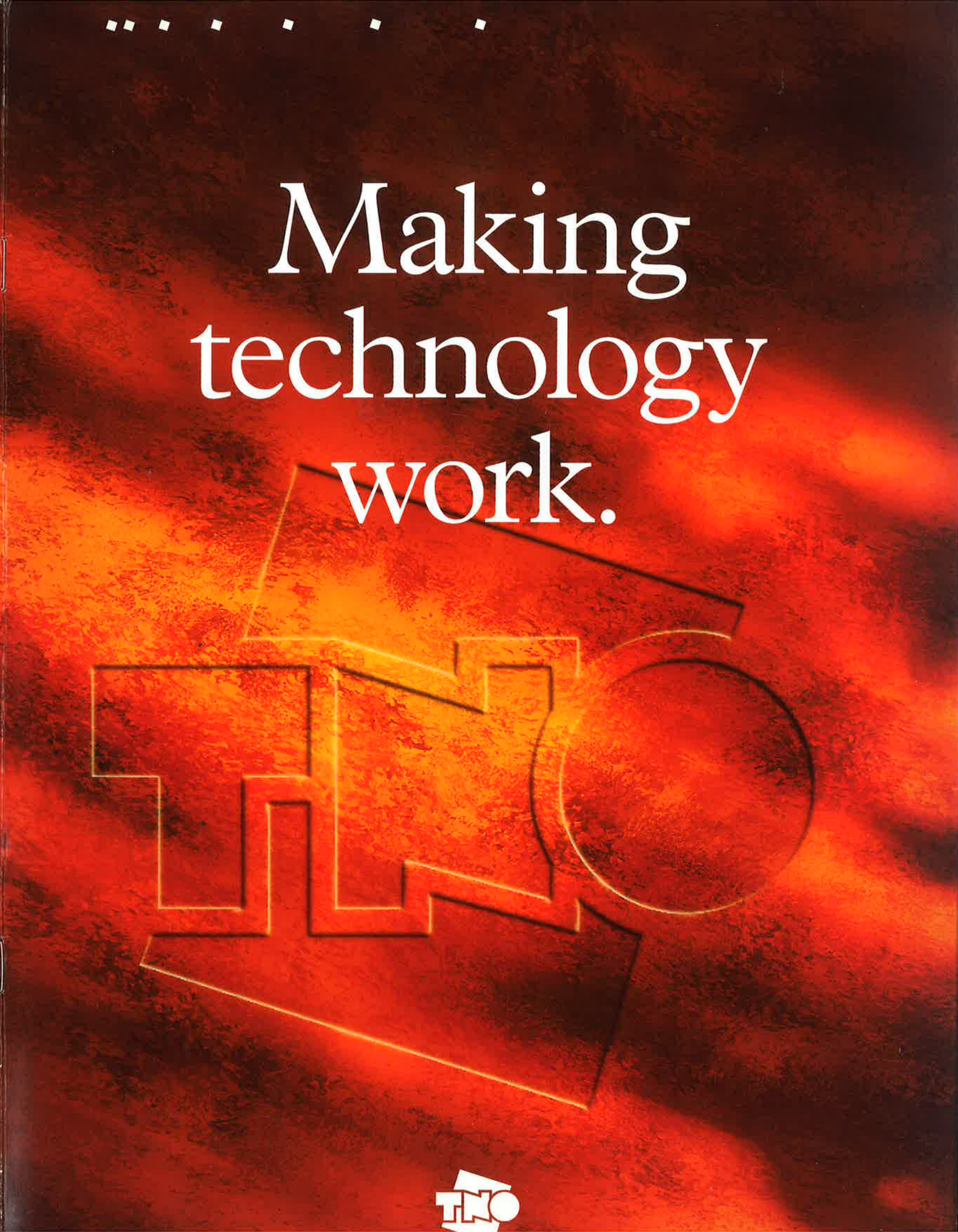
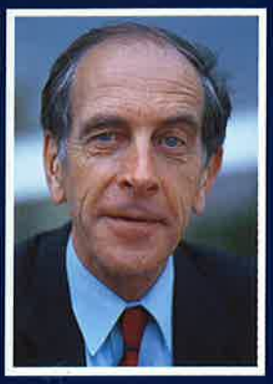
Making technology work.



TNO is a modern, Dutch, knowledge-based organization providing services in the form of research, development and application of new technologies. TNO's knowledge finds immediate and practical use for all clients, both large and small, in the Netherlands and around the world. The contribution made by TNO is crucial to the greater competitiveness of companies and organizations, and benefits the economy and the quality of society.

Making technology work.



We are on our way to developing a society in which knowledge is becoming the decisive factor. In production it is not raw materials or capital but knowledge which is starting to be the dominant influence. This applies to companies as well as industry, institutions and the authorities.

As demands on efficiency and effectiveness become more exacting, the role which knowledge plays in ensuring competitive success is vital. Success achieved through applying new methods and technologies and through the innovation of products and processes. Many companies and institutions are aware that it is precisely in the innovative process that efficiency and effectiveness are essential. And it is here that collaboration can offer major advantages in terms of speed and flexibility and in the availability of specialized knowledge. TNO is a partner which can help you achieve these benefits.

There are 4,000 professionals at TNO, and they take pride in putting their knowledge and skills at the disposal of their clients, whatever the field may be. It is this mission which provides TNO with the opportunity to prove that technology can be put to work. We do our utmost to achieve the very best results, and we hope that this brochure will encourage you to contact us or to strengthen the contacts we already have.

Jan Dekker
President of the TNO Board of Management

TNO Product Centre
Supports industrial companies and the service industry in product development, ranging from product concept to integral design, and from pilot model and prototype through to the in-house production of small test series.

TNO Metals Research Institute
Provides a wide range of practical services to the metal processing industry and to users of metal products and process equipment. The Institute's staff, who are well-versed in all aspects of materials technology, use their expertise to assist a wide range of companies, providing advice on organizational matters, quality management and the introduction of new materials and production techniques.

TNO Plastics and Rubber Research Institute/Branch-specific Research Centres
Aim to increase the competitiveness of companies by pushing back the frontiers of product development and cost-effective production. This aim is achieved by applying innovative materials and introducing new product concepts.

TNO Institute of Applied Physics
Has a wide range of disciplines at hand, such as applied physics, information technology, mechanics, electronics, materials, and process technology. Projects are often multidisciplinary, ranging from systems development to consultancy.

TNO Road Vehicles Research Institute
Performs a wide range of contract R&D activities on road vehicles and internal combustion engines. Much of the research focuses on vehicle characteristics and performance, and is often related to safety, energy and environmental issues. Particular emphasis is placed on product development studies and optimizing the performance of components and vehicles.

TNO Building and Construction Research
Makes use of the entire TNO organization's expertise in giving advice on civil, maritime and offshore construction, shipbuilding and machine building. Combines many areas of research, such as building and materials technology, fire safety, indoor environment, construction, numerical mechanics, strategic studies and quality assurance.

TNO Institute of Applied Geoscience
Employs geological and related technological research to efficiently manage and exploit the subsurface and its natural resources.

TNO Nutrition and Food Research Institute
Operates internationally in areas of research covering all aspects of food production. Emphasis is placed on biotechnology, quality control, analysis and safety assessment of foods , beverages and tobacco as well as the additives and ingredients used in their production.

TNO Prevention and Health
Aims to benefit health and health care at all stages of life: childhood, working life and old age. Has extensive expertise in the medical, biomedical, social, social health, technical and technological fields. By combining the expertise in the various fields, an integrated approach to complex health problems can be taken, with special attention to such issues as ageing, chronic illnesses and the working environment.

TNO Physics and Electronics Laboratory
Undertakes R&D in the area of surveillance systems (radar, infra-red, visible light, acoustics) and signal processing, information technology and telecommunication, trainers and simulators, and policy support using operational research.

TNO Prins Maurits Laboratory
Is involved in areas such as protection against toxic substances and against gas and dust explosions, the properties and composition of energetic materials and pyrotechnic compounds, the development of propellants for space applications, electromagnetic propulsion, terminal ballistics and research into the vulnerability/effectiveness of weapons and platforms.

TNO Human Factors Research Institute
Specializes in human performance in relation to the task environment, the design of work activities and the provision of adequate technical support. Contributes to efficient labour and optimum working conditions. Focuses on applications for defence, industry and government.

TNO Institute of Environmental Sciences, Energy Research and Process Innovation
R&D focuses on sustainable development and environmentally-oriented process innovation. Contributes to the efficient and sustainable use of energy and raw materials by developing and implementing processes, equipment, systems and methods. Focuses on the analysis of chemical emissions and the occurrence of pollutants and their effect on the environment. Industrial safety and ecological risk studies complement the core business of the Institute.

TNO Institute of Infrastructure, Transport and Regional Development
Produces recommendations for governments, the business world and the European Commission on policy development for infrastructure, traffic and transport, and regional development.

TNO Centre for Technology and Policy Studies
Supports governments, the business world and the European Commission in strategic decision-making on issues concerning the reorganization of the knowledge infrastructure, technology portfolios of businesses and research institutes, and shaping and implementing industrial and technology policy. The Centre makes scientific and technological contributions towards resolving social issues.

Working with TNO
Suppose you have a question or an idea which involves technology. A talk with TNO will always leave you wiser. Or vice versa. If TNO considers that your market sector may benefit from interesting developments, then we will take the initiative ourselves. If you do not have access to a direct contact within TNO, then get in touch with the TNO Business Information Desk. Depending on your request, you will be directed to the appropriate part of the organization. Subsequently, you may wish to discuss matters further with an account manager who will be able to translate your request into a project outline and a quotation. Whatever the project, TNO merges the required disciplines into a customized team in response to the demand. Each team combines creativity, experience in project-oriented work and knowledge of advanced techniques, together with the ambition to produce excellent results.
The quotation always provides a clear overview of the targeted project results, the tasks to be undertaken and a time frame incorporating interim progress reports. Possible use of the TNO name, confidentiality and embargos will be a matter of mutual discussion.
Very clear agreements will form the basis of a fruitful collaboration in which quality of the process and of the result are paramount for both parties.

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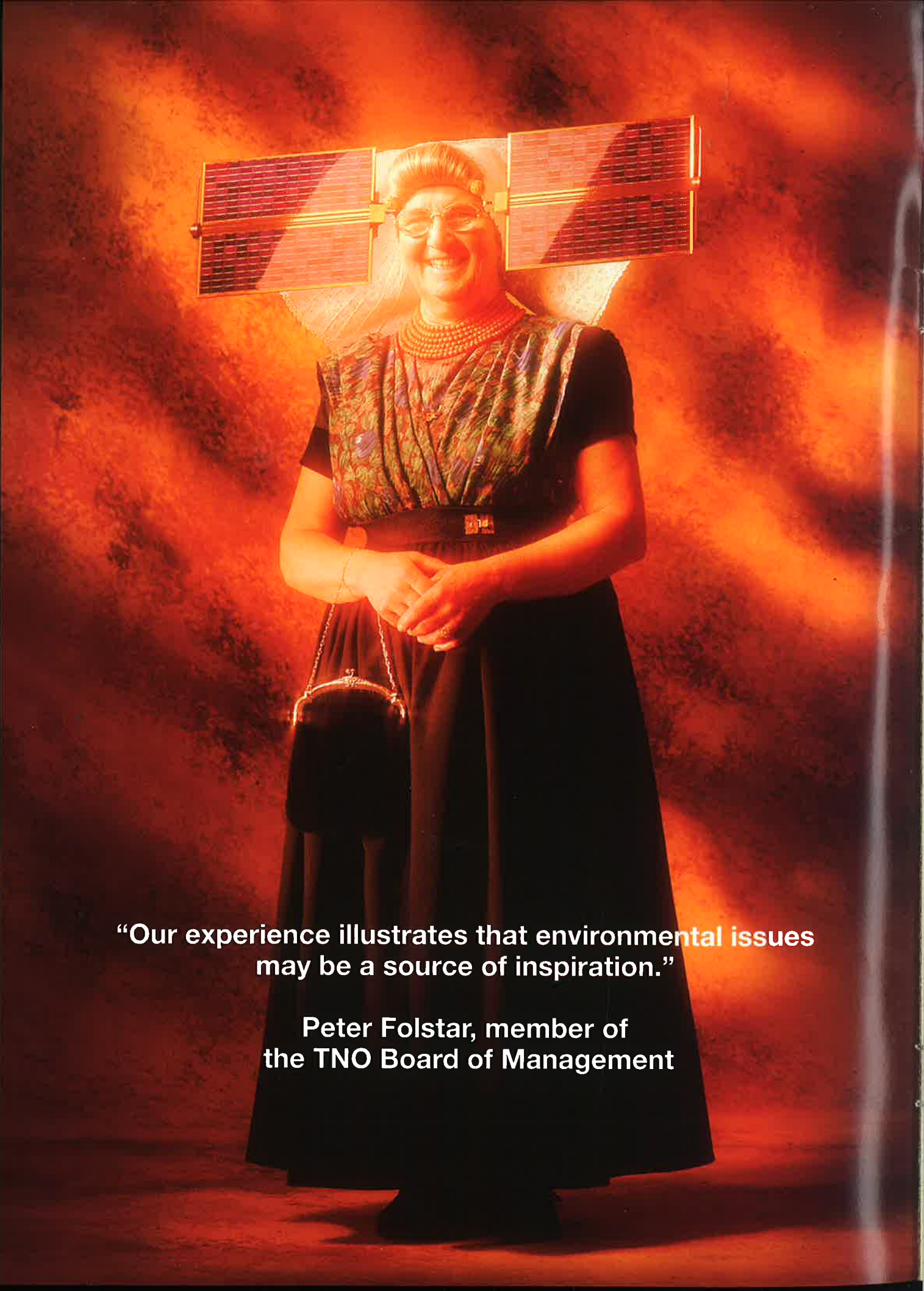
Specialized Areas of Expertise

Making technology work in practice.



"Our experience illustrates that environmental issues may be a source of inspiration."

Peter Folstar, member of
the TNO Board of Management

Innovation boosts companies' competitive strength.

Companies at the technological cutting edge of their markets enjoy competitive advantages and better prospects for continuity. They develop products with higher margins, tap into new sales opportunities and withdraw from unprofitable markets at the right moment. Time and again, experience shows that innovation really is the key to success.

And it is precisely this innovation that can benefit from the fresh approach of an external specialist. Numerous companies have entrusted their research and development to TNO, either partially or fully, and they can testify to the advantages gained, enjoying the benefits of the knowledge and skills which we have accumulated over the years. Practice has shown, and our examples confirm, that collaboration between TNO and both large and small companies alike can be very successful ventures.

Working for the extra edge.

Possessing a significant advantage in terms of product can be a formidable weapon in the competitive arena. That is why the development of any product should be focused on the end result providing an additional edge on competitors. TNO's wealth of innovative knowledge can help achieve this aim. Take, for instance, the Dutch canoe company that supplies canoes to Olympic Games participants. TNO's involvement led to the development of a white-water plastic canoe which was fibre-reinforced and could be built in a single production process. It also had the added benefit of both strengthening the canoe and speeding up the production process.

Another example is TNO's contribution to perfecting the 'Jordi' football shoe marketed in the Cruijff line. Extensive tests prompted the substitution of new materials comprising two layers of polyurethane for the original sole. The result is better shock absorption, reduced concentration of pressure on the underside of the foot and fewer complaints from playing on dry, hard pitches.

No frontiers to innovation.

TNO has a worldwide client base. The United States company Symbol Technologies Inc. works closely with TNO in the further computerization and automation of supermarkets. Future technology will enable shoppers to enter the prices of products they wish to purchase as they shop, eliminating the need to wait at the cash desk. Simply transferring information from a hand scanner will be enough.

As the largest Dutch research organization, TNO plays a pivotal role in the innovation chain between fundamental research and practical application. The acquisition of knowledge and accumulation of expertise are key aspects of TNO's input. Knowledge is TNO's main product. In some instances it is incorporated in hardware equipment, instruments or components of a new material, but to an increasing degree in software.

TNO has defined three categories of activities:

• Applied research, focusing on responding to concrete questions from clients through the application of high-quality knowledge in new products, markets and processes.

• Services and products which focus on the client's specific demands: product development, consultancy, measurement, certification, calibration, second opinions, audits, turnkey projects or training.

• Exploratory research focusing in most instances on capital-intensive strategic research programmes over several years, the goal of which is to explore and develop the possibility of putting new technologies to use.

From a simple idea to success.

It is not unusual for TNO to transform a simple idea into a success. The ARHO company in The Hague had developed a design for a sash window with a wooden frame, well insulated and easy to open and close, specially for historic buildings. The company was responding to a market need. In developing and testing the product, ARHO benefited considerably from TNO's specialist knowledge and equipment. ARHO's WinTwin sash window now enjoys a strong market position.

Cooperatives are clients too.

Though the bulk of TNO's work is for individual companies, orders also come from sectors or clusters of companies. Various sheet glass producers, for example, decided to contract their research and development out to TNO.

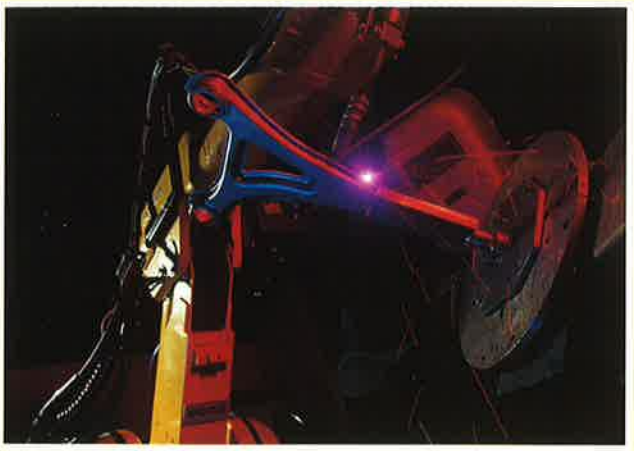
As double-glazing began to flourish, TNO responded by developing methods to define the quality of the product's insulation. A simulation package was developed for the entire glass manufacturing process, enabling companies to focus on process adjustments which can reduce environmentally harmful effects (and the environmental levies the companies have to pay).

Collective interests are also involved in research on the effects of modern biotechnology on agrofood-chain trends. TNO has undertaken research in conjunction with the Agricultural Economic Institute to identify whether future supply, production and processing will be handled by entirely new chains, and what the farmers' position will be.

TNO was called in for its expertise in sector studies and biotechnology. The first step was to outline the relevant biotechnology for each agrofood chain, based on a new methodology. Then two chains were selected for more detailed examination: the consumer potato chain and dairy chain. Initial research results demonstrate that biotechnology does not constitute a further threat to farmers' freedom.

New products for a new market.

Following some brainstorming with TNO, Score B.V., a manufacturer of chairs for the work-place, decided to focus on a range of functional comfort articles,



TNO's knowledge portfolio comprises around 400 high-quality technologies divided among eight areas: industrial technology, agriculture/food, defence, health care, technology policy, environment & energy, building & construction, transport & infrastructure. The portfolio is regularly reviewed by independent experts, ensuring that TNO's knowledge remains 'state of the art'. Some of the technologies in the strategic portfolio are protected by patent. Collaboration with TNO has enabled numerous clients to obtain patents on the results of their projects. The quality of the knowledge produced by TNO is strictly monitored. Evidence of this quality is demonstrated by the growing number of certificates and accreditations (ISO 9001, STERLAB, STERIN, GLP) issued to TNO.

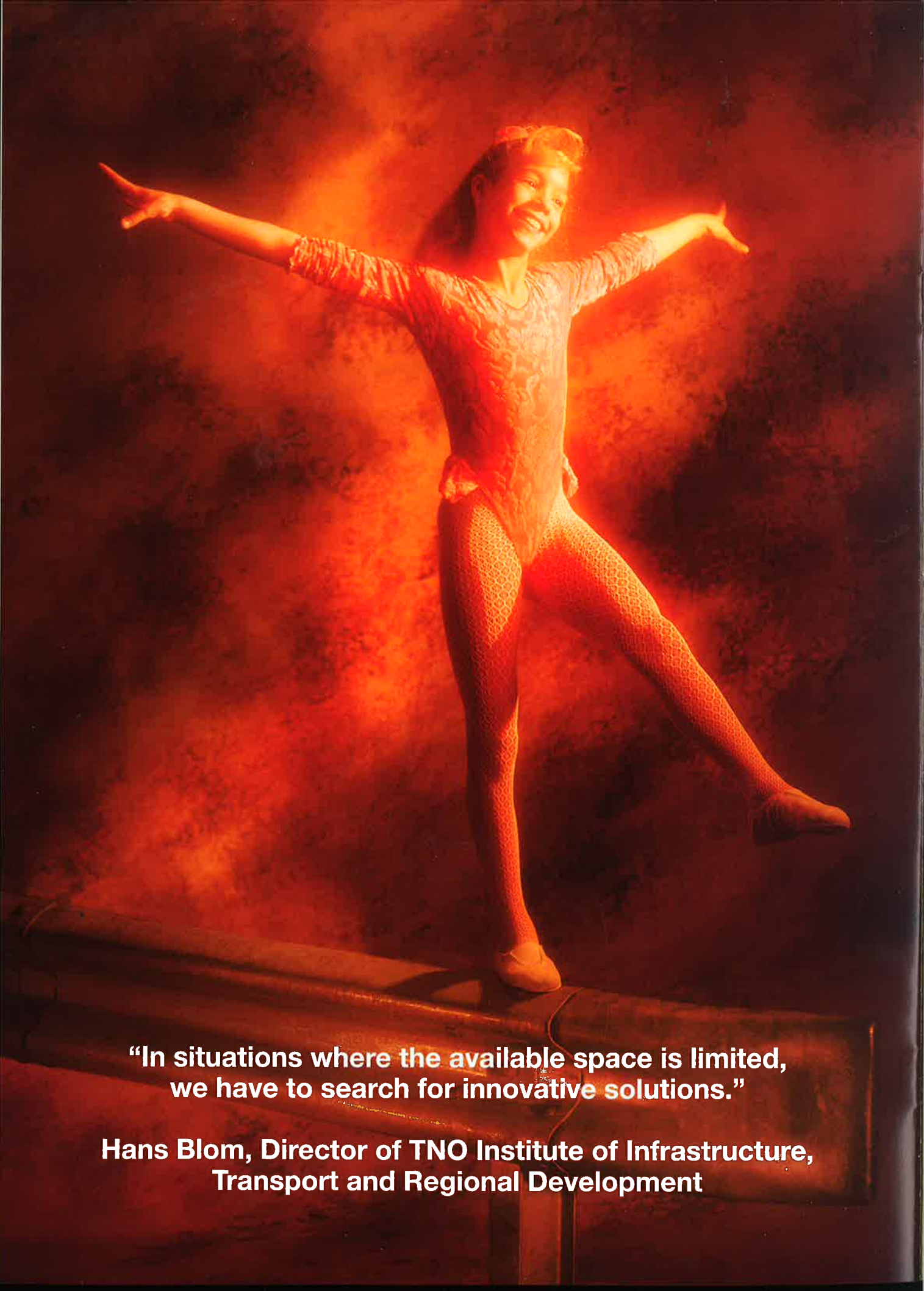
including those for senior citizens and the partially handicapped.

The upshot is a variety of products developed by TNO for the manufacturer, the first of which was the Splash fully-retractable shower seat which fits easily into the corner of a shower. This was followed by the Pico Trolley, a service trolley which also serves as a walking support. Other comfort articles are being developed.

Inspired by environmental problems.

The duty to keep the environment clean is a challenge to blaze new trails, and at TNO meeting that challenge is explored on a daily basis. Electric transport is, for instance, one way to reduce urban air pollution. The weight of the batteries, however, is currently holding back progress. So this inspired us to continue our search for new, clean techniques for storing electrical energy.

Another example is the ozone issue, which prompted TNO to initiate projects including the development of new technology for refrigerators. The result is a machine that operates on air and replaces the technology based on CFCs. TNO has now entered into a joint venture with a climate control company to produce these machines. Ecodesign is of course essential in this context. Ecodesign is a demonstration programme whose main objectives include supporting environment-oriented product development in companies. TNO collaborated closely with the leading copier manufacturer Océ in applying this environmental concept to the development and production of copiers and other Océ equipment. From the earliest drawing-board stage, environmental aspects such as energy consumption, transport, raw materials and waste were involved. And the results are conclusive: the Océ 7050 copier scores substantially higher in these respects than comparable equipment from other suppliers.



"In situations where the available space is limited, we have to search for innovative solutions."

Hans Blom, Director of TNO Institute of Infrastructure, Transport and Regional Development

Innovation is the key to a sustainable society.

TNO collaborates with the authorities and other public bodies on improving the quality of society, and this collaboration has enabled TNO to target specific areas of research: sustainable development, traffic, transport and infrastructure, labour and working conditions, ageing, fraud, and crime prevention through improving security and protection.

The following example is illustrative of TNO's contribution. Traffic jams routinely exceeding several kilometres underline the growing difficulty of a Dutch infrastructure trying to cope. That is why TNO is working on new systems to utilize infrastructure more efficiently and to boost safety on the road. TNO is participating in research on a method to predict road situations in advance, knowledge which is vital for managing and guiding traffic flows. The research makes use of road-surface detectors and, increasingly, information collected through the cars themselves.

Strategic research.

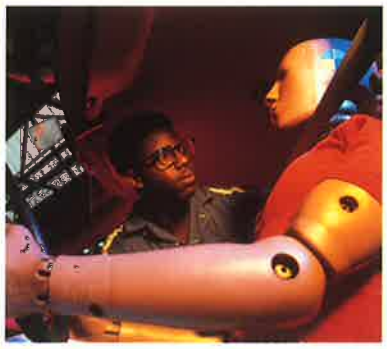
In the vast majority of cases, TNO Research and Development focuses on immediate applicability and results. But it is not always a case of entrepreneurial battles for supremacy. Let us take a few examples. As a key component of our work, strategic research has produced a number of results including the discovery of a type of brain protein which is a special factor in inflammatory reactions characteristic of multiple sclerosis. It is a discovery which opens up clues to prevention, diagnostics and therapy.

TNO's expertise in health care frequently produces beneficial results. Research into the problem of clogged blood vessels has provided more understanding of the mechanisms of clotting and declotting of blood, and has subsequently facilitated improved prevention and treatment of thrombosis and heart attacks.

Several fields of TNO expertise, such as construction and ergonomics, are being applied to improve working conditions in the construction industry. Several aids have already been developed to reduce builders' physical work-load.

Long-term research is successful in entirely different fields as well. One is noise reduction, until recently often tackled passively, using silencers, sound walls and absorbent materials. For several years TNO has been a leader in experimental research on a more active method of noise reduction known as anti-noise.
This involves actively reducing the original noise field with loudspeakers that generate

Once every four years TNO presents its strategic research plans to the Dutch government. These plans focus primarily on reinforcing the country's economic structure and on improving the quality of our society. TNO believes that this goal will be best achieved by combining the efforts of government, business and research institutes with a focus on investments in the new development and application of knowledge.



TNO's annual turnover is NLG 745 million, 15% of which originates from abroad. In certain areas of significant public interest, the government provides the required funding. For strategic, high-risk research which transcends national interests, financing is supported in some instances by contributions from the European Union. In this type of project, the collaboration between TNO and other leading research institutes is normally intense, and affords TNO a further opportunity to open up new fields of knowledge.

The ongoing renewal of knowledge is essential for effective quality control. TNO staff are aware of the latest developments in their fields, and this awareness is enriched by strong ties with research and development institutes, universities and polytechnics around the world.

anti-noise. Actual situations reveal that anti-noise is an excellent supplement to passive noise reduction. The research has now reached a stage where this system can be practically applied in aeroplanes and cars.

Multidisciplinary approach.

TNO provides most Dutch government departments with support in formulating policy, and undertakes projects to ensure that the policy works.

The Dutch armed forces use a wide range of TNO services, and the TNO defence research institutes are even referred to casually as the Ministry of Defence's in-house laboratory. Over the past few years, the nature of military activity has changed. The main focus used to be preparation for large-scale conflict. Current emphasis is on small-scale operations and on international management of local and regional crises. Tasks have taken on greater diversity and circumstances have become more complex. And the demands imposed on people and equipment are becoming increasingly tougher. The situation may be characterized as one of ongoing change. Plenty of opportunity therefore to exploit the multidisciplinary knowledge, creativity and research facilities that TNO possesses.

Projects vary from designing operational scenarios to evaluating system performance, from developing technological specifications for new purchases to designing ready-to-use systems.

Special innovations outside the defence sector are in security products, space systems, industrial safety, information technology and telecommunications. TNO's strategic research for Dutch defence provides, in this way, a significant economic and public spin-off.