THE WHITE HOUSE

WASHINGTON

March 5, 1992

Dear Mr. de Cock:

Thank you for sending me the summary of the report on your visit and the Interim Review of Activities which Stichting Toekomstbeeld der Techniek developed. I am pleased that you found your trip to the U.S.A. and Canada useful, and that you were able to meet with Bill Phillips while you were in Washington.

Although the Office of Science and Technology Policy has no reports which relate directly to technology forecasting and assessment, I am forwarding you a copy of the Science and Technology Report and Outlook-- 1985-1988.

I wish you the best of luck in your efforts.

Sincerely yours,

D. Allan Bromley
The Assistant to the President
for
Science and Technology

Enclosure

Mr. H.G. de Cock
Director
Stichting Toekomstbeeld der Techniek
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FROM: de COCK, H.G.: NETHERLANDS STUDY CENTER FOR TECHNOLGY TRENDS

TO: DR. D.A. BROMLEY

DATE OF CORRESPONDENCE: 01/09/92

SUBJECT: HE IS PROVIDING DR. BROMLEY WITH A COPY OF HIS REPORT ON HIS TRIP TO THE U.S. AND OF THEIR INTERIM REVIEW OF ACTIVITIES. HE REQUESTS ANY PERIODICALS OR JOURNALS ON ANY RELEVANT OSTP ACTIVITY.

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DIRECTORATE ASSIGNED: INTERNATIONAL/POLICY

STAFF ASSIGNED: SB/MK

ACTION REQUIRED: FOR DAB'S SIGNATURE

STAFF ACTION: 7

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SENDER'S DUE DATE:

OSTP DUE DATE: 02/11/92

STAFF DUE DATE 2/10/92

DATE COMPLETED:

DATE COMPLETED/DEPT: 3/5/92

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COPIES TO: D. Allan Bromley
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Dr. Allan Bromley
Office of Science Technology Policy
Director
Executive Office of the President
WASHINGTON, D.C. 20506
USA

Ref: 25003/HdC/TvB

January 9th, 1992

Dear Dr. Bromley,

Herewith I send you a summary of the report on my visit to the USA and Canada during last September.
I found this trip very interesting and useful. It helped me considerably in developing my views on the role and policy of STT (The Netherlands Study Centre for Technology Trends).
Once more I want to thank you for the opportunity you gave me to discuss the issues of technology forecasting and assessment and for all information you provided me with.
One of the immediate results of this visit was that STT felt the need to make some information on its activities available in English. Therefore we translated our latest issue of our Interim Review of Activities in that language. I enclose a copy for you. It will give you an impression of the studies we have in hand at the moment.

As a matter of fact I met with Mr. William D. Phillips. As I understand that he left shortly afterwards I send this letter to you.
I hope that we may keep in touch and I would welcome any periodical or any other relevant information on your activities in this field, which might become available. If there is anything we can do for you in terms of providing information and/or establishing contacts, please don't hesitate to contact me.

With kind regards,

H.G. de Cock
director.

Stichting
Toekomstbeeld
der Techniek

REPORT

Visit to the USA and Canada
September 1991

Subject: Technological Forecasting and Assessment

by: H.G. de Cock, director of the Netherlands Study Centre for Technology Trends (STT)

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INTRODUCTION

The objective of the visit was to study the process of deployment of technology in society.
The reason was the wish to verify the policy and the working methods of STT in the light of recent developments.
Special attention, therefore, was directed at the role of the different players in the domain, reaching from technological forecasting through technology policy.

The institutions and persons visited belong to the following categories:
- public authorities, executive (DOE, OSTP, OHTA, Science Council of Canada)
- public authorities, legislation (OTA)
- scientific societies and organisations (NAE, AAAS, Carnegie Commission)
- Academia (Professors Ashford, Branscomb, Brooks, Ehrenfeld, Fusfeld, Hattis, Kash, Mowery, Nelson, Rosenberg)
- research (World Watch, RAND, Foresight Institute) and
- consultancy (Coates).

So most of them are in the public domain; industry was not directly included.

Most visits were short - between one and two hours - and discussions were limited to the issues raised by STT; this report therefore, does not present a complete description of the organisations visited.

I want to thank my hosts, who were willing to give some of their precious time to me and who were so generous in providing me with information. I really enjoyed the open and often challenging discussions. This trip has given me the right kind of input to project the path forward for STT.
I also express my thanks towards the scientific staff of the Netherlands Embassy in Washington, especially Stella Moerland who gave invaluable help in planning this trip and Erik van de Linde who lended assistance as regards content and who accompanied me during the visits in Washington.

SUMMARY

Technology is a key issue in the United States today. For an extended period of time defence and space, but also agriculture and health, supported by a strong economy, served as main sources of new technology. But the economy is waning and technology is not flowing so generously anymore.
As long as technology more or less was seen as an independent, external phenomenon, holding promises for the future, public interest could be satisfied mainly by forecasts.
With the much more vital role technology plays today in many respects however, the involvement of society in technological matters has increased considerably. 'Forecasting' has given way to 'technology assessment'. That

includes not only technological aspects, but economical, social and political ones as well; and it is not restricted to providing information but it also aims at developing the public opinion and at decision making. Whereas technical analyses mainly deal with facts, the widened discussions of today also involve opinions and interests with the related emotions.

A route-map of this process does not exist.
At first sight it seems that there are quite some overlaps, but on closer examination it appears that differences in views and/or targetgroups explain most of the duplications.
An important distinction is that between initiators and commentators, as exists for instance between executive and legislative bodies or between academia and scientific societies.
The general impression is that one has a clearer view of ones sources than of ones objectives.
Strikingly everybody knows everybody and one is aware of each others opinions, activities and results. The discussion is open. There is a considerable personal overlap between the different organisations and committees, even to the extent of a certain saturation. As a result the popular 'peer-review' system is declining.

A certain uneasiness at the present process of formulating the science and technology policies has led to the setting up of the Carnegie Commission on Science, Technology and Government.
Its task is to investigate how that process can be improved upon.

In Canada the Science Council organises a yearly National Advisory Forum for Science and Technology to coordinate the programmes and activities of all bodies involved in these issues at national, federal and state level.

In the US a technology policy starts to take shape that stands midway between the traditional 'laissez-faire' and an emerging interventionism. Increasingly the impotence to transform the abundant technological knowledge into competitive products and processes, is seen as the main cause for the backlog of American industry on the international scene. And the blame for that primarily is laid on management that - as itself says - fails in directing and organising the innovation process.
As the most difficult aspect of that process is seen the interdisciplinary character of new developments. Universities take that very seriously indeed and try to adapt their curricula accordingly.

Over the entire spectrum the universities impressed me as being the most innovative actors. Although they no longer view society as something one could construct, they certainly develop new concepts and think in terms of a broad

interdisciplinary approach. Most 'agencies' on the other hand, are oriented towards 'state-of-the-art'.
Not surprisingly therefore, SPRU and MERIT were recommended to me as valuable contacts for STT.

The only glimpse of the future I got, was at the Foresight Institute: nanotechnology will certainly not become a reality before 2020.
J.F. Coates also looks into the future, but via the mirror of forecasts since 1970.

Of all institutions I visited, NAE showed most ressemblance with STT, that is to say for the studies NAE undertakes at its own responsibility (15%).

In general I got very positive reactions on the formula of STT. I had the publications on Man and Information Technology: towards friendlier systems (38) and on New Applications of Materials (43) with me to show.
If there had been an STT in the USA, NAE and OTA would have been different.

During the different discussions I received quite a diversity of recommendations as regards STT:
- focus on industry
- build a relation with parliament
- seek contacts with innovative entities (like SPRU or MERIT)
- bring advanced knowledge to the Netherlands
- but above all: cherish your own strength (sic)
- add a second stage to the STT studies, dealing with aspects of implementation; involve experienced managers for that stage (Board members and/or members of Steering Committees)
- form a clear picture of your 'constituency'
- publish in English, be it only summaries
- form a network of international relations as a frame of reference for STT's work.

Openings for the exchange of opinions and experiences were given by DOE, World Watch, NAE, J.F. Kennedyschool (as part of a Policy Analysis Exercise), RAND (on an individual basis).

Reports of interest to STT, in view of its recent and present studies, are in particular:
- OTA on Agricultural Commodities (OTA-F-476)
- OTA on Energy Technology Choices (OTA-E-493)
- RAND Bibliography on Energy 1980-1990
- RAND Eurocenter Status Report
- Foresight Nanotechnology Summary.

Reports of interest to technology policy are:
- US Technology Policy (26 September 1990)
- Technology Policy: What should it be? by S.J. Kline and D.E. Kash, 1991
- AAAS report XVI, R&D Fiscal Year 1992
- Midpoint report from the Carnegie Commission on Science, Technology and Government, 1990
- The US as a Partner in Scientific and Technological Cooperation. Some perspectives from across the Atlantic, 1991
- Towards a US Technology Policy, by Lewis Branscomb in Issues in Science and Technology, Vol VII nr 4, 1991
- Science and Technology and the Opportunity, Strategic Plan of the Science Council of Canada, May 1991
- The Consortium on Competitiveness and Cooperation, CCC newsletter nr 2, 1990
- Critical Issues in Science Policy Research, by Nathan Rosenberg, paper presented at 25th anniversary of SPRU, July 1991.

Reports of interest for environmental issues:
- Different World Watch publications
- Technology and Environment, NAE 25
- Total Quality Environmental Management Workshop (GEMI), 1990
- Technology Assessment and Environmental Impact Analysis, by Harvey Brooks, Jan. 1983
- Water 2020. Sustainable Use for Water in the 21st Century, Science Council of Canada.

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Netherlands Study Centre for Technology Trends

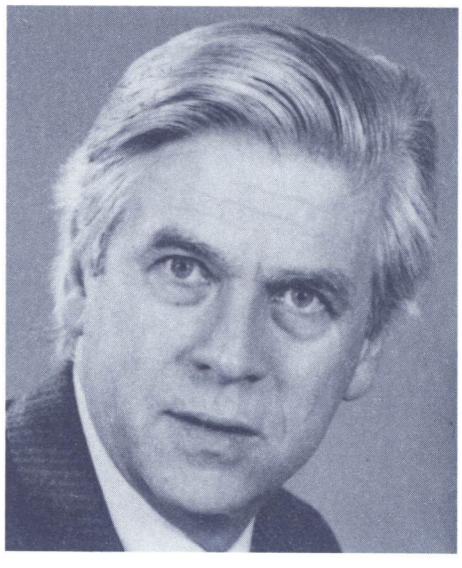
Technology: driving force or quicksand?

As the nineties progress, technology will be more important than ever for companies to keep up with the pace of competition. Most will agree that technology is an important driving force for a company as well as for industry in general. But when it comes to investing in technology and research we find that there is a clear conflict between what is possible in the short term and what is desirable in the long term. Making the right choices then becomes difficult. Technological innovation calls for large inputs of attention, money and manpower, but there is more to it than that. The cost is often incurred a long time before the benefit makes itself felt, so that a company can find itself being sucked under if its bouyancy proves insufficient for innovative projects.

This gap between technology as a driving force and technology as a quicksand is not unbridgeable. It can be closed by the industry, company, engineer or scientist concerned in a variety of ways. I shall explain what I mean against the background of developments in the chemical industry and in particular at DSM.

Until fifteen years ago the chemical industry was in the comfortable position of having demand for its products that exceeded their supply. Raw materials were cheap and spending on the environment was low. In conditions like these the growth rate in the industry was 10% a year, over twice that of the rest of industry.

All this began to change in the second half of the seventies. Labour costs and oil prices rose and supply started to exceed demand. Growth has now fallen to an average of 3.3% a year. The industry's response to this has been to shift the emphasis of its investments away from increasing capacity towards improving and renewing products and processes. In the case of products the main effort has been directed towards higher added value and a better response to market needs. Process improvements have been aimed mainly at cutting costs. In DSM's case this strategy has been a success: the bulk chemicals division, strengthened by improved processes, has been able to act as a base for a number of new activities. But developments continue. Increasing internationalization and concentration of industrial customers are having a tremendous effect on the future of the chemical industry. In Europe this is amplified still further by the coming of the single European market. For example,



Prof. P.M.E.M. van der Grinten
Director of Corporate Planning and Development, DSM

by the year 2000 there are expected to be only six or seven large international motor manufacturers. Industrial customers only want to do business with a limited number of large international suppliers and they select these on the

basis of strict criteria. Even a large chemical concern such as DSM can never meet all these requirements in all departments. The answer is focusing: concentrating on those areas in which you either already are, or where you want to be, one of the best. Industry analyses show that the leading companies in any given field are likely to show the best performance. This is also recognized by the financial world, where companies that are 'lean and mean' are more favoured than diversified giants.

It turns out that in acquiring and keeping a place in the lead technology plays a key role. It is the main driving force for the development of products and processes with new qualities and for increasing one's penetration of new markets by means of lower cost prices. This is also why technology is an important driving force for company growth, affecting both the volume and the quality of the products it produces. In the struggle between companies, technology provides new weapons which, just as in a real war, can prove crucial.
But the research and development needed for technological progress are growing more and more costly and more and more risky as time goes by, especially in projects where both the product and the market are new, as is usually the case when it comes to technological break-throughs. This is where the cost runs way ahead of the benefit: a period of ten years from creative idea to commercialization is not exceptional. Successful examples at DSM are the engineering plastic Stanyl and the super-strong fibre Dyneema. To prevent technology turning from a driving force into a quicksand, however, companies have to make sharp choices and make allowances for the lengths of their vaulting poles.

The attitude of shareholders and the stock market has a great influence on freedom of choice. In the eighties there was pressure from the financial world to improve yields. But, as I have said, technological innovations only produce results in the longer term, and there is therefore a tension between what is demanded in the short term and what is desirable for the future. In other words, to put it mildly, the wishes of companies and their shareholders are not always on the same track. In this context it is interesting to note the difference in the mentality of shareholders in Germany and Japan on the one hand and in the English-speaking countries on the other. In Britain and the US the relationship between company and shareholders is generally short-lived, with rapid changes, aimed at dividends and capital gains. In Japan and Germany, by contrast, the relationship between shareholders and companies lasts for a comparatively long time. With long-term gains as the goal, people are content with modest dividends. This is reflected by the profits of large Japanese companies which, compared with those of their counterparts in the US and Europe, are on the thin side. With profits which would be commonplace in Japan, chemicals companies here in Europe get their ears boxed. Incidentally we find that in Germany and Japan something like 30% of GNP consists of added value, whereas here in Holland it is only 18%. Perhaps this has something to do with the difference in the effort we put into research: in the Netherlands this is 2.2% of GNP and in Germany 2.7%.

So the correlation between the 'business' position and the technological position is very considerable. Here again the rule is 'nothing ventured, nothing gained'. DSM's most successful products are the result of long-term self-financed ventures such as EPDM rubber and melamine. To achieve results like these it is important that the gap between technology as a driving force and technology as a quicksand be bridged. I have a number of suggestions to make.

In the course of his training and career every engineer or scientist must try to make science and application and present and future technology come together. Each step in the process of innovation must link up with the one preceding it. Large steps do not always prove to be steps forward, sometimes turning out instead to be an escape from the realization of the previous invention. This is non-strategy: we don't know where we're going, but we'll be the first to get there.

Education and training must pay more attention to bridging the gap between technology and the market. As part of their courses chemists and technologists ought to be getting industrial marketing as a subsidiary subject. In fact this should apply to all our universities. It would give students an early familiarity with the real world and show them how to see the interrelationship between science, technology and society. Research schools of the highest international standard, where students can develop ideas and theories that tie in with the market, can also narrow the gap.

Companies must learn to see research and development in the right context. Research is an in-depth investment which must ultimately deliver profits. It is not a luxury, the last item in the budget or something to be partly paid for out of profits. It is becoming increasingly common for company annual reports to include statements of investments and research spending. In the eighties a survey was carried out to find out companies' main reasons for investing. It emerged that technology is coming higher and higher on the agenda. Whereas previously 60% of all investment was designed to increase capacity and output, now this is only 20%. 50% of the companies surveyed named technology as the driving force behind their investments as opposed to 20% in the period 1980-1990.

Some technology, of course, can be bought in, but this is really only second-hand technology which often needs extra maintenance. Really being at the forefront of things means above all developing at least half your new technology yourself.

Collaboration and coordination between production, sales, marketing and research are important. This means that the researcher must have an eye to the market and the marketing man must know what possibilities research and technology have to offer. If everyone in the company is constantly aware of both technology and market, the terms 'technology push' and 'market pull' will disappear from our lexicons gradually.

Finally there is a gap which will probably prove the most difficult of all to bridge: the gap between science and industrial development on the one hand and the general public and politics on the other. For the time being I will observe here that the saying 'unknown, unloved' also applies to technological innovation. Society must be convinced of the importance of technology for its welfare and well-being. It will then automatically see the use of a good technological infrastructure. The public must also be given a better insight into the role that technology plays in international competition. To put this idea over properly is a great and a difficult task indeed.

I would also refer back to my earlier observation that the attitude of politicians, shareholders and the general public to technological innovation is considerably more positive in Germany and Japan than it is in other countries. Here technology is all too often seen as a secondary matter, but in the battlefield of international competition it is a real and often crucial factor.

The distance between technology and the general public can probably only be narrowed by improving communication between these two worlds. Scientists and technologists must take up the challenge of debate with those around them. In that way they will be able to exert influence and at the same time allow themselves to be influenced. But above all they must make a success of generating new ideas that are focused on a societally oriented strategy on the part of industry. Technology is an essential component of this strategy and it contributes to its success. But above all it sheds a new light on it; and you have to have light in order to focus.

Prof. P.M.E.M. van der Grinten

Trends in the Study of Technology Trends

When the Netherlands Study Centre for Technology Trends (STT) was set up in 1968 Dr Lykle Schepers, the then president of the Royal Netherlands Institution of Engineers (KIvI), called upon industry to collaborate on ' providing a better insight into the most probable developments in the long term, from which both government and industry can draw a more dependable and where possible common basis for their policy.'

Since that time STT - with practical and financial support from the KIvI, industry, science and the government - has carried out over fifty studies. Of these,

- eighteen addressed subjects of direct relevance to industrial activities in the Netherlands,
- ten studied aspects of infrastructure,
- six tackled environmental questions,
- five investigated questions of energy supply,
- six looked at the health sector, and
- two examined the teaching of technology.

The remaining four studies were of a general nature.

STT studies span a broad spectrum of subjects. This is mainly due to the composition of the STT's own board, in which all the industries and technologies that are important to the Netherlands are represented. The studies are conducted with the help of a large number of experts - often more than fifty - and may therefore be regarded as representative of current thinking in the areas concerned. They are technical and scientific in nature. To make the results accessible to a wider audience they are published in the form of a book which is presented at a concluding symposium.

STT studies have two sorts of added value:

- The study process itself helps those involved to identify and understand the interrelationships, sticking-points and possibilities of the subject matter.
- The books and symposia provide a wide audience consisting of people with an academic and/or practical interest in the subject with a useful aid to forming views and opinions concerning the significance of technological developments.

Since the foundation of STT much has changed in the way society looks at the future. STT began its work at a time when there was a strong belief in progress which was based mainly on technological developments. Working and speaking from a technological background, in its early days STT more or less had the field to itself in its future-oriented research. It was not long, however, before limits hove into view. It became clear that the availability of resources and the carrying capacity of the natural environment were not unlimited. Interest in the future swiftly became more widespread. Numerous organizations and institutions were created to inform the public about the future, each with its own angle, goal and target group.

But it was not only the breadth of future research that increased. Its objectives too became more concrete. The view gained ground that the future is not something that simply happens to us, but that it is to a large extent the result of the policies of the present generation. This implied that merely informing the public was no longer sufficient: the process had to be extended to forming opinions and taking decisions.

Opinions have always been formed and decisions have always been taken, of course, both in industry and in government. But under the influence of rapid technological change and the growing complexity of social problems the number of bodies offering support and advice on them has also risen fast.

For STT this means that the path to the

H.G. de Cock
director

'end users' of its products has become longer. Under these changed circumstances there are now two possible paths open to the organization if it is to continue to reach its intended target group.

The first is to supply a complete 'end product', geared to the current needs of the original target group. This would mean broadening the studies by the addition of a number of non-technical aspects and extending STT's activities to include opinion-forming processes culminating in concrete policy recommendations.

The second path would be to concentrate on studying and surveying technological developments, i.e. STT's original core activity. The end product of this is dependable information, of the highest possible standard, on likely or imminent technological developments. This, in turn, might then be the starting-point for opinion-forming and policymaking.

STT has elected for the second of these options. One important factor in this decision is the sources from which STT

draws its information and the manner in which its products are produced. This process itself represents - as already observed - an important element of the added value of STT's work. To broaden it by adding other disciplines would detract from its strength. And extending the service into opinion-forming and policymaking (political or otherwise) would put the scientific and objective character of the studies in the balance.

The overall effect of all this is that STT is gradually moving from a seller's market into a buyer's market. It also means that the organization is no longer engaged solely in 'technology push' but is also open to 'pull'. Given the tremendous platform of knowledge which STT has on call, this affords new opportunities for making a valuable contribution to the interactive process that must ultimately result in our picture of the future.

It has been said that not everything that can be done has to be done, but if you don't know what can be done, what can you do? This is why gathering and providing in-depth knowledge continues to be of the first importance.

H.G. de Cock

STT's permanent staff (from left to right):
Mrs. M.J.A. Alkemade,
K.J.H. van Loon,
H.G. de Cock,
Mrs. T.M.F. van Bergenhenegouwen,
Mrs. R.M.P.G. Otten,
Mrs. M.W. van Zwieteren,
E.F. van de Weijdeven,
Mrs. W.G.J. Brouwer and
E. W. L. van Engelen

André Sjoerdsma retires

Director André Sjoerdsma retired from his post on 30 May after 23 years, having guided STT with a firm hand from its inception. Seldom has it been so appropriate to say 'his post': the simple fact is that Sjoerdsma personified STT, and at the same time everyone knew him as STT's director, despite all his other jobs in the social field. It is rare, too, to find a manager who takes so great an interest in every aspect of his job - finding the right experts for the subjects chosen by the board for study, giving guidance and advice to project leaders, helping to mould the results into the shape of a lucid and comprehensible report with contents that are actually useful to the reader, presenting the report at a busy symposium, and all this at the same time as running his own office and finding the necessary funding.

This list is not exhaustive: there was much more besides. Altogether, it was a demanding package of tasks. But you couldn't have told, looking at Sjoerdsma. Seldom have I met anyone who did his job with such visible pleasure and with such unflagging personal energy, and who expected the same of everyone else.

At an animated meeting in 'Diligentia' Dr Eduard Pannenborg, STT's former chairman, focused a spotlight on Sjoerdsma's past achievements in a most interesting address. Then STT's founder and first chairman Dr Lykle Schepers presented him with the STT's medal. Finally he was named an Officer in the Order of Orange-Nassau, the insignia of this honour being presented by Dr Jan Willem Eggink, alderman of the municipality of Voorburg.

A well attended reception gave Sjoerdsma's many friends and professional contacts the opportunity to express their friendship and appreciation in person. At the same time they were able to meet his successor, Herman de Cock.

A dinner for invited guests was a fitting end to what for STT has been a remarkable period of shaping and structuring into what the organization is today. On behalf of the board I should like to take this opportunity to thank André Sjoerdsma for everything he has done for STT. We all wish him a long and happy retirement. We all wish STT a shining future under the leadership of its new director.

W.A. Koumans
chairman

STT chairman Wim Koumans (right) shakes hands with André Sjoerdsma

Complexity in Technology

To control and influence his environment, man has invented and used a growing number of increasingly complex tools. But with their increasing complexity the controllability of these technical and technological aids has itself declined. The visible result of this is long development times, high development costs, systems and processes that can no longer be thoroughly tested, uncertainty about faults in systems and processes, human error, information overloads, system failures, vulnerability, uncontrollable systems and failed projects.

Increasing complexity means increasing risks and rising costs for industry and government alike. More than ever before, it is becoming necessary to turn our attention to the control of complexity. But it is difficult first to identify and then to find effective control of growing complexity. The purpose of this STT study is to help improve our understanding of complexity and to indicate ways to better control. It both identifies and summarizes points of relevance.

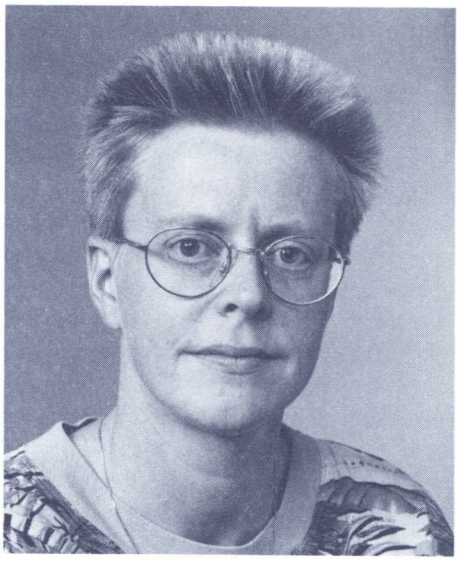
To begin with the study establishes the features of the concept of complexity and its associations. Complexity has a relative and subjective character. Measuring complexity is a difficult problem, so that measurement can not play an important role in its control yet.

In problems of complexity the relationship between man and the technological system is important. The study will accordingly examine the role of complexity in the design, construction, operation and use of technological systems. Environment, organization, cooperation and multidisciplinary character are important factors.

The study uses a number of case histories to illustrate how the different people involved experience the role of complexity and where they see problem areas both now and in the future. Possible ways of reducing and controlling complexity are discussed. This practice-oriented section deals specifically with automation projects, since it is there that complexity becomes most obviously apparent. A number of automation projects in the public sector, banking, transport, electricity generation and distribution, assembly and process industry are examined in detail.

Experts from a variety of technological and scientific disciplines explain their views on the subject of complexity, giving a multifaceted deepening of insight into the problem of complexity. There are contributions from design and analysis methodology, software engineering, management studies, production control, man-machine systems, language and speech technology and artificial intelligence.

The results of the study will be published in STT book No. 52 and presented at a symposium on 27 March 1992.



Mrs. M.J.A. Alkemade
project leader

Energy and the Environment

The current heavy burden on the environment may be seen as an unwelcome consequence of the ever-increasing use of technology. However, new technologies can also be employed in our efforts to bring about an improvement in the present and future state of the environment. Environmental technology is not a clearly delineated discipline in its own right, but has its own place in virtually every discipline of technology, for example agriculture, transport, waste disposal and the energy industry. Since every technical and technological process is driven by energy, every problem associated with the environment is more or less a corollary of energy consumption. As a result, energy consumption is an important policy instrument in environmental matters for both industry and government. It is for this reason that STT is now engaged in a study on energy and the environment.

The main emphasis of this study is on the possibilities offered by electricity in industry.
Attention is paid to new technologies for using electricity for industrial purposes. There are many industrial processes which can benefit from the efficient, universally applicable and environmentally friendly nature of electrical energy. If electricity is to be used for reasons that have to do with protecting the environment, it will clearly be important to generate it cleanly and if possible at high efficiency. For this reason the study not only looks at sustainable applications but also examines in detail the generation of electricity in combination with heat generation.

In consultation with a study advisory panel the general direction and scope of the study as well as the main points to be studied have been established. To work on these main points four working parties have been set up, each with its own experts in the fields of energy and energy technology, the environment and economics. Members of the working parties are drawn from various quarters including ECN, KEMA, NOVEM, PWK, TNO, the ministry of Economic Affairs, the universities of technology, electricity producers and heavy industry.

After an introductory chapter in which energy policy is placed in the context of energy, environment and economy, the attention shifts to developments on the demand side. A number of important efficient applications of electricity in industry are examined. These may lead to an increase in the consumption of electricity, but this will be offset by an overal reduction in energy consumption. The study then moves on to the technologies available for industrial electricity generation. Here the use of process heat is crucial. Finally a number of new or alternative electricity production technologies are discussed and evaluated as regards their applicability in industry. Below is a list of the subjects studied and presented by the four working parties.

Energy, environment and economy
- A history of demand for electricity. To what extent is the demand for electricity likely to change?
- Possible policy instruments and an assessment of their likely effects. The instruments considered include energy price control (e.g. through a CO_2 levy) and energy conservation covenants.
- Central or decentralized generation? Environmental aspects and the future of decentralized energy generation.
- Company attitudes to environmental and energy problems. The mainsprings of operating policy in electricity-intensive industry. The making of industrial environmental policy.

Efficient applications of electricity in industry
- Electrical heat: applications of e.g. dielectric and infra-red heating technologies. Dielectric heating makes it possible to heat a single targeted component of the product, e.g. an adhesive layer.
- Electricity in chemical processes: as power, for conditioning, separating, process control and electrochemical reactions.
- Electric motors: efficiency and dimensioning of motors and drive systems, improvements in drive control.
- The potential for energy conservation in industrial lighting.
- An overview of other possible applications for technologies based on electricity which may hold the promise of environmental benefits.

E.W.L. van Engelen
project leader

Process heat and electricity supply for industry
Here the emphasis will be on ways of decentralized electricity generation for industry.
- Likely applicability of heat and power cogeneration (CHP): probable demand;

economics, politics, environmental aspects and availability of energy carriers as determining factors.
- Cogeneration technologies: gas turbines, gas engines, heat pumps and heat transformers.
- A discussion of exergy.
- Avoidance, removal and partial acceptance of SO_2 and NO_x.

New production technologies for electricity in industry
- Electricity from fuel cells. Types, characteristics and economic perspectives.
- Thermionic Energy Converters and Magneto Hydro Dynamic energy conversion (MHD) (convert heat directly into electricity). Principle, maturity of these systems, technical potential and possible applications.
- Electricity for industry from renewable energy resources: solar and wind energy.
- The use of waste gases such as H_2. Applications for the use of hydrogen as a fuel.
- Industrial uses for biomass: technologies and sticking-points.
- The energy distribution companies' angle.

The results of the study will be published in STT book No. 53 and presented at a symposium on 12 May 1992.

Agricultural Commodities for Industry

On 25 April STT held a symposium on agricultural commodities for industry, organized in collaboration with the Society for the Netherlands Chemical Industry and the Royal Netherlands Chemical Society. Examples were presented of important groups of materials which can be made from plants, such as fibres, oils and fats, and carbohydrates. These demonstrated that plants can provide us with raw materials that are both chemically and physically versatile and useful. Despite this, vegetable materials are little used.

The afternoon session was devoted to an analysis of the reasons for the dichotomy between usefulness and poor utilization. Several speakers concluded that as a general rule the high cost of vegetable commodities made the likelihood that they would ever be used for the production of bulk chemicals and energy very small.
In the case of crops grown in the Netherlands there are the additional factors of high land prices and the country's temperate climate.
In the case of fine chemicals and 'performance' chemicals (tailored to specific applications) the situation is slightly different. These products are characterized by small volumes and high added value. It was also observed that there are plenty of technological and chemical uses for vegetable materials. The main limiting factors are economic and operational.

One of these factors is that agriculture in the Netherlands is not geared to the production of vegetable materials for industry. There is also no intermediate industry to convert the products of agriculture into commodities for industrial use, in addition to which industry itself is reluctant to use any other than its customary petrochemical materials.

The results of the study have been published in STT book No. 51, Plantaardige grondstoffen voor de industrie.

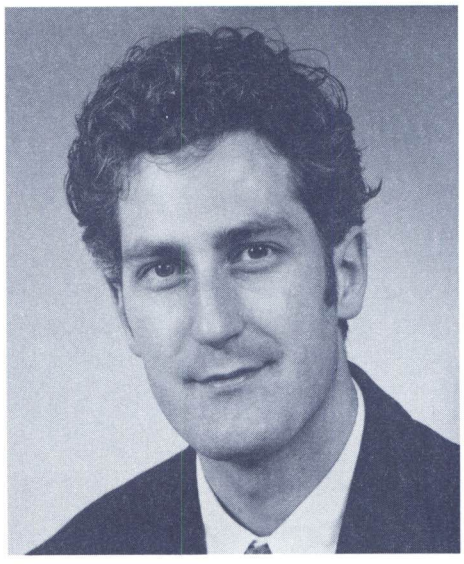
New Design Methods

The subject of new design methods was selected for an STT study because of the rapid changes that are taking place in design processes, largely as a result of information technology. The timely and appropriate use of these developments can be of great strategic importance to industry.

Rationalization of the industrial production process has hitherto concentrated mainly on the physical production process. Improvements in productivity by many orders of magnitude have been the result of mechanization, automation, improvements in quality and reductions in throughput times. At the same time new production technologies have pushed back the boundaries even further. Similar opportunities for rationalization and improvement are now presenting themselves for the design process, which, after all, may also be regarded as a production process, albeit one of producing an abstract product: information.
Many of the activities involved in the design process are repetitions of known processes or variations on a known theme. With the exception of truly new elements, for which original creative work is required, many design activities are susceptible of computerization, quality improvement and acceleration. These include:

- computer simulations which can provide information on the functioning of the intended product or system, even at an early stage;
- accessible design rules encapsulating a large volume of design experience, allowing the design process to be considerably improved and accelerated;
- the possibilities afforded by information technology for the effective and efficient control of the growing flow of information during the process of product creation and the information needed to control the design process itself. In this context it would be accurate to speak of the 'logistics' of information.

The intention is that the study should identify and analyse the various innovatory trends in the design process in a number of areas of application. These can then be placed in the perspective of the contribution they may be expected to make to industrial activity. At the time of writing a preliminary exploration is taking place which will lead to a concrete project proposal in the autumn of 1991.



E.F. van de Weijdeven
project leader

Coming Events

27 March 1992
publication of and symposium on 'Complexity in Technology'

12 May 1992
publication of and symposium on 'Energy and Environment: energy use in industry'

Recent publications

(published in Dutch only)

Kennissystemen in het onderwijs (Expert Systems in Education)
Edited by J.J.S.C. de Witte and A.Y.L. Kwee, 1987
(Publication 45, ISBN 90 14 03717 1)

Kennissystemen en medische besluitvorming (Expert Systems and Medical Decision-Making)
J.J.S.C. de Witte and A.Y.L. Kwee, 1987
(Publication 46, ISBN 90 14 03718 X)

Kennissystemen in de dienstensector (Expert Systems in the Services Sector)
Edited by A.Y.L. Kwee and J.J.S.C. de Witte, 1987
(Publication 47, ISBN 90 14 03719 8)

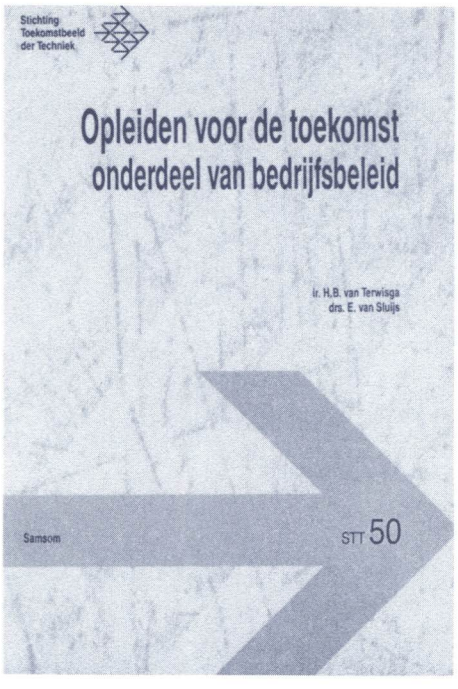
Kennissystemen in de industrie (Expert Systems in Manufacturing Industry)
J.J.S.C. de Witte and A.Y.L. Kwee, 1988
(Publication 48, ISBN 90 14 03880 1)

Grenzen aan techniek (Limits to Technology)
Edited by A.J. van Griethuysen, 1989
(Publication 49, ISBN 90 14 03880 1)

Opleiden voor de toekomst, onderdeel van bedrijfsbeleid (Training and Education as part of Human Resources Management)
H.B. van Terwisga and E. van Sluijs, 1990
(Publication 50, ISBN 90 14 04506 9)

Plantaardige grondstoffen voor de industrie (Agricultural Commodities for Industry)
Edited by W.G.J. Brouwer, 1991
(Publication 51, ISBN 90 14 03882 8)

These publications are available through bookshops.



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Interim Review of Activities 1991