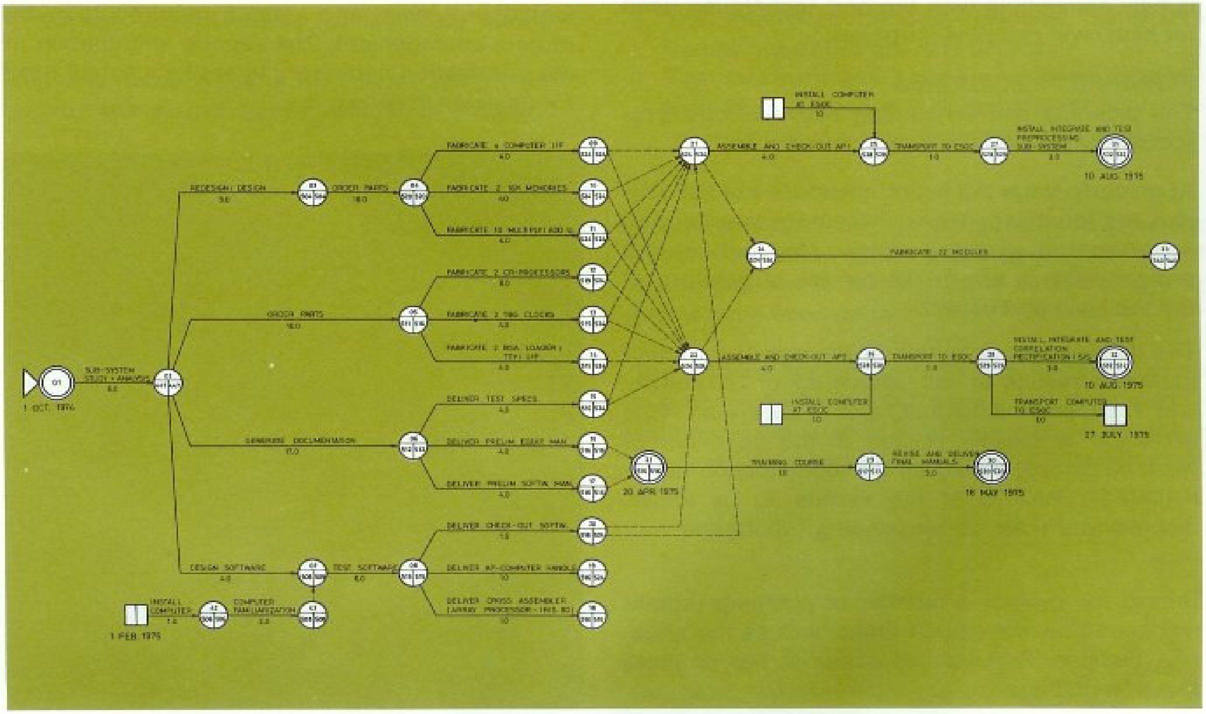
1. To set up an operational and realistic working schedule.
2. Currently to provide progress and problem information as a basis on which corrective action must be taken.

PLANNING TOOLS

The planning tools used by Christian Rovsing A/S include:

1. A top-level definition of the project activities, in terms of a PERT network.
2. A working level definition of the project activities in terms of the PROSESS PATHS through the system.
3. A set of systematic procedures to report the progress of the project.

Basically, a PERT diagram illustrates activity interdependence, and where external decisions have to be made during the project. In addition, the PERT diagram serves as a tool to determine which activities are time critical and what the effect will be of changing the duration of these activities. Finally, the PERT diagram is a comprehensive way of representing the current state of the project.



At the task level, however, pert is not normally the most useful planning tool, since:

- semi-overlapping activities cannot be represented properly in pert
- man-power allocation is subject to restrictions which are difficult to handle in pert terms
- the mechanism of using pert becomes too heavy.

The techniques of specifying systems in terms of PROCESS PATHS and defining work packages have proven to be an operational planning tool at the task level, partly as an aid to 'visualising progress' and partly in its ability to show clearly the relationship between interdependent activities. It is fully compatible with the pert techniques used for high level planning purposes.

PLANNING PROCEDURES

The planning and scheduling activities of a project are based on formalised procedures.

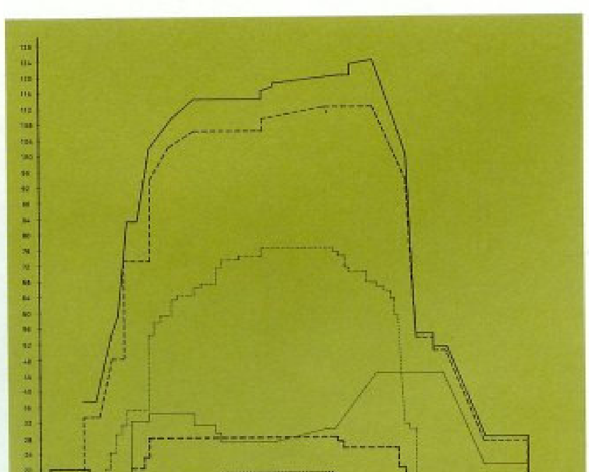
At an early stage the major milestones of the project are identified. These milestones are used to schedule the planning review meetings of the project, and as key-points for the structuring of the top level pert network.

The subsequent definition of the detailed project activities results in the setting up of an activity and manpower schedule, and a cost plan. This definition is closely related to the definition of work packages, based on the identification of the PROCESS PATHS of the system to be implemented and their corresponding inputs and outputs.

During the project a number of planning reports will occur, on scheduled times, and as the situation dictates. Reports will occur at two or more levels, including:

- Task team level reports detailing the scheduling of future activities and logging the status of present activities, stating whether the single activities are on time or not.
- Management level reports to account for the manpower used, related to the goals reached, and indicating the sensitive areas of the project, i.e. the areas where management action will be needed. In addition, the management reporting will include long term statements on the trend of both the progress and scope of the project.

These reports will be objective and comprehensive statements detailing status, current and potential problems, and actions required from the project management. The reports will contain all the information necessary to act as a sound basis for decision making.



Quality Assurance

THE QUALITY ASSURANCE (QA) FUNCTION

The function of quality assurance is to carry out unbiased reviews of all aspects of the project management and systems design. A large project has a quality assurance group whose responsibility includes:

1. Setting technical standards
2. Preparing technical procedures and monitoring their application during the project
3. Monitoring and reviewing documentation to ensure that it complies with contractual requirements and project standards
4. Monitoring procedures for all project test activities
5. Setting up procedures for technical audits.

Normally, three types of review are performed to support the overall quality assurance program:

QA MANAGEMENT REVIEWS

Management reviews are held at regular intervals (e.g. monthly) at the outset of the project, and as the situation dictates thereafter. These review meetings are attended by the project management and client representatives in order to review the project performance and ensure commitment of the resources necessary to meet the client's requirements.

TECHNICAL AUDITS

The latest technology and the experience gained from other projects, are infused into the project by a series of technical audits. During the contract initiation period new or alternative approaches are frequently presented and discussed at the technical audits, whereas the project progress is reviewed in quality assurance terms during all phases of the project.

PROJECT REVIEWS

Technical reviews are performed periodically to identify technical problems at task level. These reviews provide the basis for remedial action at the task or project level. In addition, they help identify potential problem areas and decision points requiring customer participation or resolution.

QA ACTIVITIES AT TASK LEVEL

During the project the QA group reviews the documentation of all modules of the system with particular reference to:

1. The technical approach, to ensure that it conforms to technical standards
2. The interfaces between modules, to ensure that all interfaces are fully defined
3. The hardware and software production specifications, to ensure that the system fully corresponds to the system requirement specification.

Documents with QA comments and critique are filled in on review forms, and logged. The revised documents are reviewed until all outstanding problems have been solved.

The documentation contents are »frozen« when it is accepted by the QA group. Any later modifications of the specifications are treated as changes and processed by the Configuration Management.

QA

ID 40 1.10.1975 Form 3 prime

Configuration Management

CONFIGURATION MANAGEMENT

Configuration Management is a technique for control of systems content through formal specifications and formal procedures. This technique requires a series of systems specifications to be generated; these specifications form the baseline for maintaining control of system content and act as the basis for changing the system content.

One of the primary functions of configuration management is to exercise control of the system requirement specifications. The purpose of this control is not to make technical judgement on the quality of a particular design, but to ensure that whatever design is chosen, the documentation accurately reflects the choice made.

CHANGE CONTROL

To achieve these objectives the configuration management function is responsible for maintaining the system requirement specification in a current and viable state despite requirements changing throughout the project.
This aspect of configuration management is called Change Control.

The objectives of Change Control are:

1. To establish an agreed baseline which sets out the initial system requirements. Negotiations will take place until a satisfactory amended version is obtained.
2. To provide a formal basis for handling changes to the system requirements.
3. To provide the data needed to evaluate the impact of any changes proposed.
4. To maintain a history of change decisions, so that any current version of the system requirements at any stage in the project can be justified and traced back through its history of change.
5. To ensure that all agreed system changes are printed, checked, and updated, and that all working versions of the documentation used for development are updated.

All changes must be approved by both the client and the contractor.

When a change request is received from either of the two it is allocated a control identity and then distributed to client and contractor representatives as needed to evaluate the impact of the change and make the decision whether the change should be implemented or not.

For large projects these representatives will constitute a change board. The change board will convene as often as is necessary to discuss the outstanding system requirements and change requests. The meetings should be frequent enough to ensure that adverse operational effects are not caused by lack of decision.

RESPONSIBILITY

The responsibility of the configuration manager is:

1. To define and maintain a configuration identification system.
2. To minitor its application to all items produced.
3. To see that all proposed changes are processed through the change board.
4. To maintain records of all changes.
5. To assure that approved changes are reflected in the relevant documentation.

ID 40 1.10.1975 Form 3 second

Project Documentation

THE PURPOSE OF DOCUMENTATION

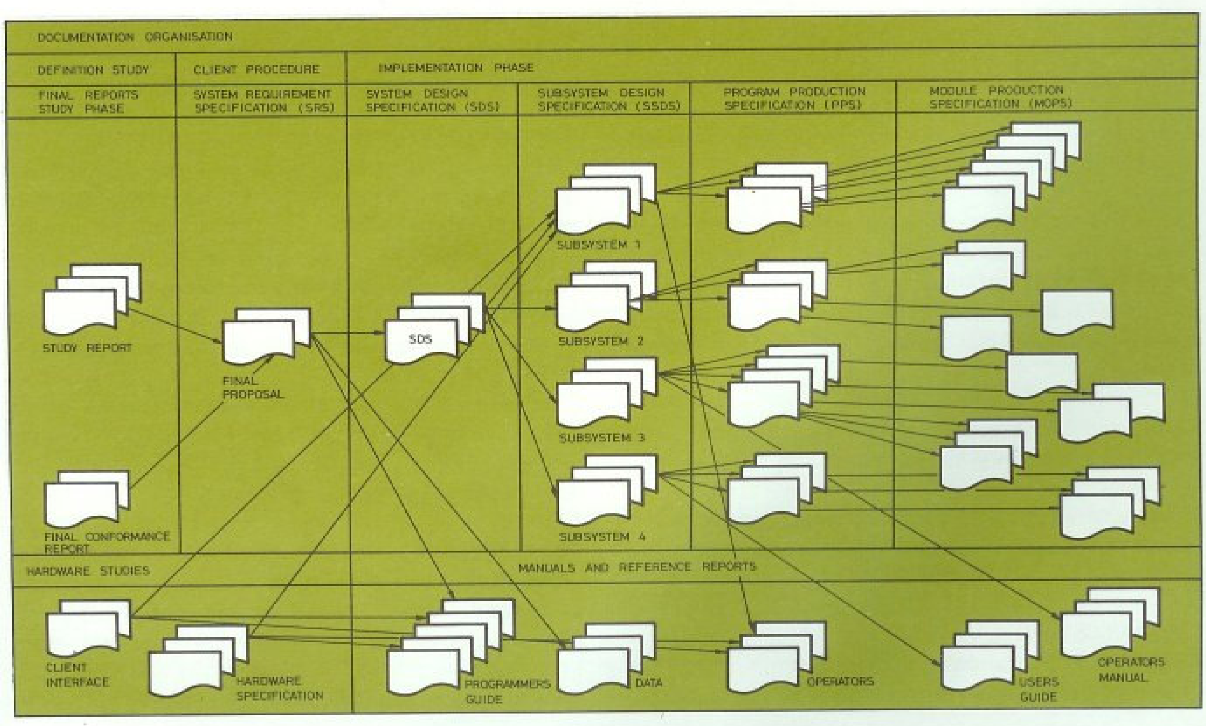
The documentation is the authoritative description both of the historical development of the project and of the developed system. From the documentation, one can learn:

- In the design phase, how closely the system planned meets its requirements
- During the development phase, how to implement the requirements
- How to maintain the system once it has been implemented.

Thus the documentation follows the project step by step, first regarding concepts and approaches – and acting as a basis for design decisions – then through the implementation stage, and finally providing a definite guide to the exploitation and maintenance of the system. One of the main principles of this approach is that the documentation should be produced before the items specified are implemented. The documentation thus serves as a specification of what is to be done, rather than as an after-the-event statement of what actually happened.

DOCUMENTATION STANDARDS

The documentation produced in a project undertaken by Christian Rovsing A/S will conform to



the documentation standards of the company.

These standards explicitly tackle such problems as:

- How to communicate the activities during all phases of the project
- How to structure the overall project documentation and how to make the structuring visible and comprehensive at all levels, thus helping the user to identify all information relevant to him
- How to identify documents uniquely
- How to present information economically and comprehensively
- How to use diagrams (of the BAR, PERT, SYSTEM, PROCESS PATH, CIRCUIT, and PROCESS types) in practice
- How to organise the distribution (including updating) of papers, and how to distinguish between authorised (library) and unauthorised (and possibly obsolete) documentation.

The documentation standard includes specifications of the documentation control management framework, the documentation process and procedures, technical text writing, diagramming, program specification, coding, typing, and other topics.

Furthermore the standard includes a number of standard stationary forms used for typing text.

These forms apply a common heading which includes a standard identification code, used for referencing.

ORGANIZATION

How the documentation standard is enforced depends upon the type and size of the project. For large projects the documentation will be carried out under the responsibility of a document controller or the project control officer. For such projects the function of the documentation controller will be to:

1. Organize the communication with the client at the technical level.
2. Control the information flow within the project.
3. Process all documents through to completion, including the steps:
   a) editing (a big project may employ one or more technical editors)
   b) typing
   c) reproduction
   d) distribution
   e) updating and maintenance
4. File all documents relevant to the project in the project library.

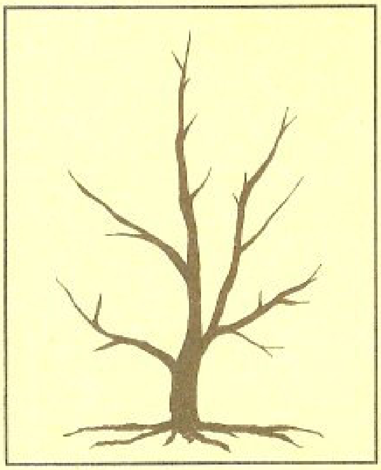
PROJECT LIBRARY

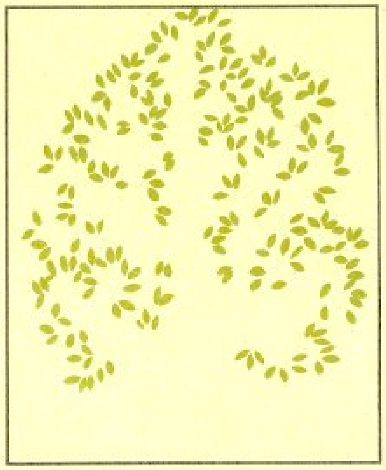
The project documentation will be stored in a project library. The library will normally maintain four document files:

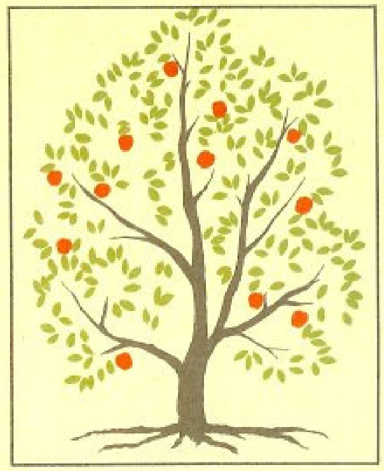
1. Master file: This file contains the working masters of all documents in their up-to-date form.
2. Control file: The file is an exact replica of the master file, but in bound form, and accessible to library users.
3. History file: This file contains a copy of all documents, back to their first issue or version.
4. Security file: This file is a replica of the history file, stored at remote premises.

For the distribution and maintenance of the documentation the project library maintains a delivery index which specifies the composition of all versions of the documentation and the identity of all receivers of these parts of the documentation.

HARDWARE + SOFTWARE = SYSTEMS







The fact that Christian Rovsing A/S is deeply engaged in the design and implementation of both electronic hardware and software has a dual impact:

Firstly, it means that the company can take full responsibility for the implementation of total systems (hardware + software), such as the delivery of complete computer control systems, on a turnkey basis.

Secondly, the fact that the company is familiar with solving problems in a systems context has an impact on the pure hardware or pure software projects undertaken by the company: It means that problems on the borderline between hardware and software will be located and solved, rather than neglected or postponed as is the case in many »pure« hardware or software projects.

HARDWARE

Most of the electronic hardware designed and built by Christian Rovsing A/S is implemented in a systems context, i.e.: as part of an electronic system where the remaining hardware is bought as standard.
The hardware designed and built thus bridges the gap between the standard hardware available on the market and the special requirements inherent in a particular user defined function. This bridging ability has allowed the company to act as consultants to many computer manufacturers in defining hardware systems.

Therefore, while the company has designed digital standard units for manufacturers of electronic equipment (for serial production) the company's main interest is in implementing electronic units in a specific hardware system environment.

SOFTWARE

The term computer software applies to a wide range of computer program types and applications, including:

1. Standard software needed by any particular computer and usually supplied by the manufacturer, such as:
   a) compilers
   b) support software
2. Application programs, which solve a specific problem within the areas:
   a) science and technology
   b) administration & finance
   c) decision making.
3. Software systems, i.e. a set of mutually interdependent programs which share a common data base.

SYSTEMS

A computer control system includes both the hardware and the software needed to carry out the control functions performed by the system. In delivering such individual systems on a turnkey basis, Christian Rovsing A/S accepts total system responsibility, covering all of the aspects:

- hardware/hardware coordination
- software/software coordination
- hardware/software coordination
- the interface between the system and its environment.

Computer control systems play an exceedingly important role in the control of processes where speed, accuracy, reliability, the handling of large quantities of information, complex calculations – or a combination of these – is required.

In a wider sense computer control systems are a vital part of a technical (or cybernetical) revolution which will divert human effort away from functions which are best carried out by machines, towards such activities as defining purpose, setting the criteria for decision making, and designing the systems which meet these ends.

ID 40 1.10.1975 Form 10 prime

CHRISTIAN ROVSING A/S
COPENHAGEN · DENMARK

Hardware Projects

HW 11

HARDWARE CONTEXT

Christian Rovsing A/S designs and builds digital electronic hardware. The hardware is typically implemented in a systems context; i.e. as part of a more complex hardware system. This implies that the hardware designs are based not only on criteria of functions defined at unit level, but also on how the unit should perform in communication terms, and how its interfaces should be defined.

HARDWARE DESIGN PRINCIPLES

The main hardware principle adopted by the company is that of modularity. Following this approach, complex electronic units are split up into simpler electronic modules, each of which performs a more basic function.

This approach has a positive impact on:

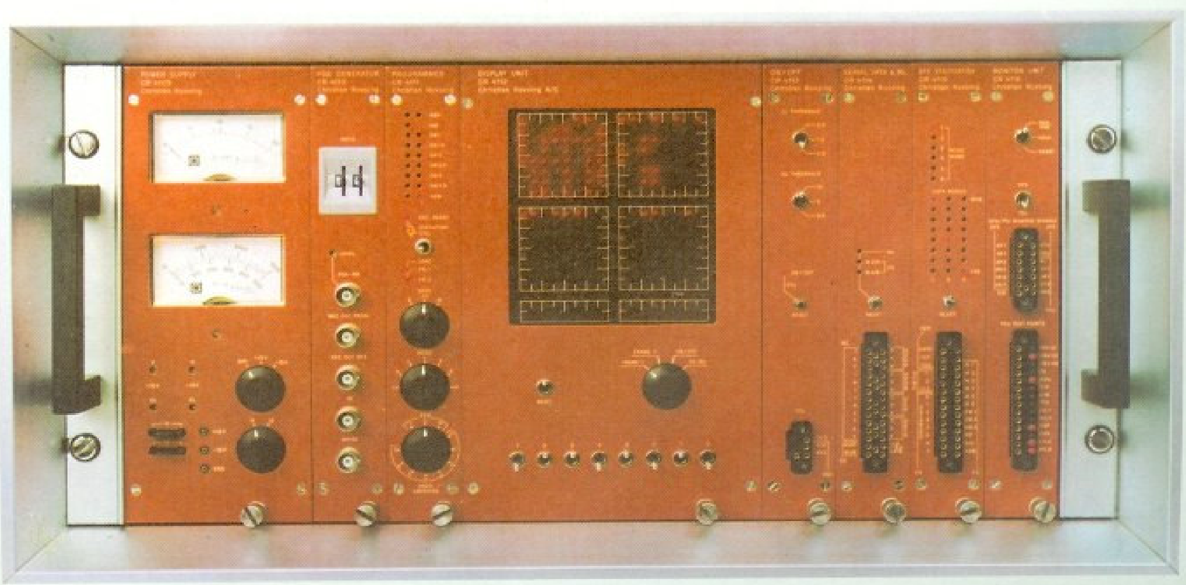
1. The flexibility: Units are easily modified or expanded when the changes needed affect only one or a few modules, rather than the unit as a whole.
2. The economy: A new unit to be designed may include existing standard modules.
3. The reliability: Logical errors will be easier to locate during testing, and standard modules will be tested in many contexts.

The photograph shows a digital unit built from individual modules, mounted to fit into a standard 19" rack.

HARDWARE CLIENTS

The hardware clients of the company include:

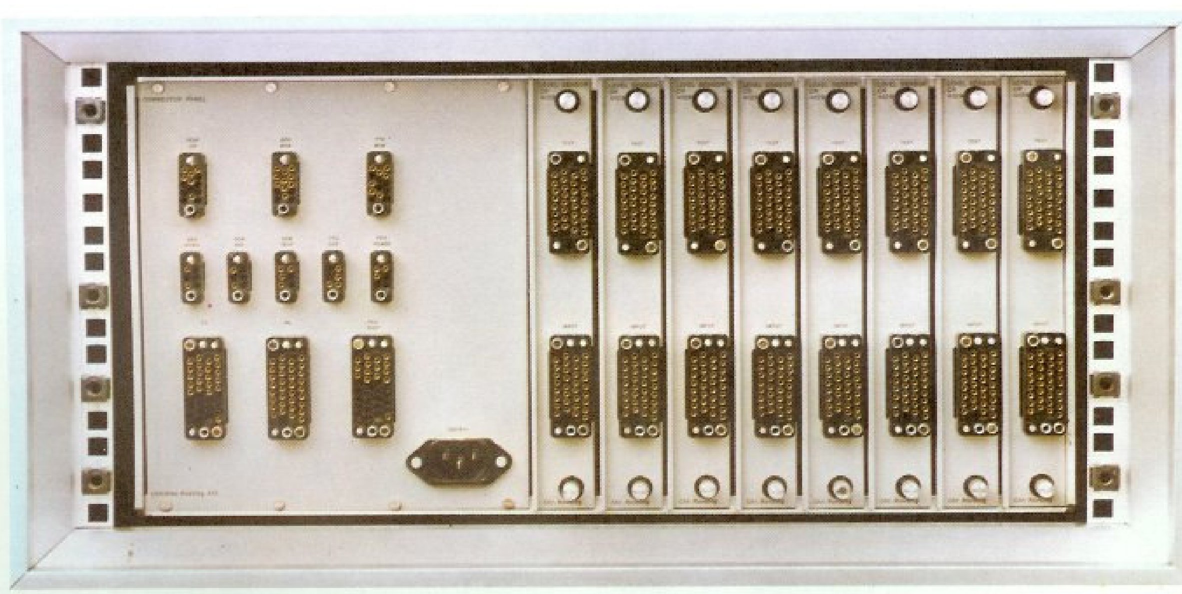
- ESA, The European Space Agency
- The Royal Danish Airforce
- The Danish Road Research Laboratory
- The Copenhagen University Hospital.



ID 40 1.10.1975 Form 6 prime

CHRISTIAN ROVSING A/S
COPENHAGEN · DENMARK

HW12



ID 40 1.10.1975 Form 6 second

CHRISTIAN ROVSING A/S
COPENHAGEN · DENMARK

HARDWARE

HW 01

ID 40 1.10.1975 Form 2 prime

CHRISTIAN ROVSING A/S
COPENHAGEN · DENMARK

Serial Bus System

HW 21

TIME DIVISION MULTIPLEX SYSTEM

The Christian Rovsing Serial Bus System is a 980,000 b/sec. data transmission and data distribution system with a maximum throughput of 864,000 b/sec.

The system uses »time division multiplexing« with a data frame length of 96 significant bits as a minimum and, in the present configuration of the system, a minimum channel allocation of one frame per second, corresponding to an average data speed of 96 b/s. The maximum channel allocation is 1000 frames per second, corresponding to 96 kb/sec. Further sub- or super-multiplexing is possible, if a smaller capacity than one frame per second, or more than one thousand frames per second is desirable.

CHANNEL CAPACITY

The total data capacity of the system can be arranged as follows:

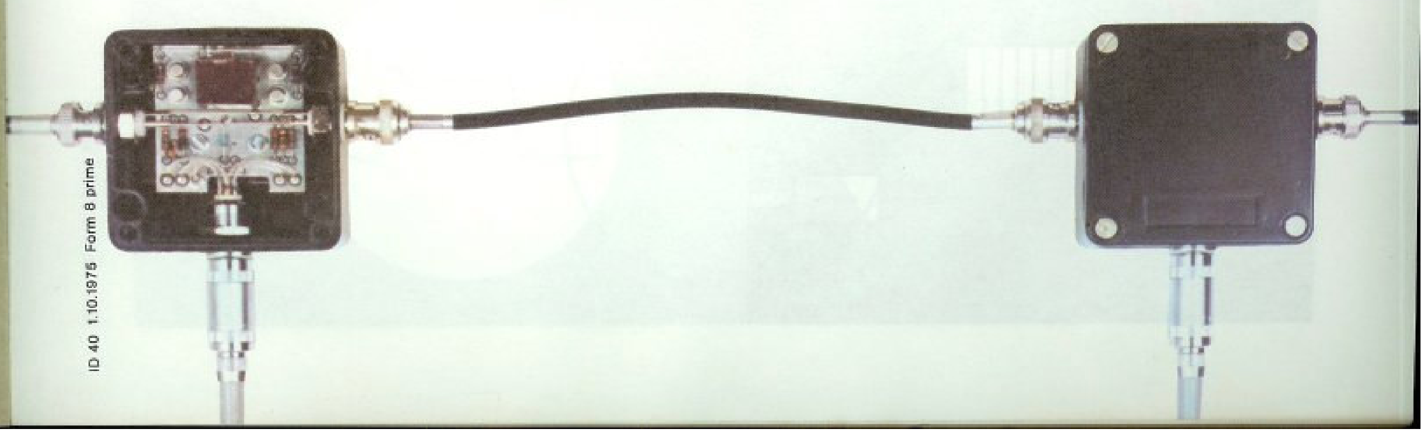
4	96 kb/s channels
36	9.6 kb/s channels
72	960 b/s channels (~ 1200 b/s asynchronous modem transmission)
81	96 b/s channels

Each channel represents one point-to-point data channel. All channels can operate simultaneously at maximum speed. It is possible to double the data capacity of the system.

FAIL-SAFE OPERATION

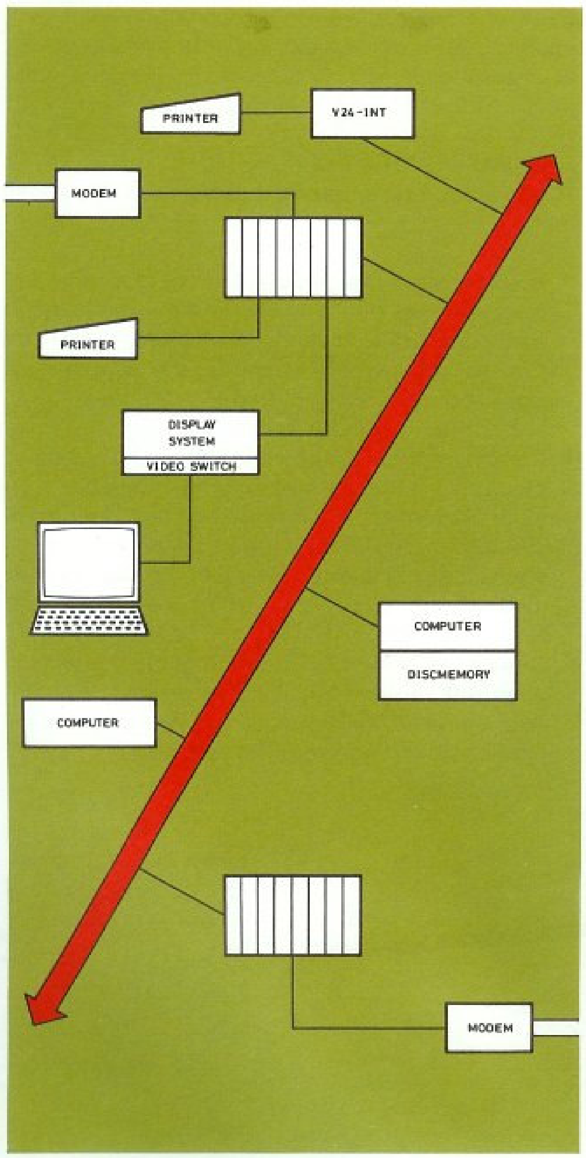
The system has a failsafe operation in the sense that:

- it administers the complete set of point-to-point connections with maximum data capacity in each link, without using any kind of interrupt system which would queue up the data and reduce the throughput during high traffic
- the connection to the serial bus – the communication medium – is designed in such a way as to prevent either short-circuit or open-circuit failures in the user's interconnection equipment from blocking the data stream on the medium
- connection and disconnection of the equipment does not require any kind of power ON/OFF-operations or restart in order to synchronize the connected unit with the system.



ID 40 1.10.1975 Form 8 prime

CHRISTIAN ROVSING A/S
COPENHAGEN · DENMARK



CHRISTIAN ROVSING A/S
HARDWARE PROJECT

Client:
ESA, The European Space Agency

MPA: Multi Processor Adaptor

HW 31

THE MPA

The Multi Processor Adaptor (MPA) is a link between two computer systems, both located at the European Space Research and Technology Centre, (ESTEC) in Holland.

DIGITAL TO HYBRID COMPUTER LINK

The MPA allows transfer of data and control information between an ICL system 4/70 and an EAI hybrid computer. (A hybrid computer is a combination of a digital and an analogue computer).

The EAI normally runs programs which simulate servo systems (for instance in satellites). The ICL system sends stimuli to the EAI which returns information to the ICL. The information is processed and analyzed in the ICL computer.

HARDWARE

The heart of the MPA is a micro processor developed by Christian Rovsing A/S. This micro-processor can handle parallel processing. The micro-program controls two interface modules, one for each computer. These modules provide the necessary signal translation from two different computer interfaces to the signal standard of the system. The micro program is stored in a 256x24 bit Read Only Memory (ROM).

The interface module to the ICL computer provides a galvanic insulation between the MPA and the ICL I/O channel.

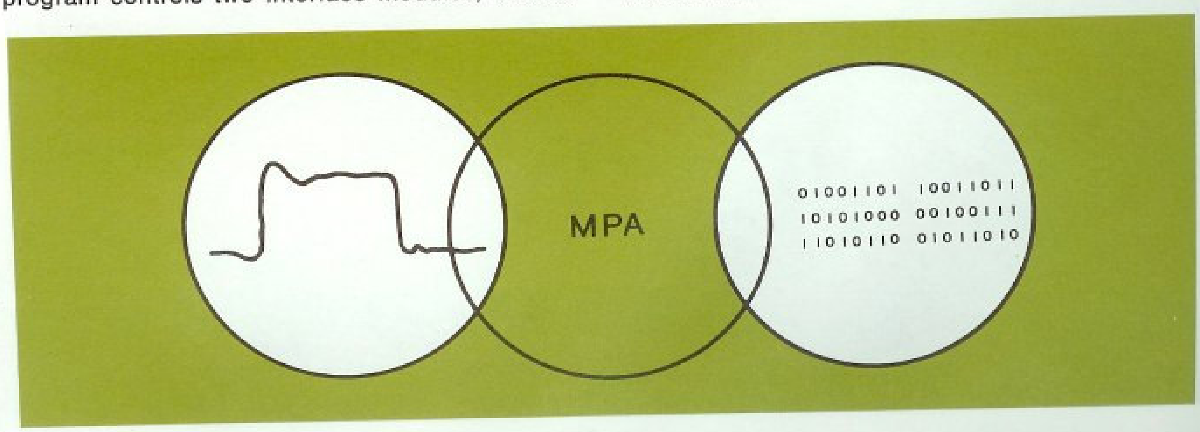
The communication between the MPA modules is handled by the Christian Rovsing A/S Serial Bus System.

PERFORMANCE

The max. data transfer rate over the MPA is 200 K bytes/sec. The transfer rate is largely determined by the ICL channel. The system uses byte packing and unpacking since the ICL system operates with 8 bit bytes as data units, while the EAI uses 16 bit data words.

FAST DESIGN AND DEVELOPMENT

Because of the flexibility of the modular micro-processor system, the MPA was designed and installed in less than 4 months.



CHRISTIAN ROVSING A/S
HARDWARE PROJECT

Client:
The Danish Road Laboratory

Stradograf

HW 32

THE STRADOGRAF

The Stradograf is a piece of equipment for measuring skid resistance and bumpiness of roads. The equipment is installed in a bus. It includes the Christian Rovsing A/S Processor which controls all measurements and calculations.

ROAD CURVATURE

The bumpiness of the road is calculated by using signals from two accelerometers. A double integration of these signals gives the curvature of the road. Distance and speed are computed from tachometer signals from the gear box. The air temperature is measured.

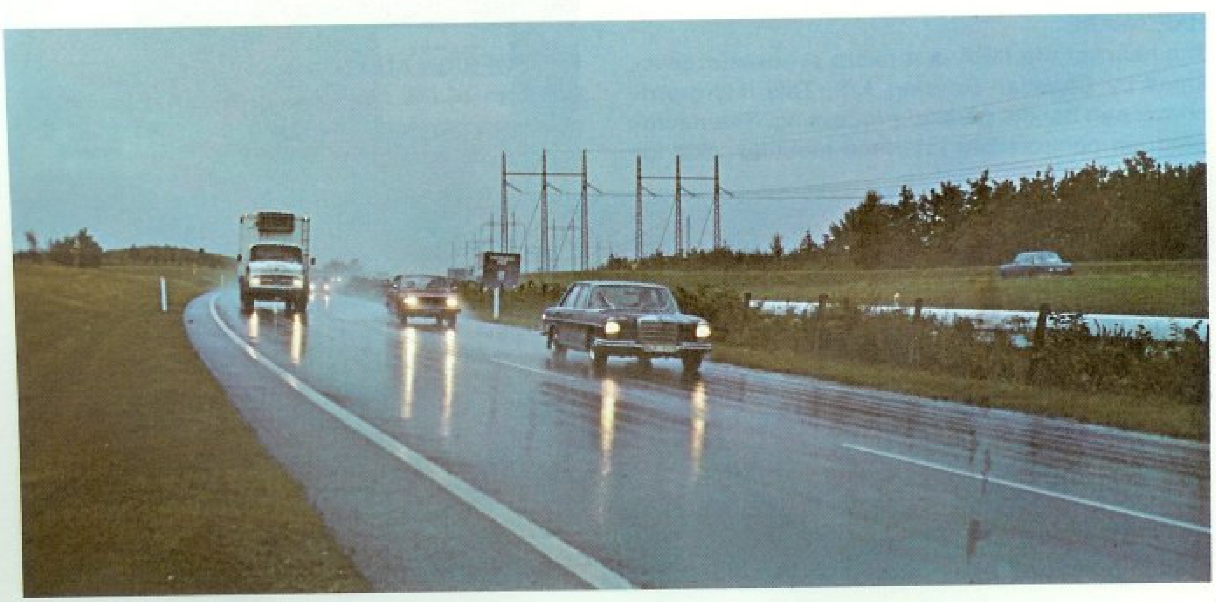
SIDEWAY FORCE COEFFICIENT

The equipment uses the well-established Sideway Force Method for measuring wet road skid resistance. Two test wheels are mounted under the bus, each with a toe-in of 12°. Water is led from tanks in the bus to the road in front of the test wheels.

The skid resistance of the road generates a sideway axial force on the test wheels, proportional to the resistance. Transducers inform the processor about the sideway forces and the corresponding vertical reactions on the axles, used to compute the sideway force coefficient.

SYSTEM – OPERATOR COMMUNICATION

Output from the measurements is recorded continuously, both on paper tape and on a strip chart. The operator may communicate with the system during the measurements, via a teletype terminal. Information about the latest measurements are shown on a VDU (Video Display Unit). When the operator presses a special push-button the VDU will display a picture sent from a TV-camera surveying the test wheels and the sprinkler system.



ID 40 1.10.1975 Form 9 second

CHRISTIAN ROVSING A/S
HARDWARE PROJECT

Client:
Copenhagen Airport

Aviation Control Tower Display System

HW 41

DISPLAY SYSTEM

Christian Rovsing A/S has implemented the display system used in the aviation control tower at the Copenhagen Airport.

PURPOSE

The main purpose of the system is to inform the air traffic controllers about the number of aircraft holding, and the number of aircraft expected to arrive in the next minutes.

DISPLAY FORMATS

The display system offers the air traffic controller a choice of different display formats. A part of the total display area may be selected and expanded four times. This feature is of great value for getting a more detailed view – especially in a period of heavy traffic.

SIGNAL PROCESSING

The display system receives its input from the DMA channel (Direct Memory Access) of an existing computer. The input signal is processed by Christian Rovsing A/S developed hardware. The hardware is based on a modular system for:

- control and storage of all information received from the existing computer system
- conversion of the input signal into a character string
- generation of a standard video signal based on the character string. The video signal is fed directly to the monitors

DISPLAY UNITS

Commercially available 625 scan 50 Hz video monitors are used as display units. These units easily satisfy requirements concerning resolution and intensity control.

ID 40 1.10.1975 Form 8 prime

CHRISTIAN ROVSING A/S
HARDWARE PROJECT

Client:
Copenhagen County Hospital Board

Electromagnetic Compatibility

HW 42

PROBLEMS

Electrical and electronic equipment in hospitals provides physicians and nurses with effective new tools. However, the equipment creates new problems. One of these is electromagnetic noise, i.e. noise which interferes with the measurement of small bio-electrical signals by reducing the signal/noise ratio drastically. The result may be that the signals disappear completely in the noise.

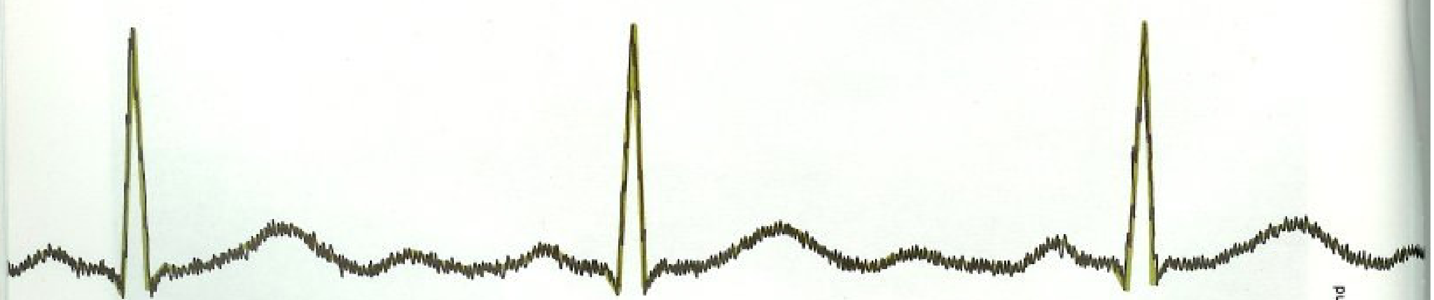
CONSULTANTS

Christian Rovsing A/S is a permanent consultant to the Copenhagen County Hospital Board in the field of Electromagnetic Compatibility. The company has the responsibility for proposing suitable precautions to be taken in the design and construction of new hospitals to allow later installation and operation of sensitive biomedical and electronic equipment without disturbance from electromagnetic noise.

SOLUTIONS

The noise problems are attacked by means of a variety of methods, including studies on:

- cable compatibility
- optimal interference fitting
- interference susceptibility improvements
- analogue and digital signal transmissions
- metal spray materials for shielding chambers
- semi-conductive materials for antistatic floors
- ground protection circuits.



ID 40 1.10.1975 Form 8 second

Client:
ESA, The European Space Agency

APSEF

COMPUTER CONTROLLED EVALUATION FACILITY

The Automatic Power System Evaluation Facility (APSEF) is a computer controlled station for testing prototype and engineering models of power distribution systems for satellites.

The system has been constructed by Christian Rovsing A/S and was delivered to the European Space Technology Centre, ESTEC in Holland in November 1973.

COMPUTER SYSTEM

The APSEF system was based on a computer system which included:

- a 16 K word main processor (HP 2100A)
- a paper tape reader
- a paper tape punch
- a teletype terminal

When applying APSEF the ESTEC test engineer programs the check-out sequences in a modified version of BASIC. After program debugging and verification the check-out sequences are executed.

SPECIAL EQUIPMENT

The following equipment is part of the system:

- digital voltmeter
- counter/timer
- signal generators
- voltage/current standard
- 5 KW solar array simulator
- oscilloscope
- selective voltmeter
- strip chart recorder
- current probes

BUS SYSTEM

The Christian Rovsing A/S Serial Bus System is an integral part of the APSEF computer system. The following modules of the bus system were used:

- Christian Rovsing A/S Processor with 256 24 bit words memory
- 2 K 16 bit data memory
- time base converters
- 10 bit A/D converters
- 10 bit D/A converters
- 8 channel level sensor (trigger unit)
- 12 channel reed-relay multiplexers
- reed-relay contact modules

The bus system allows for the transfer of analogue measurement values via the A/D converters to the digital data memory. The stored values may then be transferred to either the HP 2100A minicomputer for further processing or via the D/A converters to the oscilloscope or the strip chart recorder for display. The rate at which data are stored in or read from the data memory may

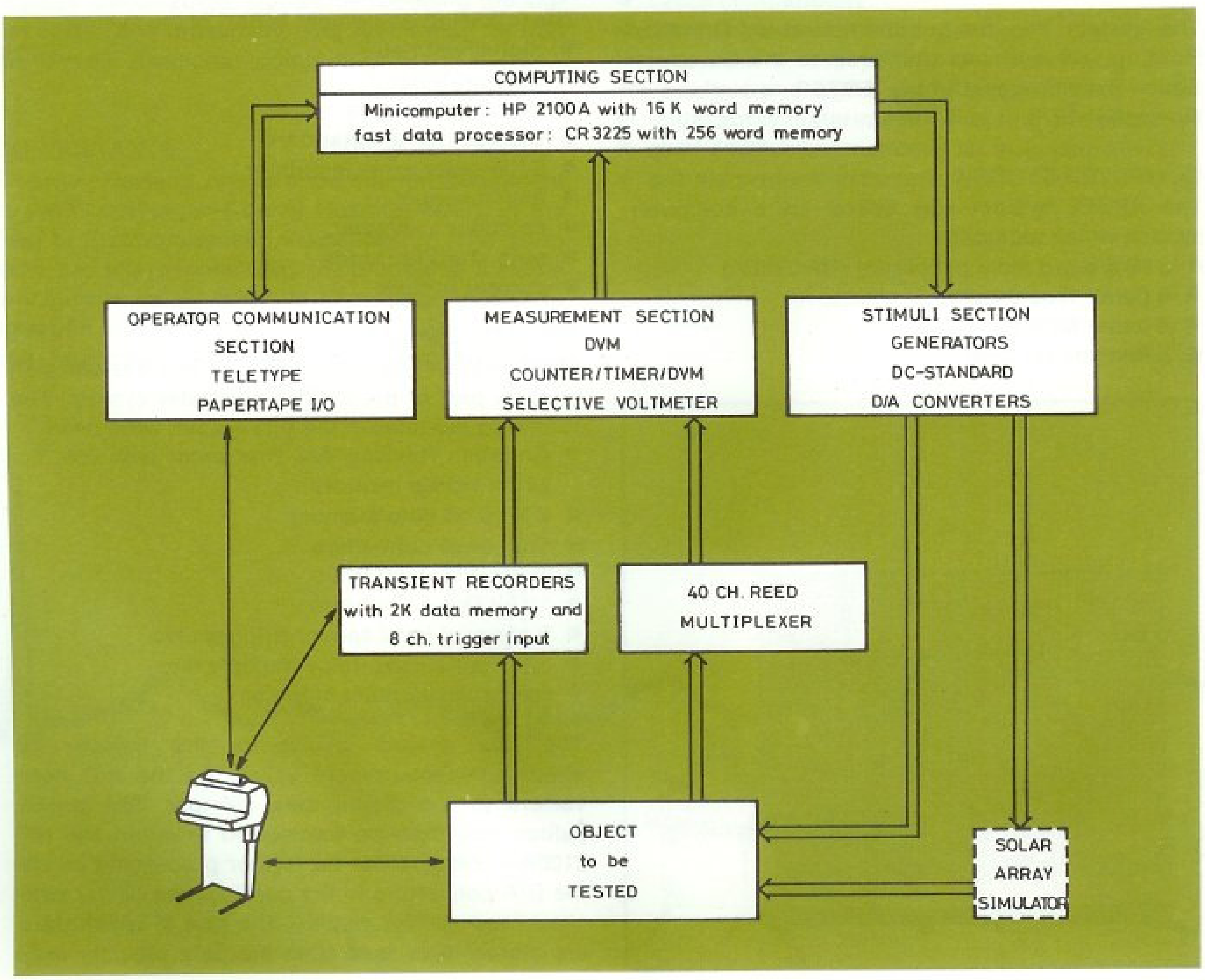
ID 40 1.10.1975 Form 4 prime

Client:
ESA, The European Space Agency

be chosen to be any value between 5μsec and 200 msec per data word. The transfer is stopped when a trigger level in the level sensor has been reached. The programs of the bus system may not be changed by the APSEF operator. All bus system modules may be controlled by the HP 2100A.

EXPERIENCE

Since its delivery to ESTEC, the APSEF system has been used successfully for testing equipment for the METEOSAT satellite. The APSEF system will later be used for testing the power supply of the GEOS satellite.



CHRISTIAN ROVSING A/S
HARDWARE PROJECT

Client:
ESA, The European Space Agency

Attitude and Orbit Control Electronics

HW 61

THE GEOS SATELLITE

Christian Rovsing A/S has developed part of the Attitude and Orbit Control (AOC) electronics for the GEOS satellite.

THRUSTERS

The spacecraft is equipped with 6 thrusters, which can displace the spacecraft or change the spinrate. The thrusters may be operated in two modes:

- continuous mode
- pulsed mode

CONTINUOUS MODE

The continuous mode is the most simple, because the thruster in use is commanded on/off by ground control. The number of revolutions is counted in order to decide when the thrusters must be switched off.

PULSED MODE

The pulsed mode requires 4 registers:

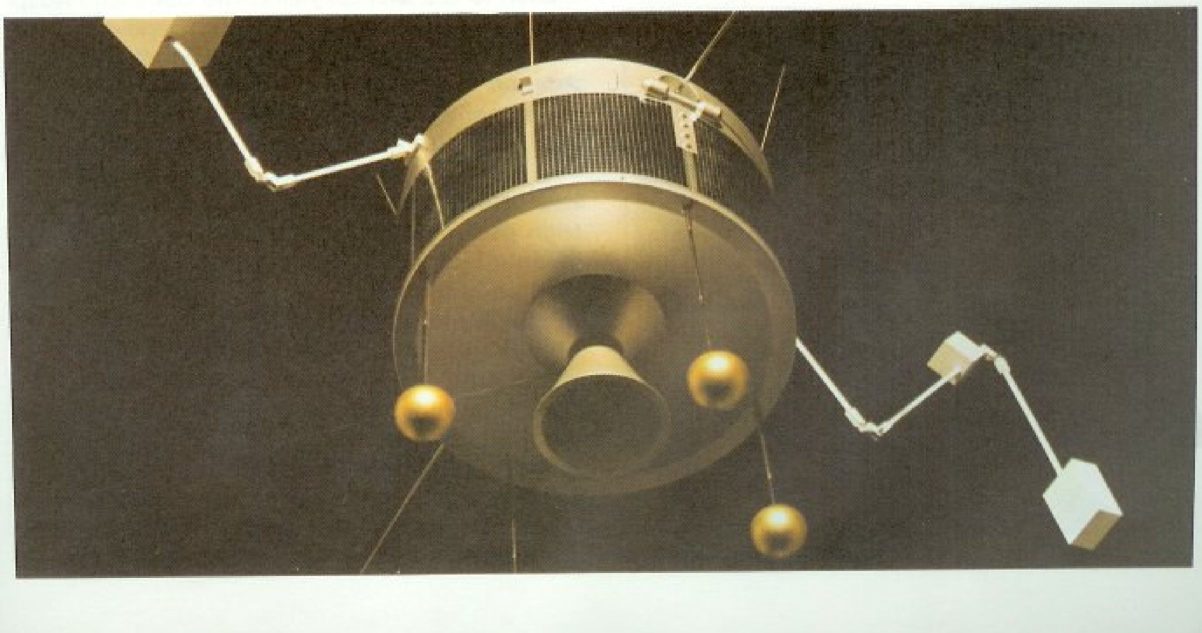
- delay
- pulse duration
- number of pulses
- rate and single command to heaters

REFERENCE

The AOC electronics receives reference information from either the sun-sensor or the infrared sensor. The delay, duration and rate are then referred to this pulse. Thus, the thrusters may be operated precisely in a defined direction.

HEAT DISSIPATION

In the project the AOC box was designed so that the high heat dissipation could be conveyed to the surface without creating »hot spots« in the box.



ID 40 1.10.1975 Form 6 prime

CHRISTIAN ROVSING A/S
HARDWARE PROJECT

Client:
ESA, The European Space Agency

OBC: On Board Computer

HW 62

SUBCONTRACTOR TO SAAB-SCANIA A/S

As a subcontractor to Saab-Scania A/S, Christian Rovsing A/S has participated in the development of an On Board Computer for the European Space Agency, ESA (formerly ESRO).

OBJECTIVE

The objective of the project, which started in 1972, was to develop a highly reliable On Board Computer to be available for future space programmes.
The first On Board Computers will be installed in the ARIANE launcher, and it is foreseen that it will be used in the EXOSAT Scientific Satellite.

DIRECT MEMORY ACCESS CHANNELS

Christian Rovsing A/S has been responsible for the three Direct Memory Access Channels (DMA) providing direct access to the memory for the telemetry and the telecommand channels. The DMA facility is achieved by the use of a bus-line to which the DMA channels and the memory, as well as the processing unit, are interfaced.

FAULT TOLERANT COMPUTING

The bus-line is doubled to achieve redundancy and fault tolerant capabilities, which means that all interfaces to the bus-line are doubled for security.

STANDARD VERSION

The standard version of the OBC uses three different DMA modules:

- TA – Telemetry Adaptor
- CA – Command Adaptor
- DA – Data Adaptor

The Telemetry Adaptor transfers the stored information to the telemetry link. The Command Adaptor will be used for loading the computer and for issuing commands in the spacecraft. The Data Adaptor constitutes the interface between the experiments and the On Board Computer, when high speed transfer capacity is required.

HIGH PACKING DENSITY

High packing density is achieved by using multilayer boards with 7 layers. Each board is 126x230 mm² containing 65 flat packages and approximately 60 discrete components.

UMBILICAL CORD TO GROUND STATION

During ground checkout of the ARIANE launcher, the On Board Computer is connected to the ground station via a coaxial umbilical cord. The communication circuits for this are also developed by Christian Rovsing A/S.

ID 40 1.10.1975 Form 6 second

CHRISTIAN ROVSING A/S
HARDWARE PROJECT

Client:
ESA, The European Space Agency

OTS: Orbital Test Satellite

HW 71

THE ORBITAL TEST SATELLITE

The Orbital Test Satellite (OTS) is an application satellite, which is being developed by ESA for launch in 1977. Its mission is experimentation in the field of telecommunications:

- telephony
- telemetry
- TV relay
- data transmission

The experiments will lead, by 1980, to the development of a satellite system, which will establish long distance communications and television links, covering Europe and the Mediterranean area.

Christian Rovsing A/S participates in the OTS program in the following areas:

PRIORITY SELECT AND INTERFACE UNIT

Christian Rovsing A/S has taken full responsibility for the design and manufacture of the Priority Select and Interface Unit. This unit has the following functions:

- it is part of the OTS tracking, telemetry, and command system
- it controls the selection between the SHF and VHF telecommand up-link
- it performs demodulation of the SHF telecommand up-link
- it performs filtering and stabilization of the telemetry signal before it is injected into the VHF and SHF down-link modulator

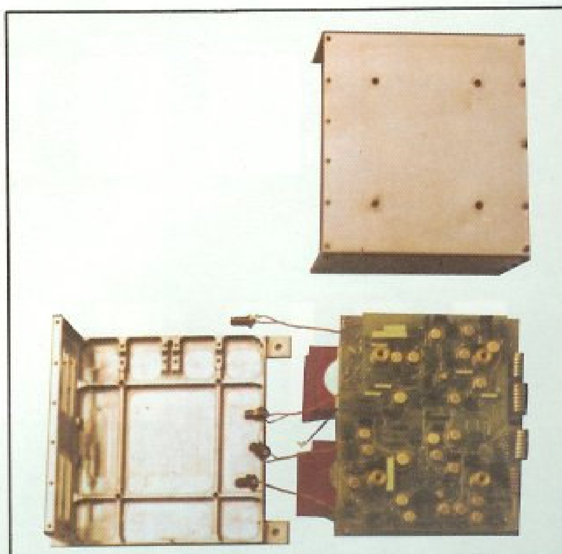
COMMAND EXECUTION UNIT

Christian Rovsing A/S has designed and developed the Command Execution Unit – the prime unit of the OTS Decoder. The design of the unit was based on the experience gained through the development of the On Board Computer (OBC). This resulted in the introduction of a separate input channel capable of receiving asynchronous signals from an OBC. In addition the Power Control Unit and the Time Tag Unit of the Decoder were also designed.

TEST EQUIPMENT

Through a number of contracts Christian Rovsing A/S has developed a modular and flexible technique for construction of electronic test equipment. The company will manufacture a large part of the test equipment for the Tracking, Telemetry, and Command Subsystem, including:

- PSIU – Tester
- Decoder – Tester
- Decoder – Simulator
- Encoder – Tester
- Encoder – Simulator



ID 40 1.10.1975 Form 4 prime

CHRISTIAN ROVSING A/S
HARDWARE PROJECT

Client:
ESA, The European Space Agency

Fault Tolerant Computing

HW 72

STUDY

The Fault Tolerant Computing (FTC) study was performed as a 3 man-year joint effort by Saab-Scania A/S and Christian Rovsing A/S. The full title of the study was:
»Study of Fault Tolerant Computing for On Board Spacecraft Applications«.

FAULT TOLERANT COMPUTING

Fault tolerant computing is the ability of a system to process specified algorithms correctly regardless of the presence of hardware failures and program errors.
Fault tolerant computing is introduced when the functioning of an entire system or of an application becomes critical for the success of a project.
FTC is used in the following areas:

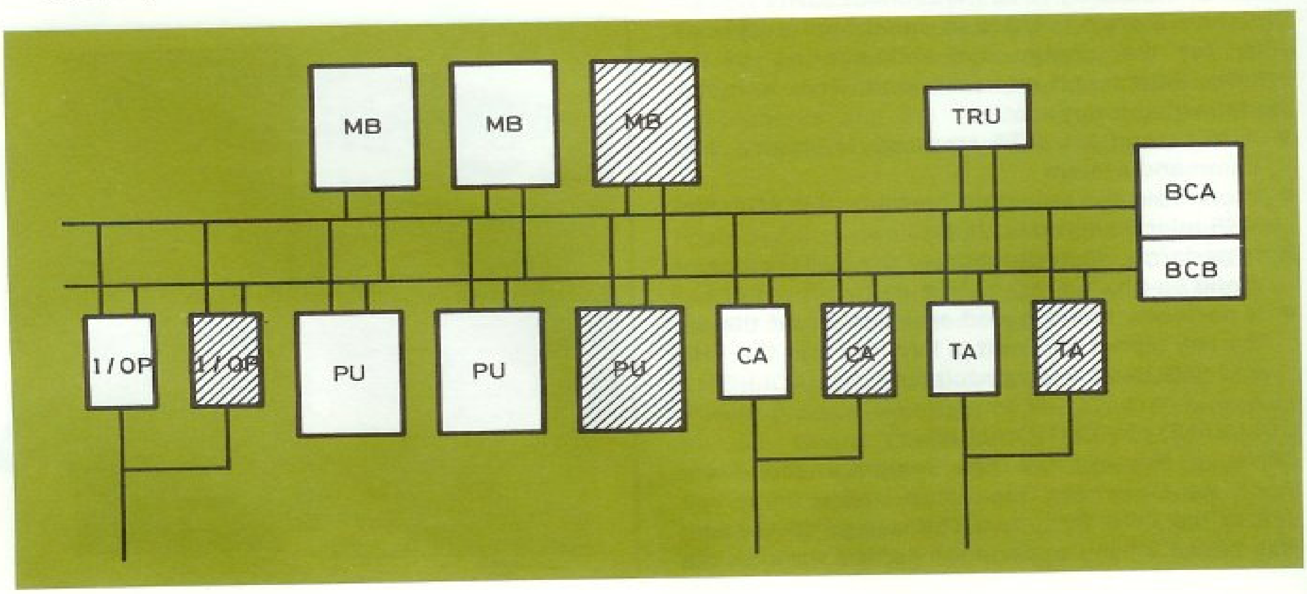
- long term space missions
- avionic systems
- industrial systems where down time has high cost implications.

OBJECTIVES OF THE STUDY

The objectives of the study were to:

- define the »state of the art« of FTC
- transfer FTC »know-how« to Europe
- outline the changes needed to make the ESA On Board Computer fault tolerant.

The first two objectives were met by performing an extensive survey of relevant literature since 1970. This was followed up by a visit to key personnel in U.S.A. who had contributed to the FTC area. The third objective was met by proposing a number of feasible configurations from the baseline On Board Computer together with the operating system needed to support the system in achieving fault tolerance.



ID 40 1.10.1975 Form 4 second

CHRISTIAN ROVSING A/S
SYSTEM PROJECT

Client:
ESA, The European Space Agency

Ariane

HW 81

ARIANE

ARIANE is the European counterpart to American launchers like the Thor Delta 3914. The ARIANE launcher is a three-stage rocket capable of placing 750 kg in a geostationary orbit.

ACTUATOR AMPLIFIERS

Christian Rovsing A/S participates in the ARIANE project by building the actuator amplifiers for the three stages.

The actuator amplifiers constitute the interface between the autopilot on top of the third stage and the servo-valves and servo-motors at each stage.

The main functions of the amplifiers are to transform the 3-axis control input to a command output. Position signals from the servo-valves and servo-motors are fed back to the amplifiers in a closed loop configuration. This loop is a part of the total guidance system.

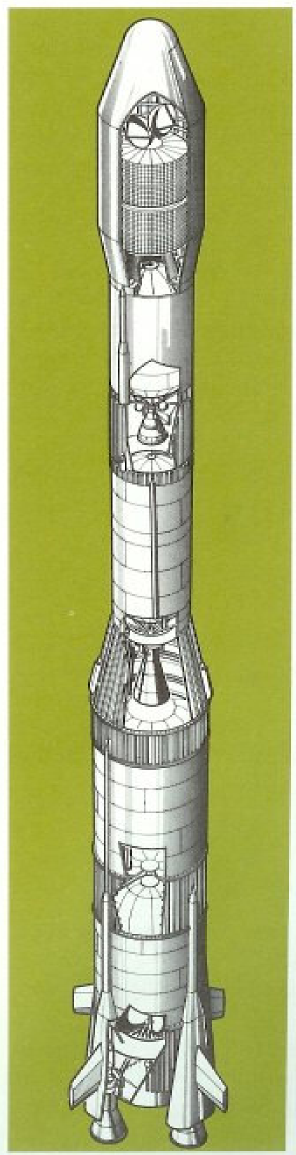
DC/DC CONVERTERS

Each of the actuator amplifiers in the three stages is equipped with a DC/DC-converter so that the power bus, the signal lines, and the telemetry signal lines are isolated from each other.

The DC/DC converter is designed to supply both DC power for the internal circuits and AC power (2400 Hz) for the actuator amplifiers.

1 ST STAGE

The four motors of the first stage are continuously controlled by four actuator amplifier modules with position detector feedback for each channel. Therefore the pitch, yaw, and roll commands are transformed into four analog outputs.



The actuator amplifiers of stage 2 and 3 differ from those of the 1st stage by having only two chains, controlling pitch and yaw.

2ND STAGE

At the 2nd stage the roll is controlled by a »bang-bang« servo with two thrusters switched ON/OFF by a level detection circuit in the amplifier.

3RD STAGE

The 3rd stage is equipped with six thrusters and consequently the amplifier for this stage is equipped with six thruster drivers giving three-axis quidance control after engine burn-out.

PHYSICAL DIMENSIONS

Each amplifier is built into a box of the approximate size 225 x 200 x 150 mm, weight 4 kg.

HARDWARE PRODUCTION

35 complete units plus a number of test and mock-up units have been planned for this project.

ID 40 1.10.1975 Form 5 prime

The CR80 Processor

MODULAR PROCESSOR SYSTEM

Christian Rovsing A/S has developed a modular processor system, the CR80.
Due to a high degree of standardisation, the processor is competitive, both costwise and technically, with other commercially available systems.

FLEXIBILITY

The flexibility of the CR80 has been achieved by micro processors, which today are inexpensive, and meet all reliability requirements. The customer's individual wishes can easily be accomodated in the system, and later extensions can be carried out without problems.

Maintenance problems have been reduced to those of testing and replacement of the defective modules.

BUS SYSTEMS

The CR80 system is built around a common bus structure, the »main bus«, to which all modules have access. For internal communication between the CPU and the memory, a »sub bus« has been implemented in the system enabling these modules to transfer data without the main bus.

MODULARITY

The CR80 system consists of the following:

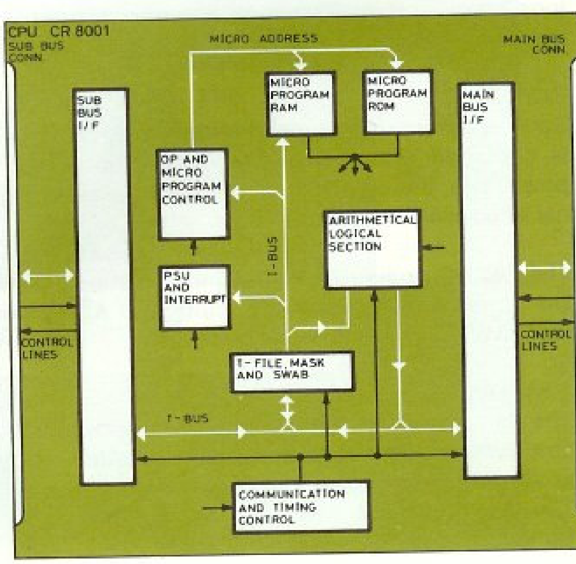
1. Interface modules used for communication with the outside world.
2. Memory modules. Standard size is 4K words of 16 bits.
3. Monitor modules used for driving CRT-monitors. Both alphanumeric or graphic pictures can be generated, either in colour or in black and white.
4. Control modules including the CPU; the CPU module controls the MAIN BUS.
5. Internal modules supervising the system. One module handles parity checking on the »main bus«.
6. Power Distribution Modules.
7. Function Modules performing special tasks under supervision of the CPU modules.

APPLICATIONS

- Process control
- CRT display (colour or B/W)
- Image processing
- Array processing

PHYSICAL DIMENSIONS

The different modules are mounted in a 19 inch crate, size: W = 460 mm, H = 266 mm and D = 221 mm. One crate contains max 25 modules.



CHRISTIAN ROVSING A/S
COPENHAGEN · DENMARK

SOFTWARE

SW 01

ID 40 1.10.1975 Form 2 prime

CHRISTIAN ROVSING A/S
COPENHAGEN · DENMARK

Software Projects

SW 02

SOFTWARE TYPES

Christian Rovsing A/S is engaged in the development of computer software at three levels:

1. Standard and support software needed to operate a given computer.
2. Application programs (technical, scientific, and commercial).
3. Software systems (consisting of a number of interdependent programs which share a common data base).

The software implemented by the company includes the categories:

- commercial systems (for budgeting, invoicing, bookkeeping, sales statistics, stock control, payroll and tax calculations)
- on-line control and communication systems
- compilers
- graphical support software
- programs for technical simulation and optimisation
- scientific calculations and simulations

SOFTWARE DESIGN PRINCIPLES

All Christian Rovsing A/S software is implemented within the general project management framework of the company, and according to the following design principles:

- Explicit requirement definition: A full definition of the software requirements, accepted by the user, is taken as a necessary condition for any programming to start.
- Comprehensive communication: All programs are designed so as to make them easy to use. Ideally the output from a program should be directly applicable to the user, without any need to consult other information (e.g. manuals).
- Modularity: Program control paths are made visible and simple in the written code, and programs are built from comprehensive modules, the process within each module being relatively simple.
- Optimal processing: Programs which are time or core critical are identified as early as in the definition phase, and an evaluation takes place of time and core limitations against such criteria as visibility, generality, and maintainability.
- Adequate documentation: Documentation for all programs adheres to company standards. This is to ensure, in the implementation phase, that the written software meets the standards set, and in the operational phase, that the software can be maintained economically.

SOFTWARE CLIENTS

The software clients of the company include:

- The Danish P&T
- KTAS: The Copenhagen Telephone Co.
- B&W: Burmeister & Wain, (shipbuilders)
- IRMA A/S (Denmarks major chain of quality food stores)
- F. L. Smidth & Co. A/S (World wide cement plant manufacturers)
- The Copenhagen Airport Authorities
- ESA: The European Space Agency (formerly ESRO, The European Space Research Organization)
- Lufthansa German Airline

ID 40 1.10.1975 Form 2 second

Data Acquisition and Communication System

IRMA A/S

IRMA A/S is the largest privately owned supermarket chain in Denmark. With more than 180 branches, 12 factories, and about 3,000 employees, IRMA is a leading company in the retail food industry.

PERISHABLE GOODS

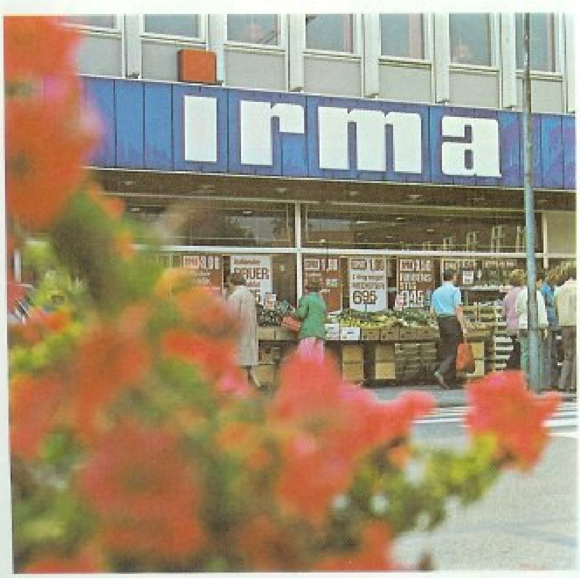
As service and quality are the two most important objectives, IRMA wanted to improve the distribution of perishable goods like vegetables and meat, by speeding up the servicing of orders for such commodities.

ON-LINE SYSTEM

The solution was an on-line system with the following features:

- on-line order entry
- statistical analysis of sales
- forecasting
- analysis of supplies on a daily basis

The system was delivered by Christian Rovsing A/S.



ORDERING PROCEDURE

During the day the supermarket personnel report sales, and order deliveries for the next morning. Orders are entered into the system immediately and processed during the night. Early the next morning schedules are sent to the meat and vegetable packing departments. Furthermore, orders are sent to the buyers at the Copenhagen Vegetable Wholesale Market. All deliveries to the branches take place the same morning.

THE HARDWARE

A minicomputer system at IRMA headquarter handles all order entries. The system is equipped with:

- a 24 K words minicomputer (MULTIBUS)
- a 10.6 M bytes disc
- 6 VDU's
- a printer

DATA PROCESSING

The orders are validated immediately by the minicomputer and stored on disc. At the end of the day all data are transmitted via a dial-up line to the Christian Rovsing B6700 computer. The data are processed during the night so that the results are available early the next morning, before work begins at the meat and vegetable packing departments.

EXPERIENCE

The system was delivered June 1, 1974. The system has enabled IRMA to reduce the order delivery cycle time to less than one day.

ID 40 1.10.1975 Form 4 prime

CHRISTIAN ROVSING A/S
SOFTWARE PROJECT

Client:
Grammofonselskabs Distributions Centralen A/S

Stock Order Control System

SW 12

GRAMMOFONSELSKABS DISTRIBUTIONS CENTRALEN A/S

Grammofonselskabs Distributions Centralen A/S (GDC) is the local distributor for several Danish and foreign record companies. The company covers one third of the total record sales in Denmark.

PROBLEMS

The main problems facing GDC were:

- difficulties in achieving fast delivery, particular of »top-ten« records
- an ever growing number of back orders, which often became obsolete and had to be cancelled

SOLUTION

Christian Rovsing A/S proposed and delivered a solution based on an on-line order entry system for:

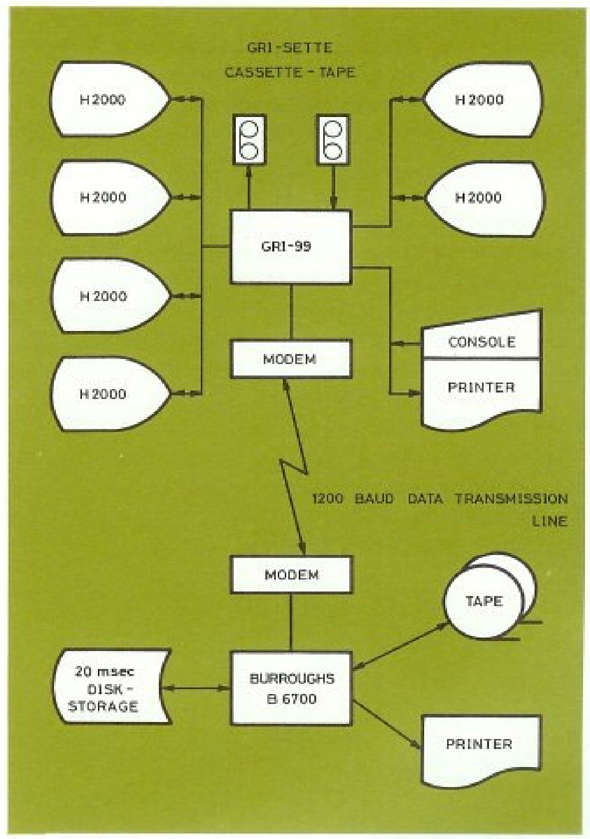
- immediate invoicing of records in stock
- automatic back order registration

THE SYSTEM

The system consists of the following equipment:

- GRI 99 minicomputer, to function as a data concentrator, and as a control unit for peripherals and the message switching unit
- 4 VDU's for entry of information
- 2 VDU's for inquiries, cash receipts, and registration of deliveries from suppliers
- 30 cps matrix printer for the printout of invoices and daily balances
- 1200 baud leased data transmission line to the Christian Rovsing A/S Burroughs B6700 computer

All B6700 files are stored on disc. The B6700 computer also takes care of all the routine work,



such as statistics and accounts, as well as the printing of all lists and reports.

EXPERIENCE

Experience until now has shown that the system easily handles up to 15,000 back orders and still maintains a reasonable response time. Today GDC is able to deliver records in the greater Copenhagen area within a few hours of the orders being received.

ID 40 1.10.1975 Form 4 second

Client:
Barfod & I. Chr. Petersen A/S

On-line Order Processing System

SW 21

BARFOD & I. CHR. PETERSEN A/S

Barfod & I. Chr. Petersen A/S is a leading wholesaler of paper and office commodities. Its customers range from paperstands, bookshops, and the company's own retail shops to public institutions and agencies. The product line consists of brand products and special products some of which are produced by the company.

TURNKEY MINICOMPUTER SYSTEM

Early in 1974 Barfod & I. Chr. Petersen A/S decided to install an on-line EDP system for:

- order entry
- invoicing
- inventory control
- production control

The company wanted in-house computing, but did not want special EDP-personnel. The solution was a turnkey minicomputer system delivered by Christian Rovsing A/S, based on a 32 K words minicomputer (MULTIBUS).

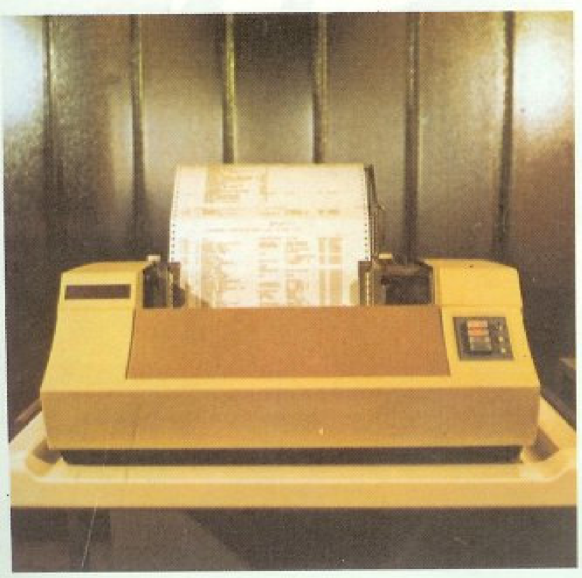
BURROUGHS B6700

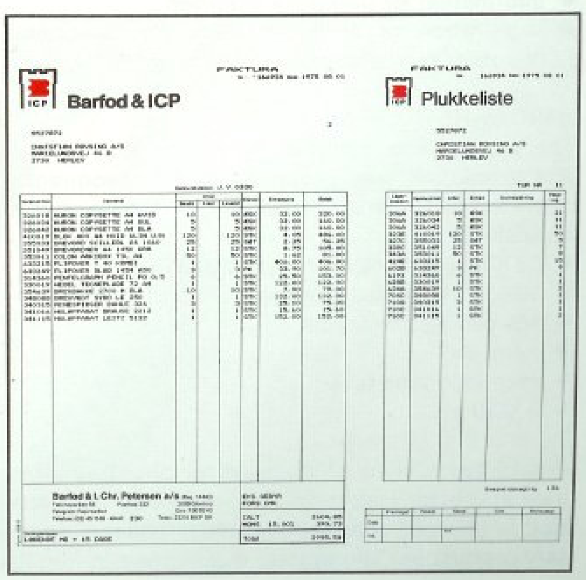
Accounts receivable, sales statistics, and some other batch procedures are not run on the minicomputer system. The necessary data are loaded on magnetic tape and brought to the Burroughs B6700 computer at Christian Rovsing A/S for processing.

BENEFITS

The system provides Barfod & I. Chr. Petersen A/S with

- all the benefits of a compact on-line in-house computer system and
- the power of a large computer center, when needed.




FAKTURA

Barfod & ICP

FAKTURA

Plukkeliste

ID 40 1.10.1975 Form 4 prime

CHRISTIAN ROVSING A/S
SOFTWARE PROJECT

Client:
Telefonverk Føroya Løgtings

Technical Information System

SW 22

THE FAROE ISLANDS

The Faroe Islands lying in the North Atlantic Ocean halfway between the Shetland Islands and Iceland is a group of about 30 small islands. The islands cover about 1,400 km², with a population of approx. 40,000 inhabitants. The Faroe Islands have a »home-rule« constitution with a local government and parliament (Løgting).

TECHNICAL INFORMATION SYSTEM

In connection with a 70 million Danish Kroner modernization programme, the local telephone company, Telefonverk Føroya Løgtings, decided to look for an EDP solution to their technical information system. The main tasks of this system would be:

- registration of all cables and wires
- registration of all technical installations of the subscribers
- information for directory inquiries
- registration of all information for telephone directory publishing.

HARDWARE

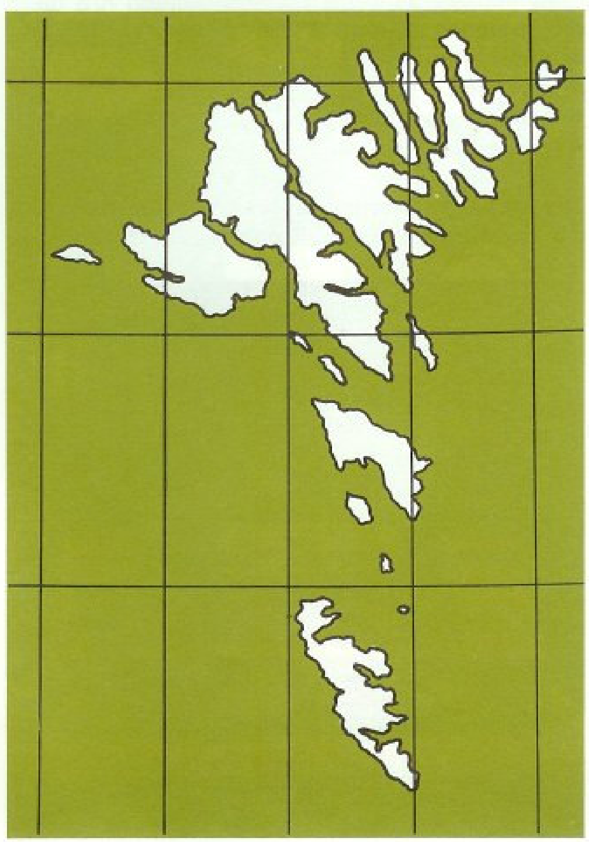
The project was initiated by a feasibility study, and a solution was proposed and subsequently delivered by Christian Rovsing A/S. The hardware consists of:

- 32 K words minicomputer (MULTIBUS)
- 10.6 M bytes disc storage
- 165 cps matrix printer
- teletype
- magnetic tape unit
- 3 VDU's

One of the VDUs is solely used for directory inquiries and error reporting. The magnetic tape station is used in connection with telephone directory production. The system is designed to handle all letters in both the Faroe and Danish alphabet (12 more than in the English alphabet).

EXPERIENCE

By using this system the Faroe Islands telephone company has been able to rationalize its technical administration of 16,000 subscriber sets and 40,000 cables. In 1975 the system will be extended to include invoicing and financial accounting facilities.



ID 40 1.10.1975 Form 4 second

TV Field Intensity Determination

INTERNATIONAL COORDINATION OF TV FREQUENCIES

The Danish Post and Telegraph Authorities (P&T) operate the Danish television network and participate in the international coordination of TV frequencies and field intensities. The fastly increasing number of radio and TV stations and the limited number of available frequency bands make such coordination necessary.

COVERAGE OF TV STATIONS

To ensure that an acceptable TV-picture can be received all over Denmark, the P&T must be able to calculate the coverage of every TV-station taking into account interfering stations. Therefore it is necessary to register relevant data concerning all European TV stations which might interfere with the Danish stations.

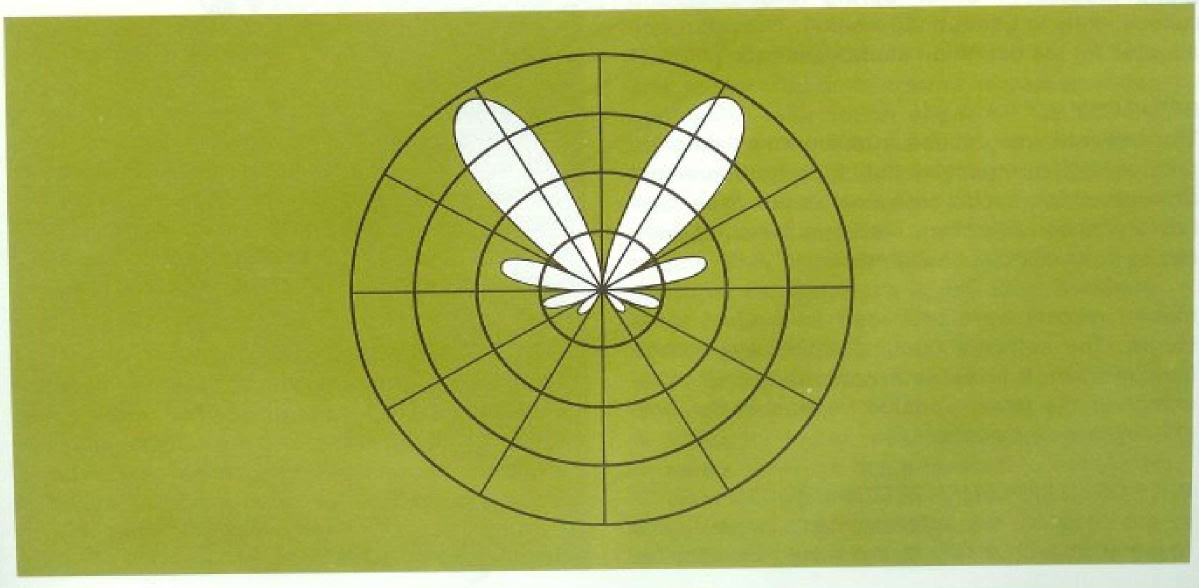
SORTWARE PACKAGE

In close cooperation with the Danish P&T Christian Rovsing A/S has implemented a software package which provides the tools for:

- registration of UHF TV stations in Denmark and neighbouring countries
- computation of the necessary field intensity for a specified TV station at a specified point
- computation of the coverage of each TV station by determination of the field intensities at points around the station
- determination of a proper channel for a specified station

The software package has been programmed in FORTRAN and COMPASS and runs on a CDC Cyber 72 computer.

Since its delivery the package has been used in the final planning of the Danish UHF TV network.

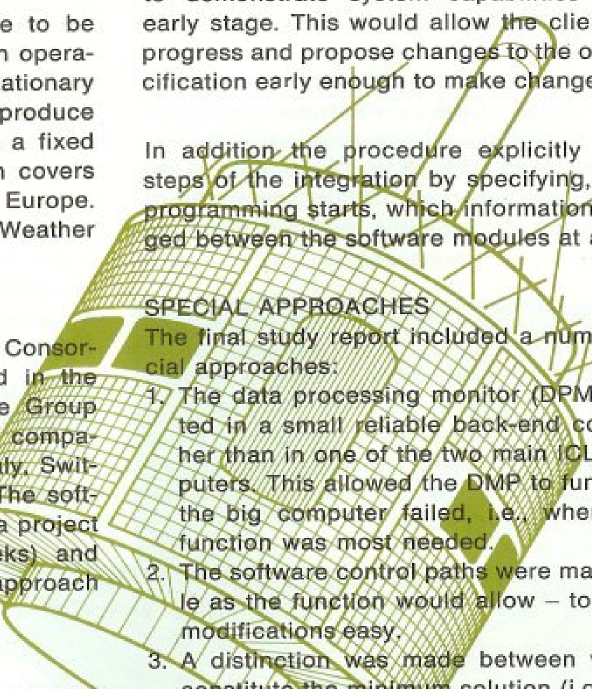


CHRISTIAN ROVSING A/S
SOFTWARE PROJECT

Client:
ESA, The European Space Agency

METEOSAT Definition Study

SW 32



THE SATELLITE

METEOSAT is a meteorological satellite to be launched by ESA. It is scheduled to be in operation from 1977. The satellite will be in a stationary position above the Equator, and it will produce meteorological information according to a fixed schedule. The METEOSAT field of vision covers most of Africa, and Southern and Mid Europe. METEOSAT will be part of the World Weather Watch System (WWW).

THE METEOSAT SOFTWARE STUDY

As a member of the Group One Software Consortium, Christian Rovsing A/S participated in the definition of the Meteosat software. The Group One Consortium consists of a number of companies from England, France, Germany, Italy, Switzerland, Sweden, Spain, and Denmark. The software definition study was carried out by a project group located in Silver Spring (6 weeks) and subsequently in London (20 weeks). The approach adopted for the definition study included:

STRATEGY

The software was defined in a top-down manner, progressing from general definition and concepts to levels of increasing technical detail. When necessary, specialists were called in for short periods to solve special problems.

Interim reports were produced as project milestones. The software documentation and classification made it possible to incorporate all information in the latest updated version in the final (12-volume) study report.

PROPOSED IMPLEMENTATION PROCEDURE

In the proposal the software items were linked together in such a way that it would be possible to demonstrate system capabilities at a very early stage. This would allow the client to judge progress and propose changes to the original specification early enough to make changes possible.

In addition the procedure explicitly defines all steps of the integration by specifying, before the programming starts, which information is exchanged between the software modules at all levels.

SPECIAL APPROACHES

The final study report included a number of special approaches:

1. The data processing monitor (DPM) was located in a small reliable back-end computer rather than in one of the two main ICL 2980 computers. This allowed the DMP to function when the big computer failed, i.e., when the DMP function was most needed.
2. The software control paths were made as simple as the function would allow – to make later modifications easy.
3. A distinction was made between what would constitute the minimum solution (i.e., which set of modules must be operational when the satellite is launched) and modules which may be added later - the aim being to have the minimum solution ready as early as possible within the very short period of time allocated.

COST STRUCTURING

In the COST proposal the consortium accepted full responsibility for the production and the integration of all software. Software costs were broken down into unit and integration costs, and included a procedure for calculating the impact on integration costs of removing software units or introducing new units.

ID 40 1.10.1975 Form 7 second

CHRISTIAN ROVSING A/S
SOFTWARE PROJECT

Client:
The Power Plants of Southern Seeland

SW 41

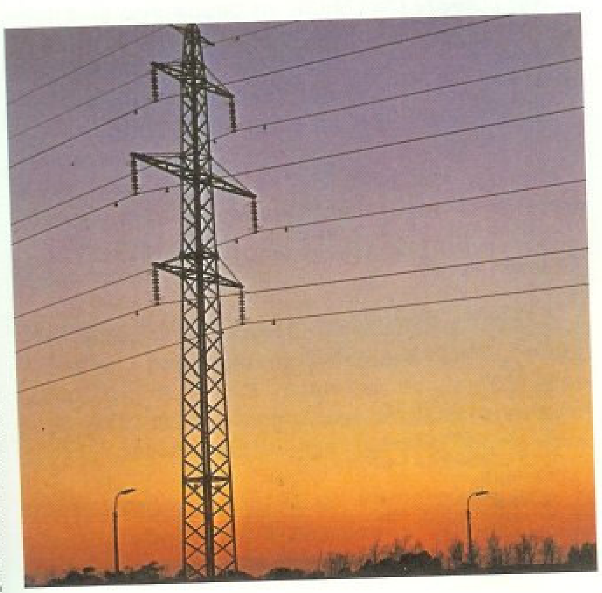
On-line Data Base System

S.E.A.S.
S.E.A.S. is a company providing electrical power distribution to approximately 120,000 customers in the southern part of Denmark (Sydsjælland, Møn, Falster, and Lolland).

PREVIOUS EDP INSTALLATION
S.E.A.S. had a Burroughs B 283, which was magnetic tape based. This installation was used for such administrative functions as

- invoicing
- accounting
- technical registrations
- salary registrations

Experience with the Burroughs B 283 led to a desire for a modern, on-line database system, where users, via terminals, would have easy access to a central database.



ON-LINE DATABASE SYSTEM
In 1972 S.E.A.S. purchased a Burroughs B3500 system. The software was designed in the spring of 1973, programmed during the autumn 1973, and put into operation, January 1974.

CONSULTANCY
S.E.A.S. had one Christian Rovsing A/S software consultant permanently stationed during the design and implementation of the database system.

The consultant had the following tasks

- design of the system
- assistance during software implementation and testing
- training of S.E.A.S. personnel to take over the new system

ON-LINE DATABASE
The system is built around a central database containing information about all 120,000 electrical installations and 4,000 transformer stations. The Burroughs database system FORTE is used. The system is so designed that the database can be easily and regularly updated from 9 data terminals. This ensures that any information accessed from the database is the latest available.

BATCH PROCESSES
The batch processes consist of a monthly cycle where

- forms for meter readings are produced
- meter readings are entered into the system
- invoices are prepared
- payments are registered
- reminders are printed

ID 40 1.10.1975 Form 8 prime

Client:
ESA, The European Space Agency

Software Conversion

SW 42

PROJECT MANAGEMENT

During 1972 Christian Rovsing A/S bid for and won the project management of the conversion of the European Space Agency's (ESA's) off-line software from the IBM 370/155 to the ICL 4/72 system.

The project was handled by a project manager with a team of 6 analysts and programmers located on the customer's site in Holland. The project also involved distribution and management of subcontracts to 6 European countries.

TASKS

The conversion project consisted of both the development of new mathematical routines, simulation languages and graphics software, and the conversion of existing application programs.

Some of the tasks were

- Conversion of approximately
  400 FORTRAN programs (350,000 statements)
  65 PL 1 programs (35,000 statements)
  70 assembler programs (12,000 statements)
- Conversion of the Octopus system, a system designed to provide effective means of introducing jobs into the IBM 370 system.
- Conversion of the MPA software. The MPA (Multi Processor Adaptor) is an interface between the IBM 370 and the EAI hybrid computer installed at ESTEC.
- Conversion of the CSMP III Package. The CSMP (Continuous System Modelling Program) is a continuous digital simulation system running on an IBM 370.
- Development of a Universal Graphics Package.
- Providing ESA with an interactive text editor.
- Providing ESA with a formula manipulation language for orbit calculations.

```
      SUBROUTINE ASD (IPR,LL,LU,DAT2,DAT3,TIM2
     *OTAB,DIF,SD,AV,ICH,SCN,*,*)
      DIMENSION ICH(1),IRS(1),SD(1),AV(1),T2(1
     *          X(100),VALS(768)
      REAL*8 DAT2,DAT3,TIM2,TIM3,SCN
      INTEGER*2 NCH(1),        IRS,ICH,JCH(100)
      LOGICAL*1 CL(768)
      CALL PROC (IPR,LL,LU,T2,NCHR,NCHS,NCHA,I
      DO 1 I=1,IC
      X(I)=0.
      AV(I)=0.
      SD(I)=0.
    1 DIF(I)=0.
      CALL CHECK (IC,IRS,ICH,NCH,JCH,NCHR,NCHS
      MK=0
    9 CALL SCAN (DAT2,TIM2,ITIM,SCN,VALS,CL,&2
      IF (MK.NE.0) GOTO 10
      MK=1
      TIM3=TIM2
      DAT3=DAT2
   10 DO 11 I=1,IC
      J=JCH(I)
      IF (CL(J)) GOTO 11
      S1=VALS(J)
      AV(I)=AV(I)+S1
      SD(I)=SD(I)+S1*S1
      X(I)=X(I)+1.
   11 CONTINUE
      GOTO 9
   21 S1=0.
      S2=0.
      S3=0.
      DO 23 I=1,IC
      IF (X(I).EQ.0.) GOTO 23
      AV(I)=AV(I)/X(I)
      DIF(I)=AV(I)-OTAB(I)
      IF (X(I).LE.1.) GOTO 22
      SD(I)=SQRT(ABS(SD(I)-X(I)*AV(I)*AV(I))/(X
      S1=S1+SD(I)
   22 S2=S2+AV(I)
      S3=S3+OTAB(I)
   23 CONTINUE
      Z=FLOAT(IC)
      N=IC+1
      SD(N)=S1/Z
      OTAB(N)=S3/Z
      AV(N)=S2/Z
      DIF(N)=AV(N)-OTAB(N)
      RETURN
   91 RETURN 1
   92 RETURN 2
      END
```

ID 40 1.10.1975 Form 8 second

CHRISTIAN ROVSING A/S
SOFTWARE PROJECT

Client:
ESA, The European Space Agency

Document Retrieval System

SW 51

AIM OF STUDY

Together with Datasaab, Sweden, Christian Rovsing A/S conducted a feasibility study to investigate and design an interactive document retrieval system for ESA, the European Space Agency (formerly ESRO). The aim of the study was to propose a replacement for the existing ESA RECON document retrieval system.

THE RECON DATABANK

In January 1974 the RECON databank consisted of 9 databases in several scientific fields:

- aeronautical and aerospace research
- chemical science
- nuclear science
- electronics
- social science

The total databank contained more than 1,600,000 abstracts referenced by more than 700,000 terms.

REQUIREMENTS

The system requirements were:

- all existing facilities to be implemented by the new system
- response time to be less than five seconds
- storage to be more than three Giga bytes (3×10^9 bytes)
- low cost

PROPOSED HARDWARE CONFIGURATION

Datasaab proposed a hardware configuration consisting of a D23 computer as central computer with D5 minicomputers as front end computers, concentrators, and terminal computers.

PROPOSED DOCUMENT RETRIEVAL SYSTEM

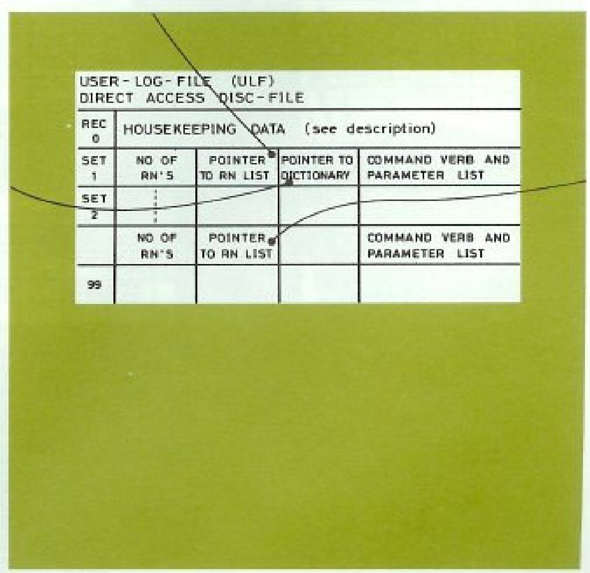
Christian Rovsing A/S designed a new document retrieval system with the following features:

- all existing features incorporated
- facilities for connecting a variety of terminals to the system
- inquiry language allowing the user to communicate with the system in his own language using either full words or abbreviations
- special features enabling the user to improve his search strategies and to minimize his connection time
- easy restart after failure

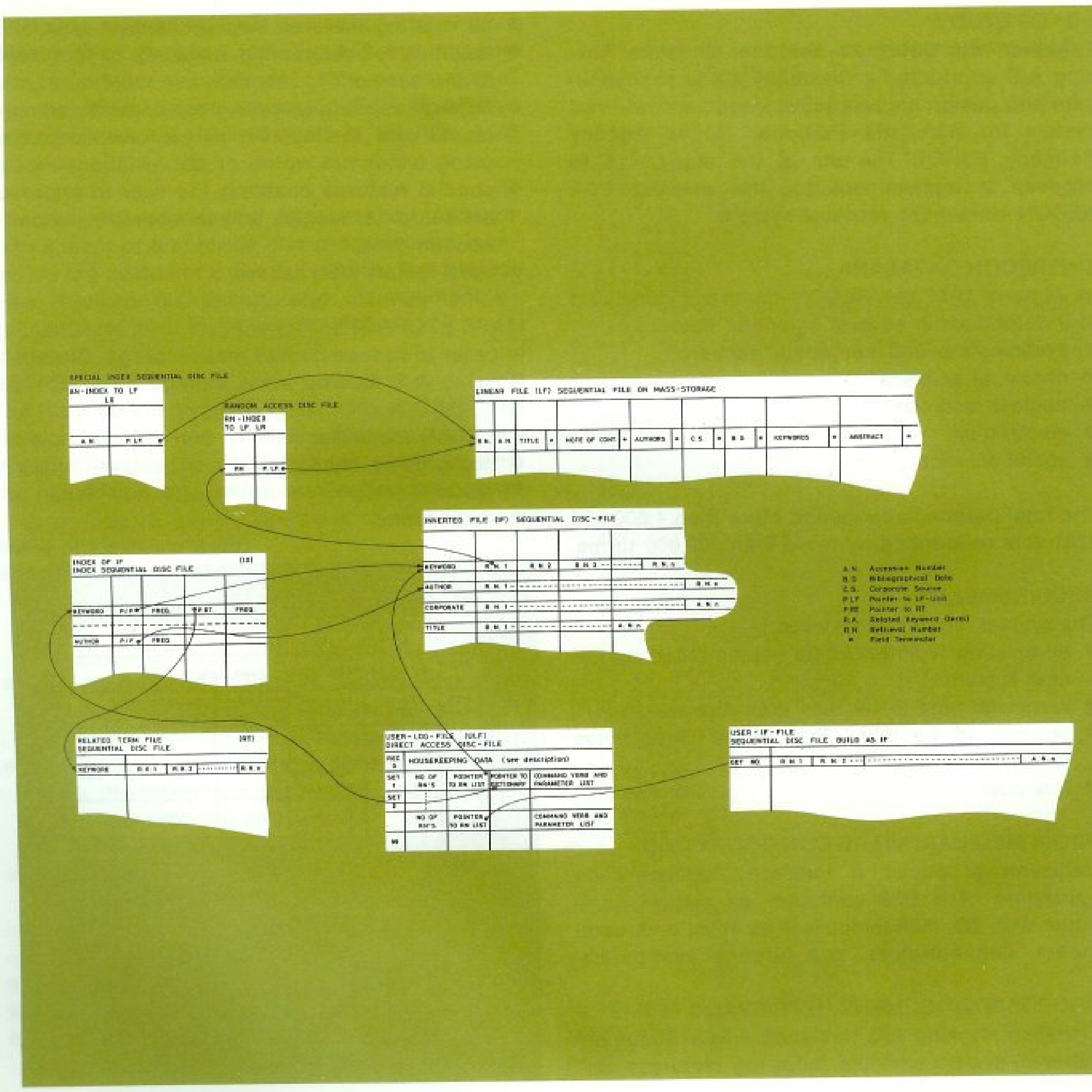
MASS STORAGES

In order to reduce cost of mass storage, Christian Rovsing A/S studied mass storage devices such as

- LASER memories
- holographic memories
- discs
- mass tapes



ID 40 1.10.1975 Form 5 prime


SPECIAL INDEX SEQUENTIAL DISC FILE
RANDOM ACCESS DISC FILE
LINEAR FILE (LF) SEQUENTIAL FILE ON MASS-STORAGE
TITLE
AUTHORS
KEYWORDS
ABSTRACT
INVERTED FILE (IF) SEQUENTIAL DISC-FILE
KEYWORD
AUTHOR
CORPORATE
TITLE
INDEX OF IF
INDEX SEQUENTIAL DISC FILE
RELATED TERM FILE (RT)
SEQUENTIAL DISC FILE
USER-LOG-FILE (ULF)
DIRECT ACCESS DISC-FILE
HOUSEKEEPING DATA (see description)
POINTER TO RN LIST
POINTER TO DICTIONARY
COMMAND VERB AND PARAMETER LIST
USER-IF-FILE
SEQUENTIAL DISC FILE BUILD AS IF
SET NO.

CHRISTIAN ROVSING A/S
SOFTWARE PROJECT

Client:
ESA, The European Space Agency

Attitude Determination

SW 61

STUDY CONTRACT

In 1972 the Information Handling Department of ESOC placed a study contract with Christian Rovsing A/S. The purpose of the contract was to evaluate three different attitude determination methods for the HEOS A2 satellite.

HEOS A2

Heos A2 is a spin-stabilized satellite investigating interplanetary magnetic fields and solar particles. HEOS A2 was launched on January 31st 1972.

ATTITUDE DETERMINATION METHODS

The three attitude determination methods evaluated were.

- a least squares estimation using the Lagrange multipliers technique
- a least squares estimation using an iterative technique
- a direct determination of the spin axis vector

COMPUTER SIMULATION

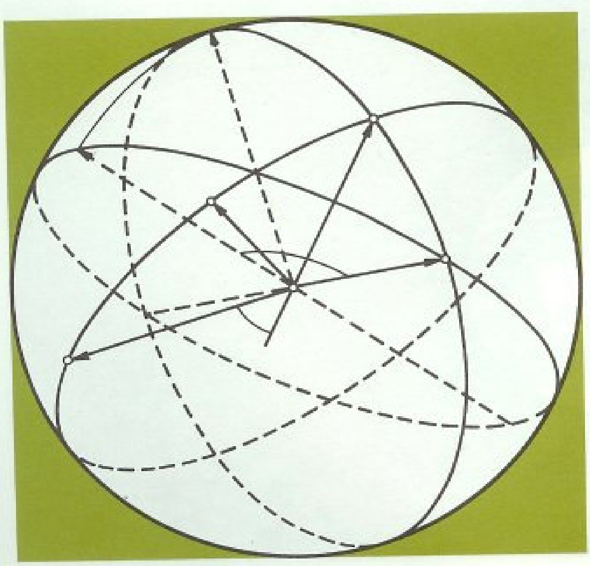
Computer programs simulating the methods were written, and HEOS A2 attitude data were used to evaluate the algorithms.

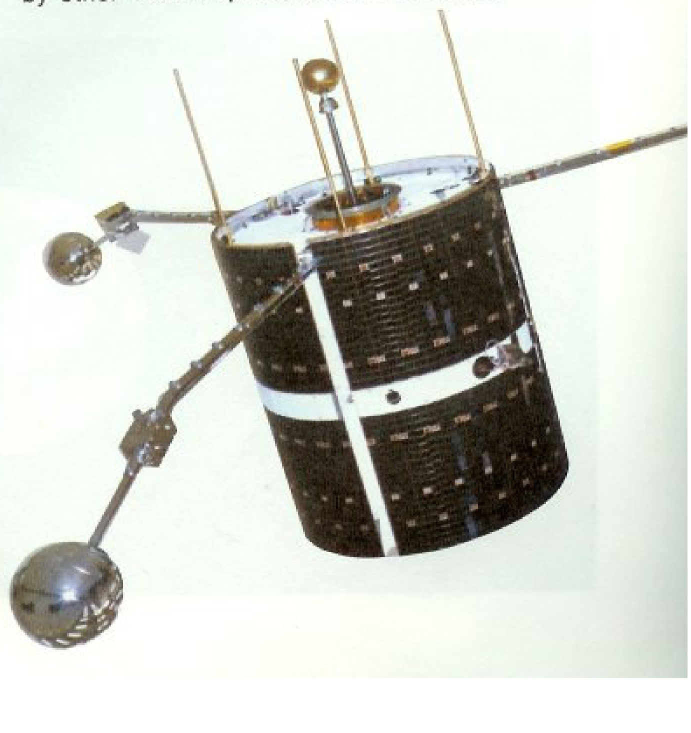
The evaluation criteria were the following

- accuracy
- ability under poor data conditions
- necessity of an a priori estimate

FUTURE USE OF THE INVESTIGATION

Special versions of the computer programs were developed for use in connection with the COS-B satellite. However, the investigation and the developed programs are not limited to the HEOS A2 and COS-B satellites, but may also be used by other future spin-stabilized satellites.





ID 40 1.10.1975 Form 5 prime

CHRISTIAN ROVSING A/S
SOFTWARE PROJECT

Client:
ESA, The European Space Agency

MSSS: Multi Satellite Support System

SW 62

SPACECRAFT DATA PROCESSING

During the period 1974 - 1976 the European Space Operations Centre (ESOC) is developing computer program systems for the spacecraft control and payload data processing support of the satellites:
COS-B, GEOS, OTS, and MAROTS.

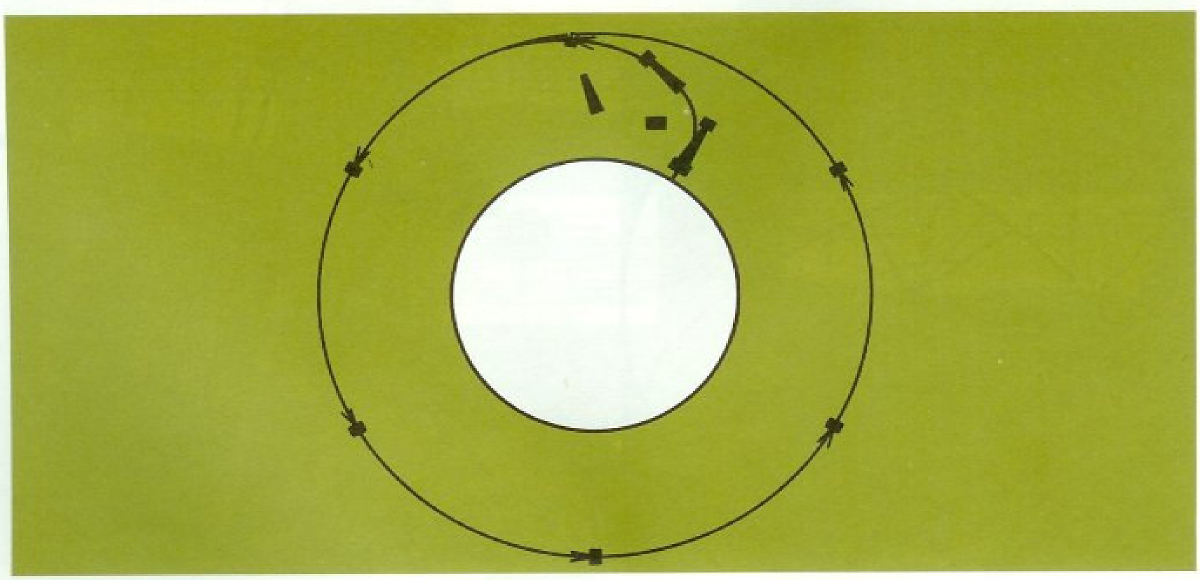
THE MSSS SYSTEM

Due to the similarity of these satellites it is possible to construct an overall system capable of covering all the missions. For the on-line support, it was decided to develop such a system, called the Multi-Satellite Support System, or MSSS.

Christian Rovsing A/S participated, with a 20% share, in a European software consortium, which won the contract (value 5 million DM) 1973 in competition with 27 other companies.

The MSSS consists of the following four different software packages, which are being developed by four consortium teams working at ESOC in close cooperation with the ESA staff:

1. The software system for the control of the spacecraft and its payload.
2. The automatic task and data handling software necessary for the orbit and attitude determination and manoeuvre systems. This software package will be particular useful during the long routine periods of the spacecraft.
3. The necessary mathematical tools for attitude determination and manoeuvre support consist of software routines for statistics, classical mechanics, and numerical analysis.
4. The special tasks of the GEOS and COS-B data processing systems.



CHRISTIAN ROVSING A/S
SOFTWARE PROJECT

Client:
NASA/ESA/ERNO

SPACELAB

SW 71

SPACELAB

Spacelab is a re-usable manned space laboratory which can accommodate many different payloads and experiments in the fields of space science, applications, and technology. The missions will last between 7 and 30 days.

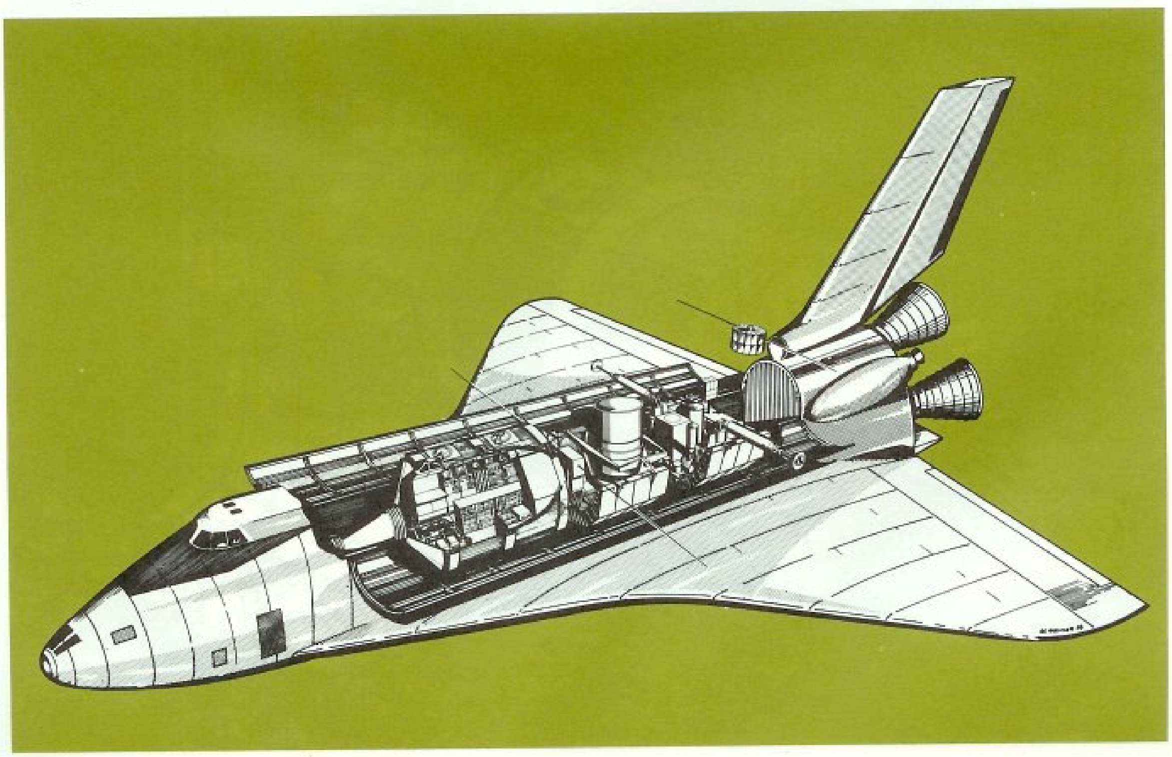
The Spacelab will be brought into orbit housed in the cargo bay of a special spacecraft called a Space Shuttle. The Shuttle is somewhat similar to an airplane, but will be launched vertically using rockets. After deorbiting the Shuttle lands like a glider at an airport.

ORGANIZATION

Spacelab is a cooperative program between the European Space Agency (ESA), and the National Aeronautics and Space Administration (NASA).

DEVELOPMENT

Spacelab is currently under development by a European industrial team lead by VFW Fokker - ERNO under an ESA contract, and with a number of European firms as co-contractors. The Danish co-contractor, Kampsax International A/S, invited Christian Rovsing A/S to participate in the project, and a joint team was formed.



ID 40 10.10.1975 Form 7 prime

Client:
NASA/ESA/ERNO

SW 72

CHECKOUT SOFTWARE

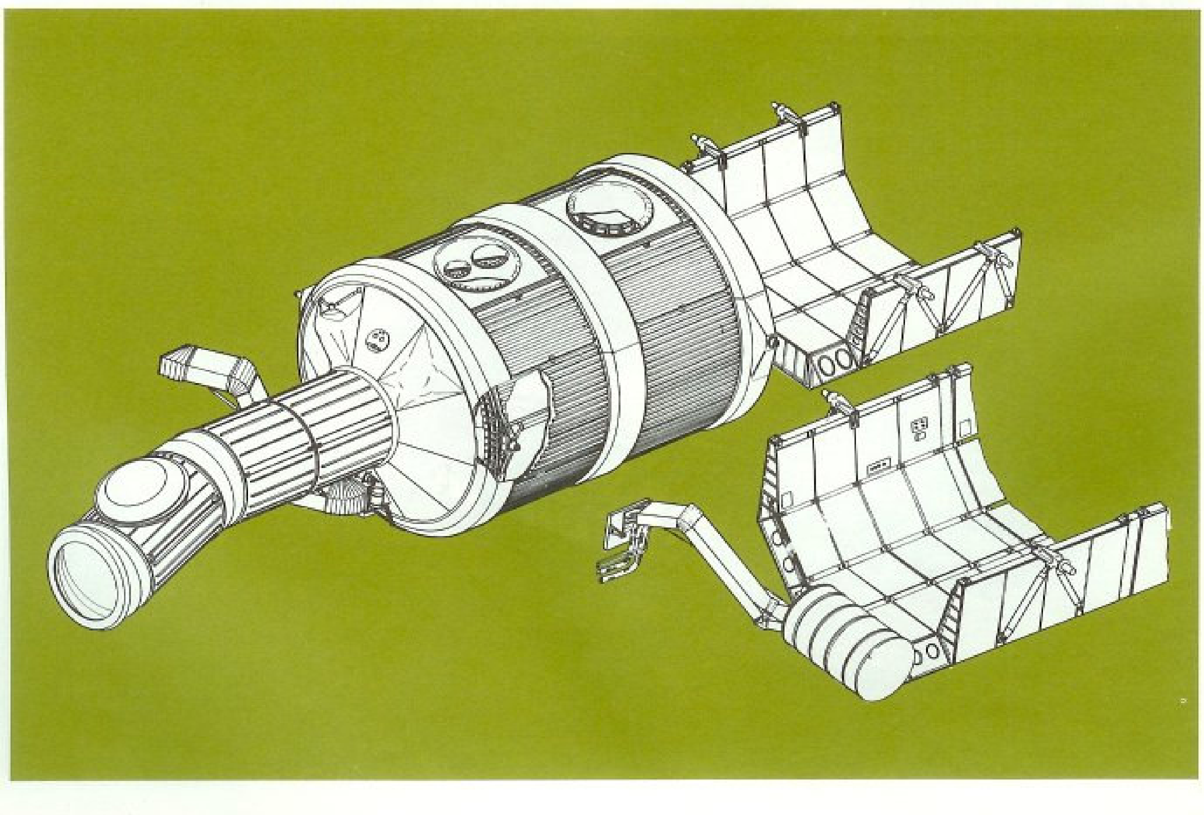
Christian Rovsing A/S and Kampsax are responsible for the design and implementation of the software packages to be used for checkout of the entire Spacelab during both ground and flight operations.

Part of the checkout software is initiated when a test engineer or an astronaut wants to verify that a piece af hardware works properly; the other part is constantly monitoring the Spacelab.

The software performs a series of predefined steps such as:

- opening or closing of valves and relays
- sensor readings
- stimuli generation
- limit checking
- calibrations

If a malfunction is detected within the hardware, the test engineer or the astronaut is informed by a message on his terminal. The software then performs a fault isolation procedure.



CHRISTIAN ROVSING A/S
SOFTWARE PROJECT

Client:
ESA, The European Space Agency

Universal Graphics Package

SW 81

UNIVERSAL GRAPHICS PACKAGE

Christian Rovsing A/S has implemented a Universal Graphics Package (UGP) for the European Space Agency.

The UGP is a library of subroutines providing graphical functions for generating pictures expressed in a device indepedent data format, known as the picture file instruction set. These instructions may be sent directly to an interactive, real time interpreter in order to produce graphical output, or they may be stored on picture files and interpreted at a later stage by batch interpreters.

UGP LIBRARY

UGP is written in FORTRAN. The package ranges from basic routines for displaying a single point to interactive manipulation routines and high level routines for plotting complete graphs.

The UGP subroutines may be divided into the following classes:

- system initialization and termination routines
- frame initialization routines
- graphic control routines
- plot routines
- text and subpicture routines
- macro routines
- input routines for interactive devices

SPECIAL FEATURES

- device independence, i.e. a picture file may be displayed on different devices
- default values are provided for omitted parameters
- mode set parameters, such as scaling mode (linear, logarithmic), and character size stay in effect until superseded
- pictures already constructed or parts of these may be used in building new pictures.

DESIGN

A characteristic feature of the UGP design is the »two jobstep« procedure. The total process of creating graphical output is split into two steps:

1. Picture generation and transformation into an intermediate device independent data format, which may be stored on disc or tape.
2. Post-processing and displaying of the intermediate picture using a device dependent interpreter.

This design principle allows for the easy addition of new graphic devices to the system. The procedure is simple and involves no pertubation of the package already existing.

ID 40 1.10.1975 Form 7 prime

CHRISTIAN ROVSING A/S
SOFTWARE PROJECT

International Consultancy

SW 82

SOFTWARE CONSULTANCY

Systems analysts and programmers from Christian Rovsing A/S work as software consultants to foreign firms and international organizations. Consultants are stationed in USA, Germany, Holland, Italy, France, and Kuwait.

Two major clients are Lufthansa and the European Space Agency (ESA).

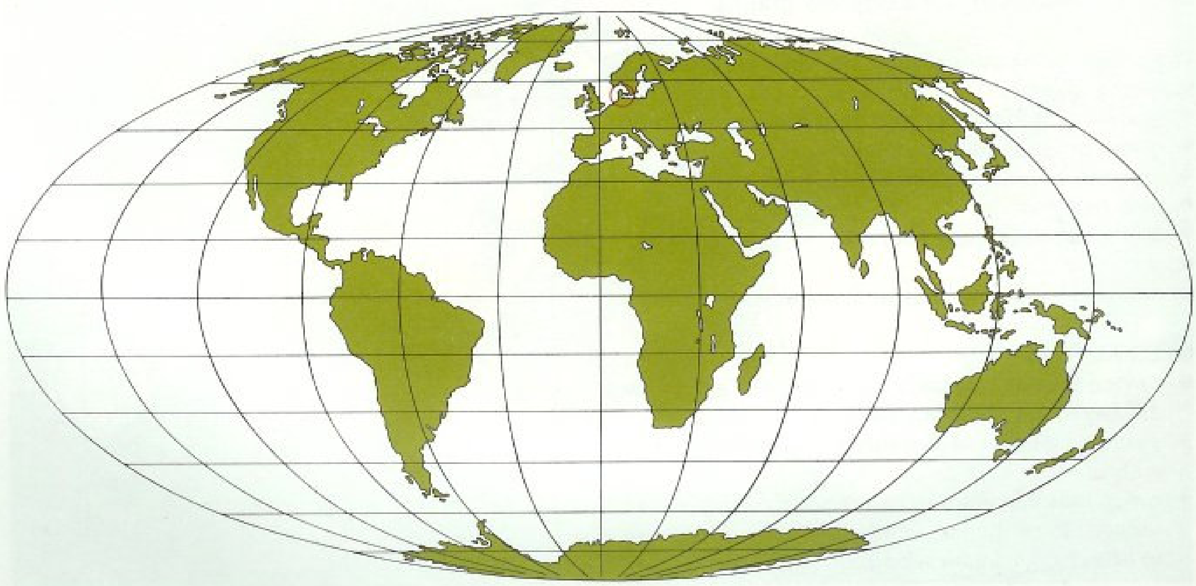
LUFTHANSA, FRANKFURT

In the period between 1969 and 1975 personnel from Christian Rovsing A/S have been assigned to Lufthansa German Airlines at their base at Frankfurt am Main Airport. The tasks undertaken include the design and implementation of the Passenger Reservation and Check-In Systems currently in use. These systems operate on real-time basis on a Univac 494 with links to Lufthansa offices throughout the world. In connection with the development of these systems a message-switching system was designed to facilitate the communication between computer and terminals.

THE EUROPEAN SPACE AGENCY, ESA

Since 1969 Christian Rovsing A/S has had between 10 and 20 engineers and mathematicians stationed at the European Space Technology Centre (ESTEC) in Noordwijk, Holland, and at the European Space Operations Centre (ESOC) in Darmstadt, Germany. The consultants have been involved in various projects such as:

- operations research
- air traffic control
- telecommunications
- meteorology
- simulations on hybrid computers
- telemetry data handling



ID 40 1.10.1975 Form 7 second

CHRISTIAN ROVSING A/S
SOFTWARE PROJECT

Client:
The Copenhagen Telephone Co., KTAS

Data Collection and Verification System

SW 91

LARGE SCALE COMPUTER

The Copenhagen Telephone Company (KTAS) has for many years used a large scale computer for administrative functions such as accounting, invoicing, etc. The input to this system includes:

- orders for new installations
- orders for changes of installations
- orders for cancelling of installations

DATA COLLECTION AND VERIFICATION SYSTEM

In order to reduce the expenses for correcting errors in the input stream, KTAS in 1972 decided to purchase a minicomputer based data collection and verification system.

Christian Rovsing A/S bid for and won the contract for the design and implementation of this system. The system was delivered in July 1973.

FUNCTIONAL REQUIREMENTS

- entry of orders for new installations, changes or cancellations
- verification of input
- computerization of data from manual system

SOFTWARE

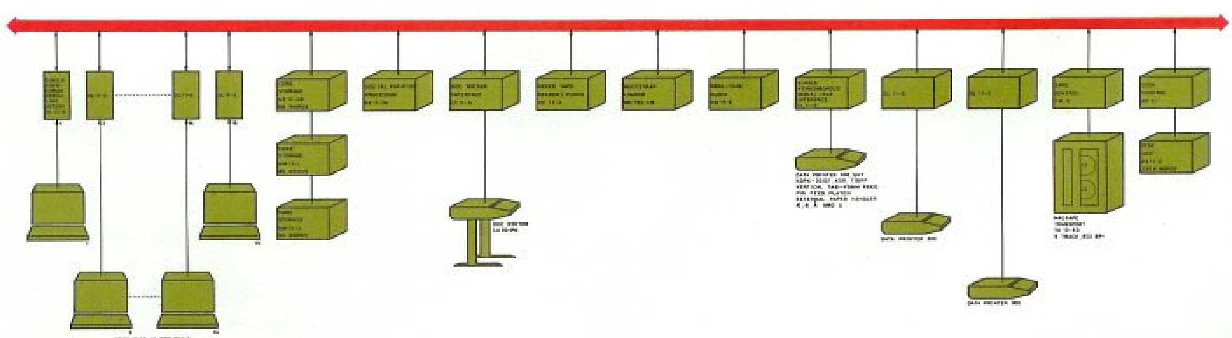
Data is entered into the system via data terminals. The system displays, on the VDU, the form to be filled in. The operator enters the required input via alphanumeric keyboards.

Each input form consists of approximately 160 data fields such as:

- name
- street
- postal code
- type of order
- entry in telephone directory

All data fields are verified as thoroughly as possible. The validity tests may be divided into the following categories:

- simple check (numeric contra alphameric fields, field positions, etc.)
- limit check (based on core or disc resident tables)
- simple cross check (e.g. postal code against street name)
- combined cross check (interdependencies between several fields)



ID 40 10.10.1975 Form 7 prime

Client:
ESA, The European Space Agency

Power System Optimization

SW 92

During the period 1971–73 Christian Rovsing A/S has implemented a system of computer programs for the optimization of power systems in satellites.

PROBLEM STATEMENT

Designing a power system for a given satellite mission is a balancing act where a better performance with respect to one system variable is normally obtained at the cost of other system variables. As an example an increase in reliability may be paid for by an increase in weight or cost.

This type of conflict is common to most design tasks: Design problems do not normally have an ideal solution where the utility of all performance variables is a maximum at the same time. This means that the system cannot be optimized by optimizing the single performance parameters in isolation; it thus forces the designer to account for all performance variables simultaneously.

OPTIMIZATION PARAMETERS

In the computer model the parameters weight, cost and reliability were optimized in terms of a criterion function. All other parameters, including power capacity and electrical tolerances, were treated as satisfying parameters, i.e. as limits which must be respected by all feasible solutions.

THE OPTIMIZATION PROCESS

The application of the computer as a design tool follows the principle that the computer should not do things which computers do badly, but humans do well, and vice versa. Thus the definition of the design criteria and the specification of the main alternatives to be explored should be the job of the designer, whereas all storing of technical data and all calculations should be left to the computer.

When using the optimization program the designer must specify the network structure of the power system to be optimized, and he may wholly or partly specify which electronic units should be used in one or more of the power system links. Once this specification has been made the computer optimizes the choice of all system parts which have not been pre-selected by the designer. If it is not obvious from the mission constraints what will be the optimum system network structure, the designer may use the computer to optimize a number of alternative structures. The utility of each system is measured by the criterion function, identifying the best network structure proposed so far.

THE COMPUTER AS A DESIGN TOOL

The questions which can be answered by the computer in the design process include:

- How will a given system perform within a given set of constraints?
- How should a change in the relative importance of the performance variables influence the system design?
- How should design requirements be communicated at unit level, and below?
- Which branches of search for good solutions are worth exploring, and which are not?
- What is the best system that can be constructed within a given set of project constraints, and with a given technology?

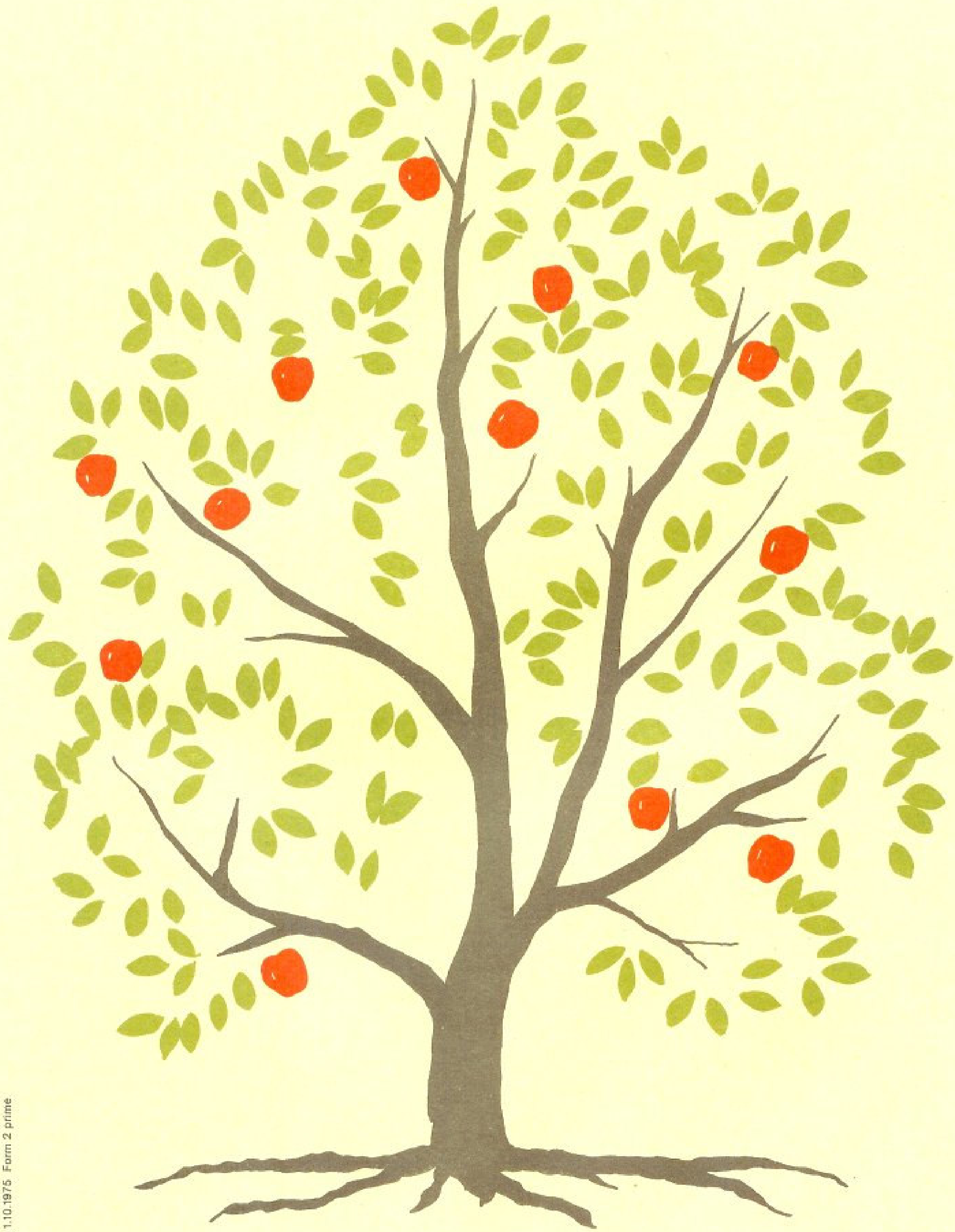
The simulation and optimization programs thus allow the designer to experiment with the power system model, to gain experience with it, and to increase his, and the computer's, understanding of what a power system is, how it reacts, and how it can be improved.

ID 40 1.10.1975 Form 7 second

CHRISTIAN ROVSING A/S
COPENHAGEN · DENMARK

SYSTEMS

SYS 01



ID 40 1.10.1975 Form 2 prime

COMPUTER CONTROL SYSTEMS

COMPUTER CONTROL SYSTEMS

Christian Rovsing A/S undertakes the delivery of complete computer control systems, including both hardware and software, on a turnkey basis. A typical computer control system includes on the hardware side:

- A computer
- Standard electronic units to carry out part of the system function (measuring, conversion), and data collection (extraction, storage)
- Necessary electronic units which are not available as standard, but which are custom-built
- The interface and communication units needed to link the hardware units together to form a hardware system.

On the software side the computer control system includes all the software needed to make the system run, i.e. to:

- Carry out its automatic functions
- Execute special functions on request
- Communicate with the human operator.

Computer control systems are typically used for such functions as:

- The extraction, collection, processing and communication of data, on a real-time basis
- The control of physical processes
- Preprocessing, reduction, communication, and storage of data
- The simulation of physical processes.

SYSTEM DESIGN PRINCIPLES

Computer control systems are implemented within the overall management framework applied to all projects undertaken by the company, with the implications this framework has on the systems design.

The design principles applied to system projects ensure that:

- The system structuring establishes a clear relationship between the system and the system requirements.
- The system is developed and implemented in stages. This eases the testing of the system.
- Both hardware and software are built from relatively simple modules. This helps in documentation, production, testing, and maintenance.
- The system documentation is operational: It includes any information needed by the user, and it is detailed enough to supply the information needed to carry out modifications or extensions to the system.
- The system is designed for growth. Both hardware and software are planned for future extensions, and the documentation will specify where and how the system may grow.

SYSTEM CLIENTS

The system clients of the company include:

- APCF: The Aalborg Portland Cement Plants
- F. L. Smidth & Co A/S (cement plant manufacturers)
- Niro Atomizer A/S
- DSI: Dansk Signal Industri (manufacturers of traffic control equipment)
- The Danish Road Research Laboratory
- The Copenhagen University Hospital
- ESA, The European Space Agency (Formerly ESRO, The European Space Research Organization).

ID 40 1.10.1975 Form 2 second

CHRISTIAN ROVSING A/S
SYSTEM PROJECT

Client:
Dansk Signal Industri A/S

Traffic Monitoring

SYS 11

TRAFFIC MONITORING SYSTEM

Christian Rovsing A/S has designed and implemented a monitoring system for an installation which controls all traffic signals in Copenhagen. The monitoring system was ordered by Dansk Signal Industri A/S.

FUNCTIONS

The system is based on a minicomputer, monitoring a central installation. The system:

- monitors all output of the central installation
- checks that correct programs are executed
- registers all events in the central installation (reports are printed every 24 hours)
- reports all errors encountered in the central installation
- assists in the programming of the central installation by providing the programmer with relevant information and by checking the consistency of his programs.

HARDWARE AND SOFTWARE

The hardware consists of:

- minicomputer (HP 2100)
- time base generator
- teleprinter
- HP6940A multiprogrammer
- Christian Rovsing A/S interface module

The software consists of the following routines:

- clock interrupt handler
- dispatcher (queue handler)
- drivers
- monitoring routines
- report generation routines
- communication routines
- table update routines

ID 40 1.10.1975 Form 9 prime

CHRISTIAN ROVSING A/S
SYSTEM PROJECT

Client:
The Danish Road Laboratory

Axle Pressure Registration

SYS 12

DATA ACQUISITION SYSTEM

In 1972 Christian Rovsing A/S installed a new data acquisition system at the Danish Road Research Laboratory for use in the investigation of highway loads. Special equipment was developed and built by Christian Rovsing A/S.

FUNCTIONAL UNITS

The system includes three main functional units:

- a TARA central system (4 K minicomputer)
- a medium scale computer system with remote access (Burroughs B6700)
- TARA terminals

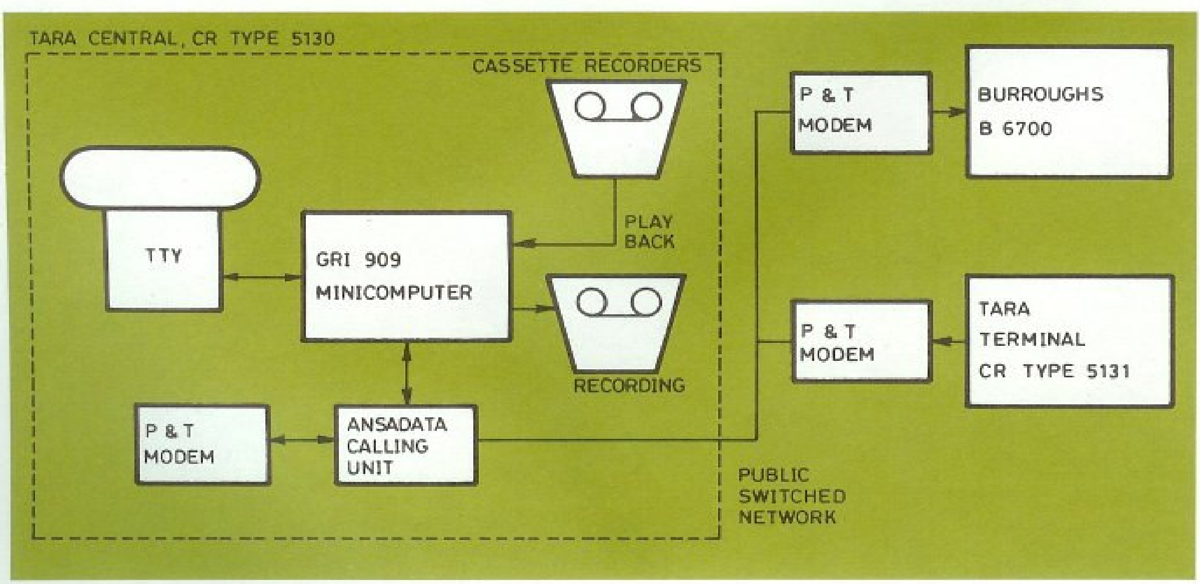
DATA ACQUISITION PROCEDURE

A number of roadside terminals collect traffic data continuously and independently of the rest of the system. At certain time intervals (e.g. 30 min.) the TARA central system automatically polls the terminals for data; local buffer memories are reset. The collected data are stored on a cassette tape deck attached to the minicomputer.

When the tape deck is filled with data (normally after 2 weeks of operation), the data are transferred to the medium scale computer and processed using statistical methods.

COMPUTER NETWORK

The three main functional units are connected by means of the public switched network. The minicomputer of the TARA central system is able to dial up any terminal, or the medium scale computer. In addition, the minicomputer controls all other parts of the system including a teletype (TTY) used for communication between operator and system. The operator may supervise operations and perform on-line modifications.



ID 40 1.10.1975 Form 9 second

CHRISTIAN ROVSING A/S
SYSTEM PROJECT

Client:
A/S Aalborg Portland Cement Factories, APCF

Cement Plant Supervision and Control System

SYS 21

RC 4000 SYSTEM

In the period 1970-1972 Christian Rovsing A/S took part in the installation of an RC 4000 system (Danish computer delivered by A/S Regnecentralen) on the largest Danish cement plant, at Rørdal, Aalborg.

PURPOSE OF THE PROJECT

The purpose of the project was

- to supervise the production process
- to control certain critical parts of equipment, e.g. the raw material preparation based on on-line X-ray analysis.

THE SYSTEM

A comprehensive reporting system and a convenient operator communication philosophy implemented by means of alphanumerical display/keyboard allow the computer to exchange information with the operating staff of the plant to any desired extent.

Furthermore, the operating system which was tailored for this installation allows unlimited possibilities in the on-line updating of the specified software. This feature has been used by APCF throughout the existence of the system for performing experiments with the process-information to develop new methods in control, optimization of throughput, etc.

DATA TERMINAL SYSTEM

At a later stage Christian Rovsing A/S expanded the configuration with a data terminal system. Use of alphanumerical VDU terminals with specially tailored keyboards allow insertion of off-line information (e.g. laboratory results) directly into the on-line system from the plant floor.

ID 40 1.10.1975 Form 9 prime

CHRISTIAN ROVSING A/S
SYSTEM PROJECT

Client:
F. L. Smidth & Co. A/S

Computer Supervision of Cement Plants

SYS 22

F. L. SMIDTH & CO. A/S
As one of the world's largest suppliers of cement plants, F. L. Smidth & Co. A/S (FLS) are among the earliest vendors of computerized process control and supervision systems.

SYSTEM DEVELOPMENT
In a number of cases Christian Rovsing A/S has participated in the implementation of these systems with a working effort on:

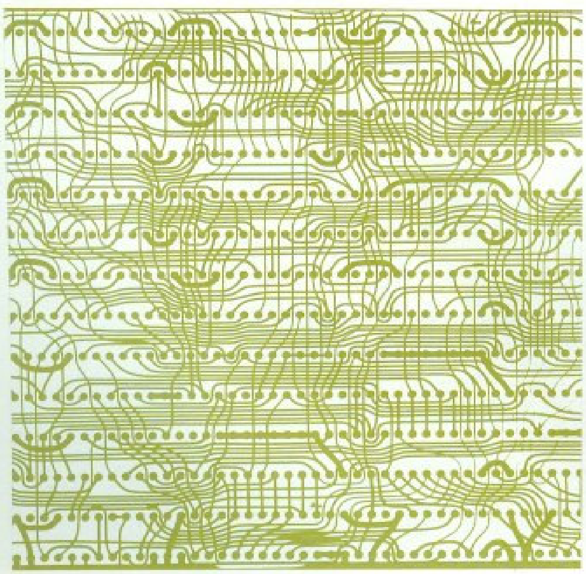
- system consultancy
- software development
- specification of hardware

In one case construction of specialized hardware for interfacing purposes was undertaken.
For Christian Rovsing A/S the work has involved implementation of complete software solutions as well as dedicated programming jobs with emphasis on development of real time operating systems software.

KNOW-HOW
Due to the participation in the implementation teams of different projects, a considerable amount of know-how has been obtained by Christian Rovsing A/S concerning solutions to general application type problems, e.g.

- computerization of signal supervision and alarm handling
- on-line process control
- operator communication systems
- production reporting

These disciplines are very similar no matter whether the implementation is done in assembly language on an 8 K minicomputer or a larger configuration utillizing high level languages.



ID 40 1.10.1975 Form 9 second

CHRISTIAN ROVSING A/S
SYSTEM PROJECT

Client:
The Copenhagen Airport Authorities

Automatic Weather Chart Plotting System

SYS 31

THE SYSTEM

Christian Rovsing A/S has developed a reliable and economic computer system for drawing meteorological charts.

The system accepts on-line input from a normal telex line carrying meteorological telegrams in standard codes, or from a faster line, e.g. a 1200 baud line. The data received are checked for correct format, decoded and stored in a buffer.

The decoded information controls one or more plotters, which draw the meteorological symbols on the charts. Telegrams may also be selected for print-out in text form.

OPERATION

No experience or training in data processing and programming is needed for system operators.

The system is operated via a keyboard/printer. The operator types abbreviations of the functions to be initiated, and the responses from the system appear in readable text.

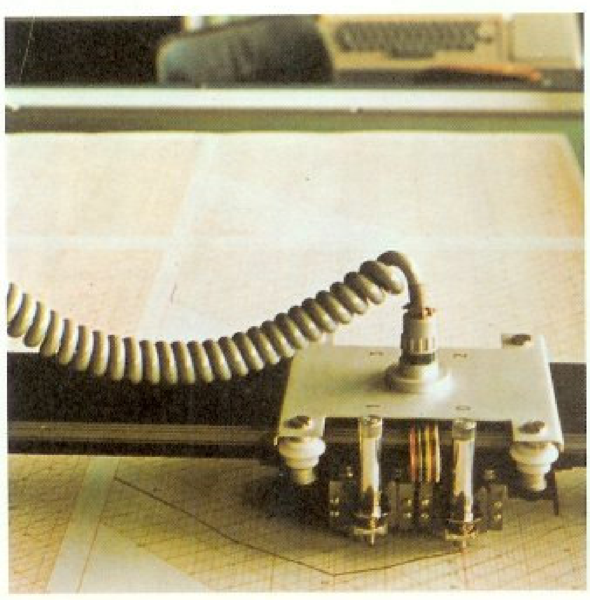
MODULARITY

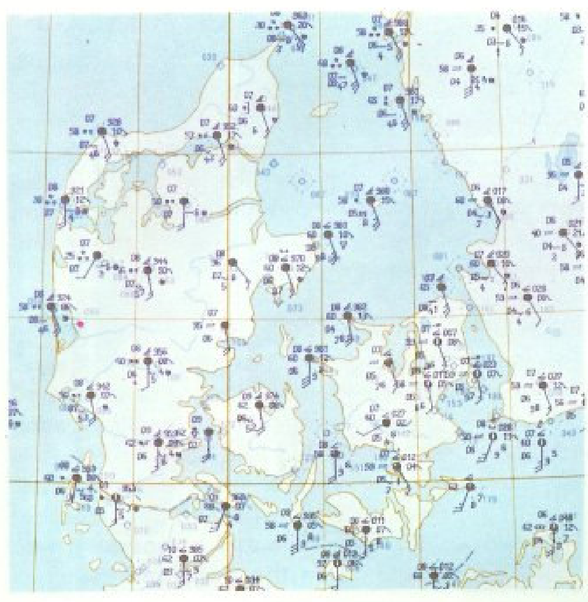
The plotting system is modular in both hardware and software.

As a consequence the hardware system may be equipped with one or more plotters of exactly the speed and size needed for a particular meteorological office. Data displays can be added; and input to the system may come from several sources.

EXISTING INSTALLATION

A system has been in operation at the Copenhagen Airport, Kastrup since Juli 1974.





ID 40 1.10.1975 Form 9 prime

Client:
Niro Atomizer A/S

Computer Control of Blending Ratio

SYS 32

THE COBRA SYSTEM

The COBRA system (Computer Control of Blending Ratio) was designed and implemented by Christian Rovsing A/S for Niro Atomizer A/S. The system has been installed as part of a large material processing plant for the refinement of Cu/Ni ore. The plant is located in Botswana.

The COBRA system controls the blending of two components:

- Cu/Ni concentrate
- flux sand

The main tasks undertaken by the COBRA system are:

- exercise of the process control necessary to obtain an optimum production
- registration and reporting of the total plant production

DESIGN REQUIREMENTS

The COBRA system is designed for continuous, automatic operation and thus requires no special attention under normal conditions. Furthermore, as the installation site is located far from conventional sources of assistance, it is very important that the system design allows the production to be maintained even if certain parts of the equipment break down.

PROCESS CONTROL

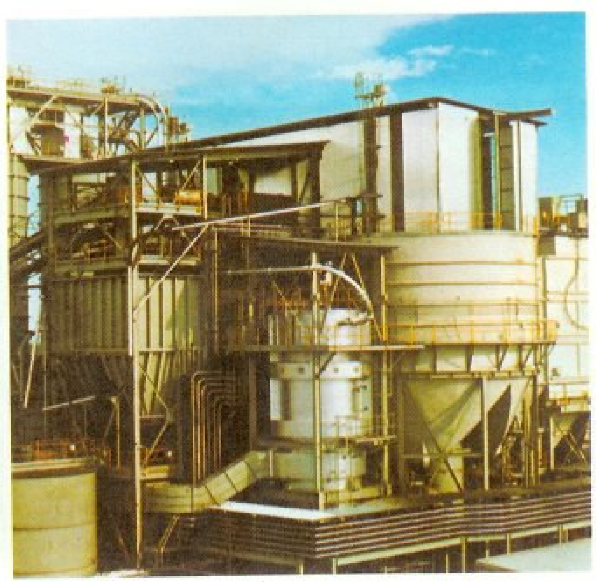
The information needed for control and registration is obtained from transducers, which measure the amount of Cu/Ni concentrate and flux sand added. These data are fed to a minicomputer via standard units and special units designed and built by Christian Rovsing A/S. The computer determines the blending ratio and compares it with the desired value. From the deviation, the computer decides on the action to be taken. The computer stores in its memory the deviation in order to determine the trend of the process.

The decisions made by the computer are translated into physical action by the adjustment of the set-point of a conventional analogue controller. Human intervention is possible during all phases of the process.

EQUIPMENT

The COBRA system is based as far as possible on equipment available as standard. The system includes:

- minicomputer (GRI 909/30)
- typewriter
- indicators
- controllers
- flux transducers



ID 40 1.10.1975 Form 9 second

CHRISTIAN ROVSING A/S
SYSTEM PROJECT

Client:
The University Hospital of Copenhagen

Patient Monitoring System

SYS 41

CORONARY CARE UNIT

Christian Rovsing A/S has designed a complete coronary care unit at the University Hospital of Copenhagen. A coronary care unit is used for patients suffering from an acute heart disease and therefore requiring intensive care.

The coronary care unit, which has been in operation since 1970, allows for continuous monitoring of up to 24 patients at a central nurses station, with alarm functions in case of missing or inconsistent electrocardiological signals.

REQUIREMENTS

- no necessity for special training of nurses
- patient safety (electrical)
- electromagnetic compatibility
- high reliability - fast back-up
- fast response
- flexibility

PARAMETERS

The following parameters may be monitored continuously:

- electrocardiogram - ECG
- arterial and venous pressure (intravascular)

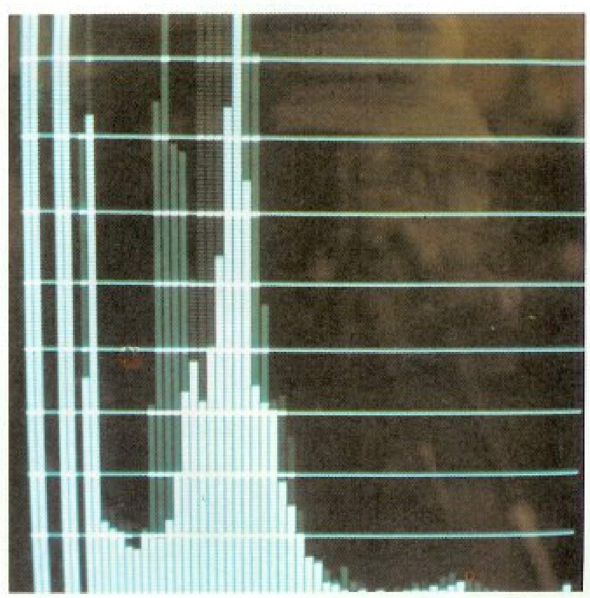
THE SYSTEM

Pre-amplifiers are placed near the patients, and the amplified signals are transmitted to the nurses' station. For up to 6 patients the ECG-signals may be transmitted via telemetry. These patients may walk freely in a certain area of the hospital.

The physiological signals are displayed at four TV-monitors placed in the nurses' station. Two monitors display continuously the ECG-signals from all patients. The other two monitors display other parameters and information, and are normally concerned with one patient at a time. A TV-monitor is placed in each of the patient rooms; the monitor can be switched in parallel with any of the four monitors at the nurses' station by use of a keyboard. The monitoring of all patients can therefore take place from any patient room (»moving nurses' station«). All ECG-signals are recorded on magnetic tape for subsequent analysis. The heart rates are displayed in digital form. Alarm limits are set individually for each patient.

PROCESS CONTROL COMPUTER

For the purpose of automated data collection, data reduction and data presentation a computer system was installed. The hardware configuration consists of two Honeywell Bull H-316 central processors, peripherals, and a number of digital and analog input and output units. The programs were written by Christian Rovsing A/S.



ID 40 1.10.1975 Form 8 prime

CHRISTIAN ROVSING A/S
SYSTEM PROJECT

Client:
The University Hospital of Copenhagen

Catheterisation System

SYS 42

CATHETERISATION

At the University Hospital of Copenhagen Christian Rovsing A/S has designed and installed a complete system for heart catheterisation. A catheterisation is an operation where a small tube – a catheter – is entered into the heart via a vein.

MONITORED PARAMETERS

During a catheterisation a number of physiological parameters are monitored, including:

- electrocardiogram
- intravascular pressures
- heart sounds
- respiration

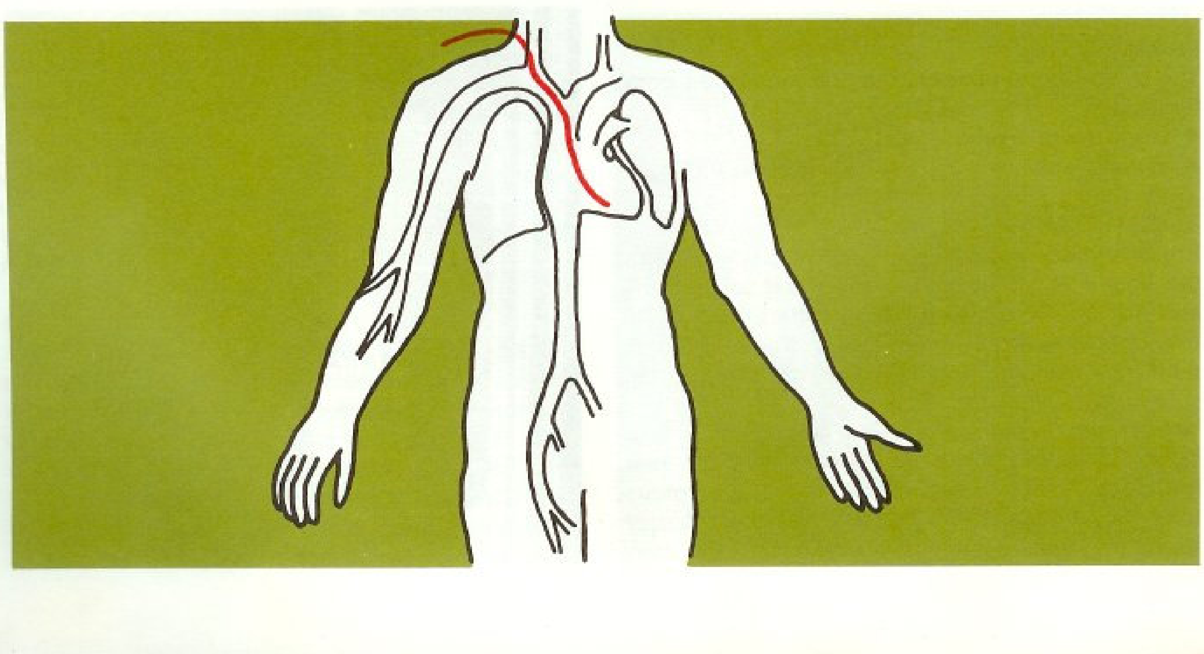
DISPLAY

The physician may select certain sets of six dynamic parameters to be continuously displayed (as curves) during the catheterisation. In addition to these parameters five static parameters may be displayed digitally. The parameters are displayed on pairs of TV-monitors located both in the catheterisation room and in the control room.

Up to 500 pictures displayed on the TV-monitors may be stored on disc during the catheterisation. The pictures stored are sequentially numbered and a previously stored picture can be selected for display using a small keyboard. The picture is redisplayed on one of the monitors; the other continues to monitor the patient.

POST OPERATION PROCESSING

All parameters monitored are continuously recorded on a tape-recorder. After the catheterisation these data may be analysed. Event marks recorded by the physician during the catheterisation may be used to control the play-back of the tape.



ID 40 1.10.1975 Form 8 second