



Centre for Mathematics and Computer Science

Bibliotheek
CWI-Centrum voor Wiskunde en Informatica
Amsterdam

Frontier research for practical applications

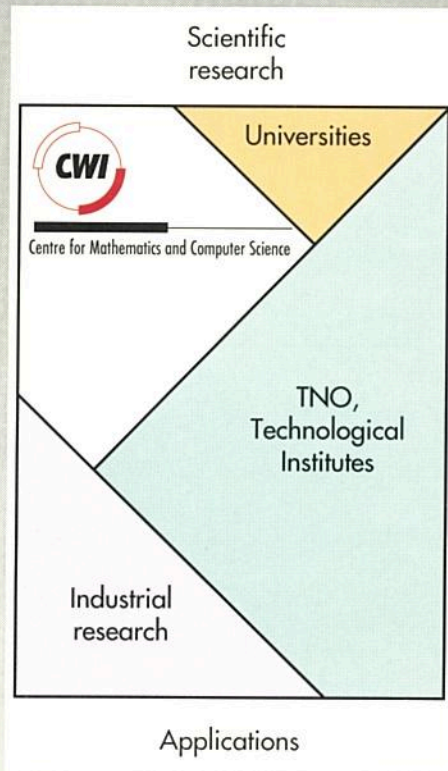
The research institute CWI

The center for mathematics and computer science CWI is an independent research institute, active in the fields of mathematics and computer science. CWI is part of the Mathematical Centre Foundation, a non-profit organisation founded in 1946, aiming to foster mathematics and computer science research in the Netherlands.

Mission

The mission of CWI is twofold:

- to perform frontier research in mathematics and computer science;
- to transfer new knowledge in these fields to society in general and trade and industry in particular.



Frontier research

CWI research activities are at the frontiers of science. Fundamental contributions are made to the progress of mathematics and computer science. At the same time, much attention is paid to the applicability of results of fundamental research. Strategic considerations and applicability play an important role in the selection of new projects.

The Dutch Organisation for Applied Research, TNO, other technological institutes (ECN, NLR, WL, GD and MARIN) and research laboratories in industry, are involved in the translation of results of scientific research into practical applications. CWI has many contacts with such organisations. In several projects there is co-operation with these institutes for applied research.

Knowledge transfer and contract research

Results of research carried out at CWI are made available in publications and reports. In addition, results are presented at scientific conferences, and advanced short courses are held. Knowledge transfer also takes place through the mobility of scientific staff, either in the form of exchange of personnel with or transfer to universities, research institutes or industry.

The execution of contract research is considered to be an important form of knowledge transfer, and interaction with society generates new areas of investigation.

CWI's relations with university research

Many senior scientists at CWI hold part-time positions as university professors. As a result, an extensive network of personal contacts has developed, which forms the basis for co-operation with university research groups. Through CWI, knowledge available at universities is readily accessible.

With its specialised scientific knowledge CWI contributes to practical developments. In many instances CWI co-operates with other institutes and with industry. In such joint efforts the partners provide the knowledge of specific applications, which in combination with CWI's expertise in mathematics and computer science leads to optimal results. Examples of areas of application in which CWI is involved are the environment, transport, industry and financial services.

Environmental mathematics

Nowadays it goes without saying that scientific research into environmental problems is of utmost importance for our future.

It is evident that environmental research must be multidisciplinary: specialists in biology, chemistry, oceanography, physics and other disciplines all have to collaborate. In investigating environmental problems, mathematics is an indispensable discipline for constructing mathematical models, to study and simulate numerous aspects and subsystems which are of importance for the environment. One area of research at CWI involves the modelling of pollution of soil, water and air.

Another study is concerned with modelling of the spreading of contagious diseases. Mathematical modelling is of particular importance for environmental research, because experiments are out of the question. Computer simulations are often the only way in which one can gain insight into the behaviour of environmental processes.

Modelling of the diffusion of pollutants in air, water and soil is a spearhead within environmental research at CWI.



Database Management Systems

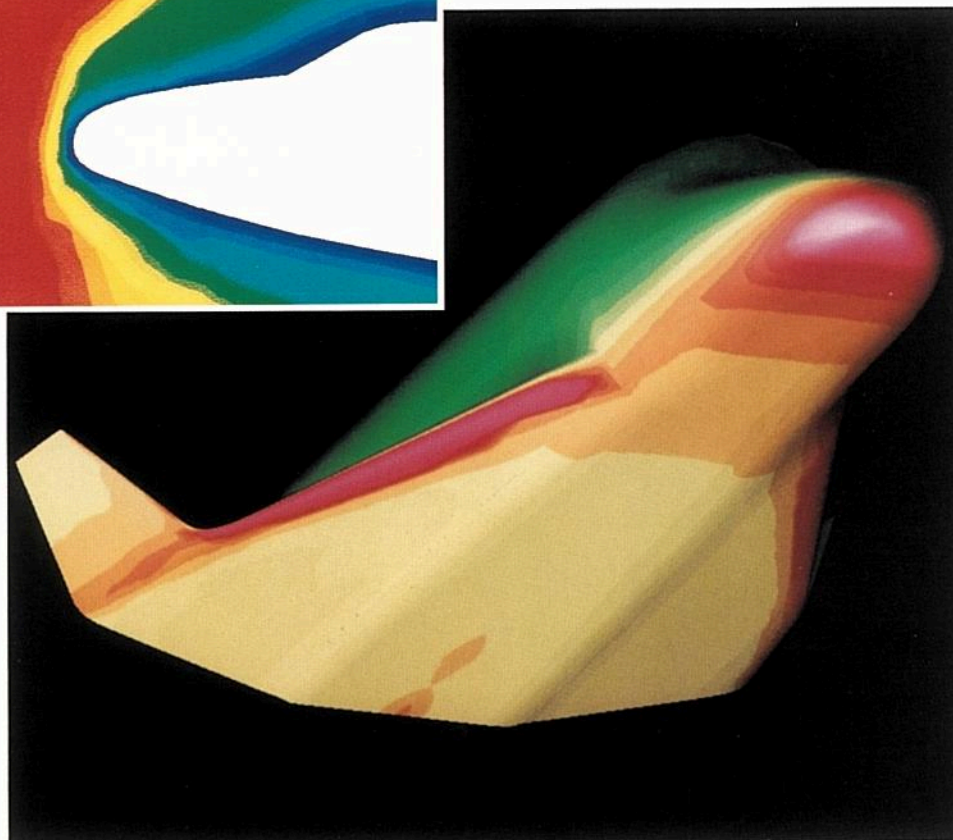
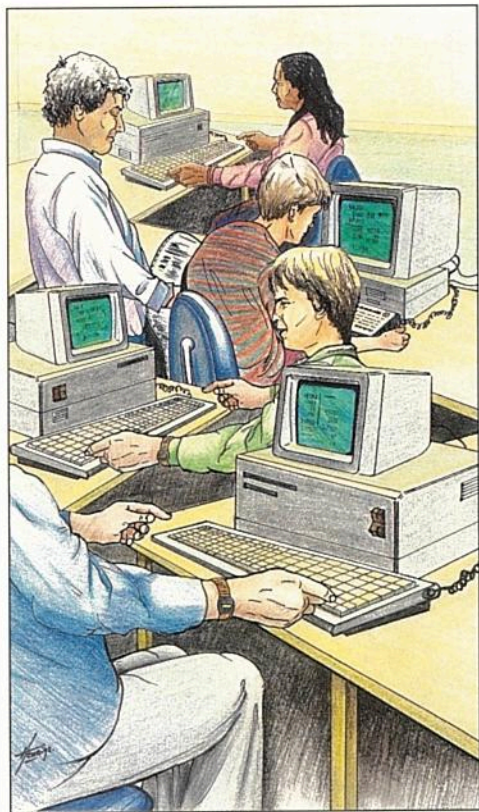
In modern information systems, database management systems (DBMS) play a key role.

Optimal use of such systems, however, requires that high demands are made upon quality, dependability and efficiency. Often, new systems exhibit too much instability because exhaustive testing in specific fields of application is usually

lacking. There is also little known about how to obtain the most efficient operation in distributed computer systems.

During the construction of a system the bottlenecks, such as implementation errors, too many users or too much data, remain obscure: they become manifest only at a later stage. As the leading partner in the

ESPRIT project PYTHAGORAS, CWI is active in solving the problems of present day database management systems. The aim of this project is to develop a test pilot which is able to take over the role of testing a database system from the human user. Thus, an important contribution is made to quality control of modern software products.



In present day information systems, databases often exhibit shortcomings. Within the scope of the PYTHAGORAS project a software test pilot for database management systems is being developed.

In shallow parts of the North Sea, water motion induces transport of sediment. CWI is involved in the construction of a

numerical model to describe this process and in the development of efficient solvers.



Numerical simulation

For understanding and predicting reality, mathematical models are indispensable. Often such models can only be "solved" by means of approximations. This is the realm of numerical mathematics. Well known applications can be found in aerospace technology, where for instance computational fluid dynamics is used to predict the flow of air around aircraft. There is, however, a wide variety of other applications. Mathematical simulations are used in weather forecasting, in studying ocean waves, in predicting chemical processes and to develop IC's.

The pace of development is rapid. Within existing fields of application, cases of increasing complexity can be handled because of the development of more powerful hardware and more efficient software. In addition, numerical simulations are applied more and more in new areas because this method is often more economic than traditional physical experimentation, and it opens new perspectives in fields where experimentation is not possible.

CWI's expertise in the field of multigrid methods was used in the development of the European space shuttle HERMES.

Numerical simulation is of most importance to determine the parameters of the model. There is especially interest from process industry for numerical methods which are developed at CWI.

Photo: Courtesy AKZO Chemicals International bv, Amersfoort.



CWI and international co-operation

Scientific research is increasingly carried out in an international context. In recent years European co-operation has increased in particular.

CWI has extensive international contacts and provides hospitality to many visitors from abroad.

CWI participates in many European Community research projects and is a member of ERCIM, the European Research Consortium for Informatics and Mathematics.

The objective of ERCIM is to promote research in the fields of applied mathematics and information technology in Europe, and to intensify contacts between research organisations and industry.

CWI was one of the founding members of ERCIM and continues to play a prominent role in the consortium.

ERCIM membership:

GMD Germany
INESC Portugal
CNR/IEI Italy
INRIA France
CWI The Netherlands
RAL United Kingdom
FORTH Greece
SINTEF Norway

ERCIM



Activities:

- * the formation of networks between research institutes and industry in Europe
- * joint proposals for research projects
- * initiation of international research efforts
- * fellowship programmes for promising young scientists
- * organisation of advanced courses
- * sponsoring of conferences
- * publication of a quarterly newsletter (ERCIM News)

Finances

CWI receives a subsidy from NWO, the National Organisation for Scientific Research, for performing fundamental research. This subsidy accounts for 70 percent of the total income of the institute.

The remaining 30 percent is obtained through national research programmes, international programmes (ESPRIT, RACE, BRITE, etc.) and contract research commissioned by industry.

Location and infrastructure

CWI is located at the Watergraafsmeer Scientific Centre (WCW) in Amsterdam, together with the academic computer centre SARA, the FOM-institutes NIKHEF and AMOLF, and the mathematics and computer science faculty of the University of Amsterdam. The business centre of Amsterdam Science Park (ASP) is also located on the WCW premises.

CWI has the disposal of an advanced computer network which is connected to national and international computer networks and has access to the national Cray Y-MP supercomputer facility at SARA. There is also an extensive library at CWI.

Scientific staff

CWI has a staff of 170 fte (full time equivalent), 110 of whom are scientific staff. In addition, many scientists from universities or other institutes are detached at CWI. Every year, around 200 scientists from abroad spend some time at CWI.

CWI performs advanced research and provides consultancy in the following areas:

- * biomathematics
- * CFD (Computational Fluid Dynamics)
- * complexity of algorithms
- * computer algebra
- * computer graphics
- * constructive algorithmics
- * control theory
- * cryptography
- * database management systems
- * dynamical systems
- * distributed algorithms
- * environmental mathematics
- * high performance computing
- * image analysis
- * industrial mathematics
- * information systems
- * intelligent CAD systems
- * logic programming
- * machine learning
- * multimedia
- * multigrid methods
- * numerical simulation
- * operations research
- * parallel processing
- * parallel and distributed systems
- * planning
- * performance analysis
- * process algebra
- * processing of natural languages
- * programming environments
- * queueing
- * semantics
- * software engineering
- * system identification
- * system theory
- * user interfaces
- * visualisation

Multimedia

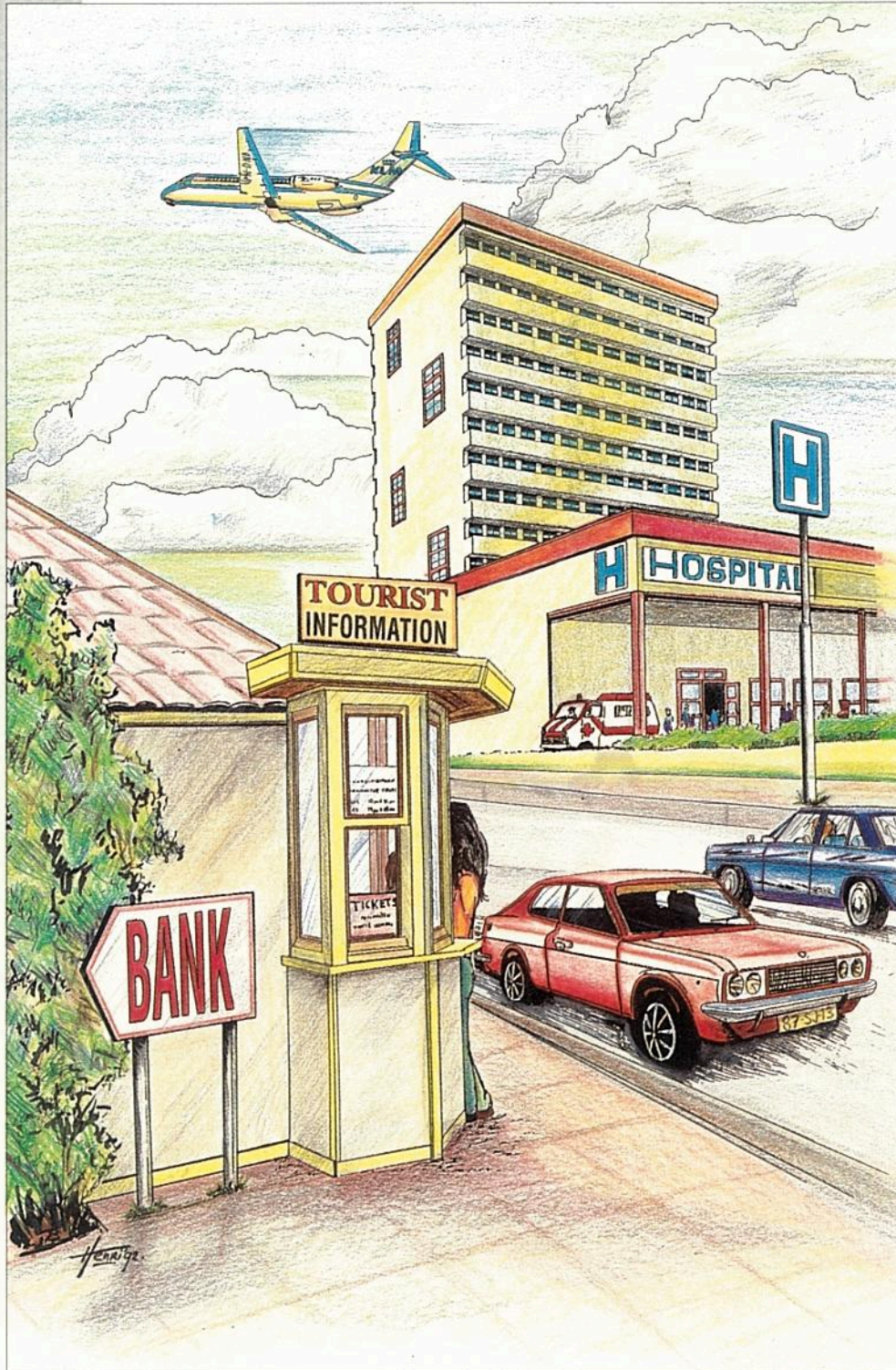
A recent development in computer science concerns the processing of multimedia information. The application of multimedia information systems is rapidly increasing.

The integrated manipulation of data, text, images and sound is an important field of research at CWI.

The possibilities for transferring multimedia documents from one platform to another are being extensively investigated.

CWI is participating in the ESPRIT project MADE, which objective is to design a development environment for multimedia applications.

Portability of the developed tools is an important aspect of this project.



A wide variety of end-users is involved in the European Community project MADE. In this project tools are being developed for the development of multimedia information systems.



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