

THE DUTCH COMMUNITY SERVED BY ITS APPLIED RESEARCH ORGANIZATION, TNO

1 background philosophy

No sensible mind will nowadays deny that research stands at the root of progress. Never before has this conviction been so strong, but let us feel sure that this research and progress relationship is not at all as new as it seems to be.

On the other hand, there is no doubt either that science is very much older than the modern conception that research is an essential factor in economic and social development.

When and how did this modern aspect come up? Actually, there is no definable point or moment for the very rise of applied research as a momentum for progress. Even so, it can be safely accepted that it was during and after the first world war (1914-1918) that science manifested itself as a basis for power and strength of a nation in these three aspects: status, economic progress and mastery.

The preceding period, i.e. the turn of the century, had yielded some very useful scientific discoveries, plus inventions, and thus the earlier scientific knowledge came to more or less general application. However, at that time the research set-up was mainly that of either an individual or a very small group with a clear view of some presumed possibility, rather than a system with well-defined oriented targets. It has been the second world war, and the post-war period, not so much the years immediately after the war as the last 15 years or so, that the upswing of research and scientifically based development was brought to its present dimensions; "R&D" are now generally accepted twins.

This brief review of evolutions in this scientific age of ours can easily be retraced in the establishment, and the growth, of the Dutch TNO organization, i.e. the Organization for Applied (Toegepast) Scientific (Natuurwetenschappelijk) Research (Onderzoek) in the Netherlands.

A few pages on this organization, in an international context, may find some general interest. Especially so because at the present time the TNO organization is more active than before in orienting towards international co-operation and interchange.

2 historical development

In the 1880s, when Holland's agriculture was hit by a very serious crisis, it was not only the subsistence of her farmers that was imperilled; the very foundation of her economy was shaken.

Could science come to the rescue? At the time, artificial fertilizers had just come in; the agricultural college at Wageningen was established in 1874, and Holland had thus introduced science in agricultural instruction. Accordingly, in the eighties the farmers could be helped through adequate information aiming at increased yields of arable land in order to fight the economic crisis. Within a few years a system was set-up for the dissemination of agricultural advice. It was soon found, however, that more rigorous steps had to be taken, which would enable adaptation by the farmers to the conditions of the several types of soil, underground water level, local climatological phenomena, etc. In this more fundamental approach, regional experimental stations were created comprising test plots for specific soil treatment and for specific crops, in combination with small laboratory facilities. Agricultural engineers and biologists, there, carried out scientific tests. The efficiency of the work, started about ninety years ago, is proved by the fact that to-day Holland is among the countries with highest yields per acre.

It was the Dutch government that took the initiative, acting in close co-operation with private enterprise. There was no other way; only the government could help to restore prosperity to a considerable sector of the population. There is no doubt whatever that it was the government that pointed the way to the proper application of science. The Dutch authorities were aware of their responsibility and sought, and found, the knowledge available and the new paths to tread.

This is still the very basis of the Dutch system, and so is the collaboration between the government and private initiative. Those interested and those concerned in the battle for progress are thus joining forces. The Dutch system prevents an attitude of laxity and rash confidence that the mighty provider, as which a government can easily be personified, will do the job.

The system also offers a prevention against excessive penetration of official activity into the executive work of every day.

This comprehensive system of government monies, non-government workers and scientists, devoted to the supply of information as well as the performance of R&D, had been so successful that the basic principles of this system are clearly distinguishable in all the nation's evolutions to follow.

At the start of the 20th century there was a certain complacency, chiefly inspired by the rather pronounced economic stability, by the considerable progress in science, and by the gradual change-over to industrial realizations. It seemed to be implicitly understood that the world was to slide smoothly into some ideal state of socio-economic equilibrium.

On August 1st, 1914, this illusion was radically destroyed. World war I broke out unexpectedly, except perhaps for the very few with acute insight. Holland did not become involved in this war, but she did experience its effects through scarcity of materials, goods and edibles.

Participating and non-participating countries alike witnessed that this was a type of war that would no longer be decided by the genius and organizing power of the "top", nor by the force, number and training of the soldiers. It would be decided by the spirit of initiative and the practical approach of all at the front, and behind it. The ultimately decisive factors were: science, inventions, and their applications. For example: explosives, gases, aircraft; in other words technology would clinch the matter.

The advantage of Holland's non-participation in the war was that unharmed one could observe things from a distance, and draw one's own conclusions. The disadvantage was that the true significance of possibilities and developments could only be realized by very few people. And not by the majority of the population, nor their representatives in parliament, or even the government. One of this few men who very well realized what developments would mark the future, was a man of science.

It was "Nobel laureate" H.A. Lorentz, the theoretical physicist of world-fame; at the same time a man with much practical common sense and feeling for human possibilities.

In the Royal Netherlands Academy of Sciences, its president Lorentz asked already in 1917: "whether it was not a matter of great urgency to use all the science and experience available in Holland in the search for ways and means that would yield the highest possible return from the few raw materials and means of production that were available in Holland".

A committee was set-up, and reported in 1919 to the government. The report emphasizes the necessity of attention being focussed on the development of applied scientific research, so that the country would not lag behind the forthcoming industrial developments in Europe, and those at the other side of the Atlantic Ocean.

The reactions were very slow, but a first start had been made. A definite decision was not taken before 1930, when a bill passed our parliament to become an Act by which the Netherlands Central Organization for Applied Scientific Research was created. And this is the organization that is now known by the three letters TNO.

TNO's assignment has a very wide scope in that "the aim will be to ensure that such research is put at the service of the community in the most efficient manner possible".

3 the organization; its structure and its board

Application of scientific research is a very wide issue indeed. To-day all of western civilization is based on the results of scientific research. It is certainly no longer only in agriculture and industry that scientific achievements are needed. Defence and national health are other domains of great importance. It had been clear from the very start that the TNO organization thus created under law could not by itself do all the work implied by its assignment. The cabinet ministers, as well as the central organization, were therefore enabled to call into existence so-called "Special Organizations", under Section 14 of the said Act, which reads:

1. On the recommendation of the central organization or after having consulted this body, Our ministers shall, whether acting in co-operation with others or not, be authorized to call into existence special organizations charged with the task of ensuring that applied scientific research shall be put at the service of any national interest or any branch of national welfare in the most efficient manner possible.
2. These organizations shall be bodies corporate and shall have their seat at The Hague.

It was the intention that the special organizations would always be set up in such a manner that their regulations would harmonize with the TNO act. Also that the central organization inasmuch as it had not itself taken the initiative to call into existence a special organization, would be consulted in the event of any such decision and that the budget of each special organization would be subject to the subvention regulations for the Central Organization TNO as pursuant to the law.

The central as well as each of the special organizations is a body corporate and, accordingly, they can handle moneys, appoint staff, conclude contracts and sue and defend in proceedings.

The central organization is headed by a Board consisting of prominent people from the world of science, the commercial sector in the widest sense and experts from the several sectors of the community interested in applied research.

Symbolic of the significance vested in the organization is the fact that the members of the board are appointed by the crown, by and with the advice of the cabinet ministers concerned and under a system that need not be described here.

The result is that these functionaries occupy positions that are equal to those of professors at universities and technological universities, members of the Royal Netherlands Academy of Science, etc.

It is the crown only that can dismiss them and, accordingly, they possess a certain degree of liberty that would not exist should this royal appointment not be the case.

The boards of the special organizations have a similar structure. Also the appointment of their members occurs, by and with the advice of the ministers concerned, by the crown.

Their members are selected from that sector, or those sectors, for which the special organization carries out the pertinent applied research. There are four such special organizations now:

Organization for Industrial Research TNO	established 1934
Organization for Nutrition and Food Research TNO	established 1940
National Defence Research Organization TNO	established 1946
Organization for Health Research TNO	established 1949

Due to circumstances that are not relevant here, the institutes for agricultural research have since 1957 been connected with TNO on a scientific basis only, i.e. according to their programmes and co-ordination of the work.

The above is the management structure in a nutshell. The true force of an organization can only be judged when the interrelationships as well as the financial background are known.

The "classical" example set in the 19th century for agricultural research is still followed for the TNO organizations in that it is the government which grants the central organization a subsidy; for this purpose, the central organization submits a budget. The budget for the central organization comprises the budgets of the special organizations as well. The combined budget of the central organization is handed in with the Minister of Finance. In the Netherlands, Holland for short, this procedure is restricted to TNO; no other body corporate is in the same position. In respect of each calendar year, the central organization distributes the moneys received under this government subsidy among the five organizations.

To avoid possibilities of undesirable situations, the TNO Act lays down what "It (= the central organization) shall refrain from direct action with regard to any subject which can be regarded as lying within the scope and competence of any of the special organizations".

To ensure that the results of R&D are put at the service of the national interest or branch of national welfare that belongs to the care of any of the said organizations, the organization concerned will do all that is necessary, and possible, on the basis of the amount allocated to this organization. It will be appreciated, in this context, that each ministry interested in the work of one of the TNO organizations knows exactly to what amounts TNO spends the research moneys in the sector of interest to the ministry concerned. In other words: the Ministry of Finance distributes in a pertinent accounting procedure, the budgetary amount for the central organization over the other ministries; it is thus found that, except for the Ministries of Justice and Foreign Affairs, all the Netherlands ministries are somehow interested in TNO-work. The total amount of the government subsidy to TNO, as a whole, ultimately figures on the budget of the Ministry of Education and Sciences. This stands to reason, as the explicit purpose of the TNO Act is that the scientific element in the entire organization will be in charge, and carry the responsibility for it. I shall revert to this point in what follows.

With regard to the structure of TNO one point remains to be elucidated, viz the interrelationships of the five bodies corporate. The TNO Act provides the key to this configuration. An executive committee is formed out of the board of the central organization. On this committee serve the chairman of the central organization and the chairmen of the special organizations, and a vice-chairman, who does not come from the "circles" of the TNO organizations. Consequently, the chairmen of the special organizations are members of the board of the central organization. The chairman of the central organization chairs the meetings of the executive committee. This committee meets every week; here all matters pertaining to the organizations are dealt with. The fact that anyone who establishes a contact with TNO on anyone point, will quite naturally be in touch immediately with all the components of the family of TNO organizations, finds its basis in the existence of the executive committee.

There are other factors safeguarding the unity in the interrelationships of the TNO organizations. The TNO Act furthermore specifies that: "The secretary and the treasurer respectively of the central organization shall provide the secretariate and the financial administration of a special organization". Broadly speaking this may be translated into another feature, viz. that the organizations have one joint head office, in which the secretariates of the special organizations are accommodated.

Regular meetings of secretaries are furthermore arranged, which, in addition to those of the chairmen, warrant the unity in the overall organizational pattern.

So far the structure of TNO has been discussed in the context of relation between science and industry. The government provides the subsidy; the influence of the government in the organizations is therefore an essential element. The following arrangement applies: In each organization the crown appoints a delegate (and a deputy delegate) by and with the advice of the minister or ministers concerned. These delegates are members of the board of the special organization in question, so that the ministers can as well as possible make known their wishes relative to the policy to be followed. Moreover, the ministries can thus continually be conversant with what goes on in the special organizations.

Obviously, these delegates are experts on management; they are not scientific insiders. However, they can form an idea of a policy to be followed, and of its purposes, and thus instill the wishes on the research work that each ministry concerned deems necessary. They are also brought in touch with what industry considers to be of importance, or what experts (e.g. the medical profession) consider to be points calling for investigation. It will be appreciated that the TNO Act in its true intent and meaning aims at policy of the organizations on scientific criteria, and not only on management principles.

Never can this mean, however, that the provider of the subsidy (the government) would ultimately and definitely renounce the right of intervention.

The provisions of the TNO Act on this point may seem hard, but in reality they stimulate joint consultations and cautious conduct of affairs through these consultations: "each delegate" the pertinent section of the act reads "shall be competent to lodge an objection to a decision by the board". This right of "veto" belongs with all the delegates serving on the boards of the special organizations, who are also delegates on the board of the central organization. This right of veto can be exercised to suspend a decision that is considered to be in contravention of the government policy at a specific ministry; the decision of the board is then submitted to the judgement of the minister. The said right belongs in particular to the delegate of the Minister of Finance appointed with the central organization under the provisions of the TNO Act.

Actually, the position in which a "veto" must be given is not appreciated by anyone, nor will it by anyone be sought or desired. As a result, consultations take place at a stage that the course to be steered can easily be further defined. Accordingly, as a good habit, ideas and views are exchanged profitably; thus procedures are not inelastic, but very smooth running indeed.

Naturally, there are some deeper causes for this feature. Holland is a small country; the people know one another and we did learn in the past that caustic relations hardly ever lead to progress and that mutual understanding paves the way to good results. TNO largely owes its very existence to this wisdom. Because one can easily establish personal contacts, because distances are short, because practically everyone can be telephoned, because Holland is one of the most densely populated areas in the world, and one can therefore not beyond a certain limit act on one's own authority, there is only one solution: wherever possible operations should be "oiled" by joint consultations. The natural procedures thus evolved, generally tend to be effective against complications that might arise from the written laws. Without these backgrounds the idealism on which in fact the TNO Act is based would not appear to full advantage. Understanding why one does something is often more important than knowing how things are done.

In the above I have therefore dealt more elaborately with the motives and unwritten laws and the personal atmosphere of TNO rather than with the work that the organization does.

On this work I shall now give some information and, against the backgrounds just pictured, this information can indeed be concise.

For the whole of TNO, the central organization is the service organism. It comprises the central administration, the department for personnel management, the patent department, the statistics department, the economic technical department and the section for public relations.

The economic technical department of the central organization inter alia streamlines that part of the technical aid to developing countries that involves scientific assistance.

Only three research institutes belong directly under the central organization (see schedule). This is a historical development which certainly need not be perpetuated. The point is that generally the special organizations should carry out the research and development in their own institutes.

4 activities of the special organizations

Irrespective of the chronological sequence in the creation of the special organizations, I shall deal first with the Organization for Health Research TNO. It is assigned to attend to the research in which the medico-preventive polity of Holland is interested primarily. To this activity belongs, more so than in the sister-organizations, the subsidizing of investigations carried out all over the country, and which are important for public health.

Incidentally, it should be noted that the boundary between typically medical and general public health interests cannot easily be defined, although some line of course must be drawn in order to avoid illimitableness in the domain of subsidy allocation. In addition to that, the Organization for Health Research TNO is responsible for five institutes and a number of working parties.

The National Defence Research Organization TNO has six laboratories. In Holland, research on behalf of the navy, airforce and army is accommodated in the national organization for civil research. Obviously, a large sector of this defence research is carried out under military security regulations. The great advantage is, however, that this special organization can collaborate efficiently with all the other laboratories of TNO, viz those on food, medical care, chemical, physical and technological laboratories, as well as with the centres for the knowledge on materials: plastics, textiles, packaging and so on. All this justifies the approach under which, in Holland, military research is not handled in an isolated, self-contained organization. It stands to reason that the military element in the board of the National Defence Research Organization TNO is very largely the policymaker, and that also, more than with the other organizations, the National Defence Research Organization TNO has ties with one ministry.

The Organization for Nutrition and Food Research TNO has two different fields of research: that on the reactions of the healthy and sick humans on their nutrition and that on the technology of food and foodstuffs. In nutrition again two aspects are discerned: the components of food that man needs (e.g. amino acids, vitamins) or the components which make food attractive (consistency, aromatics, etc.) and the manner in which man uses these; the latter two comprise nutrition physiology, as and when necessary with the inclusion of the nutrition aspects under conditions of illness.

Food technology is concerned with the preparation of food, analysis of harmful components, conservation and quality control.

Through this last part of its work, the Organization for Nutrition and Food Research TNO serves the foodstuffs industry which, in Holland, is an important industrial sector. The boundary line between agriculture and fisheries on the one hand and nutrition and food research on the other lies in the transition from harvesting and catch to the field of supply. When supplied, the products of agriculture or fisheries have become foodstuffs. This also applies to the products of cattle breeding and poultry farming (milk, meat and eggs).

Obviously, there must be very good co-operation and interchange of activities and, equally obviously, there are many transgressions due to the wide range of specialist research techniques that are available. This once more illustrates the advantage of one organizational "family" in which duplications are avoided as much as possible.

Finally I would mention the Organization for Industrial Research TNO. It was the first special organization spun-off (1934) by the Central Organization TNO; and it is the largest special organization by far. In fact it is about as large as all the other organizations together. It has 15 institutes (laboratories, see schedule), 7 specialized departments or centres and 7 foundations. These foundations are very closely linked with the Organization for Industrial Research TNO, although each is a body corporate. It is mainly these institutes that work for the Dutch industry. There are two types: the group of institutes serving specific branches of industry (wood, leather, plastics, textiles, building materials, paints, ceramics, etc.) and which are therefore subject-oriented, whilst the second group of institutes is method-oriented (chemical laboratory, mechanical constructions, general technical institute).

The Organization for Industrial Research TNO provides powerful support to the middle size and small industries. It organizes courses for the low cost automation of small sized serial productions. It does work aiming at new techniques for production and processing, and it does R&D for new products too. This special organization also carries out quality tests that are so complex and refined that the private laboratories equipped for routine jobs simply cannot do that work. This organization can render assistance to practically every branch of industry (see schedule).

From the above one can understand that it was the Organization for Industrial Research TNO which, directly and indirectly, made a vital contribution to the rapid industrialization that, after World War II, was a must in view of the loss of the Dutch colonies of the past. In about 10 to 15 years, the country which had previously been agricultural and commercial became an industrial country of fame.

Holland also has research associations, more or less of the British type. The basic difference, however, is that the Dutch research associations do not have a joint research centre; they apply to TNO. Research projects are carried out by the TNO institute most suited for it, or by a combination of TNO institutes, and the research programmes are set up in consultation with representatives of all the member-firms of the association. In this manner, the furniture industry can for example apply to the Forest Products Research Institute TNO, to the Fibre Research Institute TNO or to the Paint Research Institute TNO according as the problem to be solved belongs to the respective field of work; the collective approach in such a project will of course benefit the entire furniture industry.

Investigations of this type are reported, and these reports are addressed to the parties who submitted the problem, if they bear the full cost of the research and will thus prefer to have the exclusive use of its results. When such exclusivity is not a primary consideration, the knowledge gained through the research project may be disseminated, for example by means of publications. Then the so-called stimulation arrangement can come into play. Under this arrangement, the government makes available a sum of money that is equal to the amount which the branch of industry pays to TNO in respect of the investigation in question. As a rule, the publication is effected some considerable time (e.g. two years) after the sponsors have received their TNO reports.

Just one company or firm can place an order for research with TNO too; this is the well-known contract research. The sponsor then pays the TNO institute concerned the entire cost of research, overheads included. Any such sponsor of contract research has the full and exclusive use of these research results. In order to make TNO's system of contract research work properly, secrecy is of course a must. Therefore, all TNO employees working in situations that involve confidential contacts with sponsors of contract research have signed an agreement containing a clause that enjoins their secrecy. Moreover they will be bound to secrecy for a period of mostly two years after their labour contract with TNO has been discontinued; this is laid down in a so-called competition clause.

All in all, anyone applying to TNO for research work to be carried out under contract will be absolutely certain that discretion and secrecy are warranted.

One may wonder what will happen when TNO is approached for sponsored research to be carried out on a problem that has already been submitted by another party. The easiest procedure will then be that, on the item of research concerned, the second party is referred to the first party. Actually, this procedure has sometimes yielded several types of co-operation between firms, and even research associations have been established in similar situations; e.g. in the industrial sector of the Organization for Nutrition and Food Research TNO and also in the Organization for Industrial Research TNO.

However, when any such combination is not desired, TNO will have to disappoint the second party and advise them to consult other agencies for research. I am pleased to record that TNO has very rarely indeed been obliged to disappoint any such second party.

How does one get in touch with TNO ?

In the Netherlands the letterword TNO is generally known due to continued publicity, how rather modest its scale may be. Most of the firms needing research know to which TNO institute they must apply (see schedule). Even so, when a question has to be worked out further, it is sometimes found that someone has knocked at the wrong TNO door, for it will always be a problem how to formulate questions in such a way that they will point to the right scientific approach.

Questions and disclosure to the right scientific attach can thus be harmonized best when the applicant for research and the research worker come to personal contact. This should be carefully built up. It is the very advantage of the organization that always the right doors can be found; as and when necessary the one after the other ! Besides, Holland is a small country !

However, if no such contacts pave the way, one can get in touch with the central office or any other point on the "TNO map". Because, as I said, anyone ringing a TNO telephone number can easily be referred to the right institute. This does not only apply to the national situation; TNO is known internationally too. Also in this context it may be emphasized that the good personal contacts in the organization are perhaps its strongest keystone.

5 finance

It is nowadays customary to emphasize finance with regard to any type of science; pure, fundamental and applied. Of course money is important but one may sometimes get the impression that science would be for sale; the fact that science must be unfurled through sheer creativity is less conspicuous. Anyhow, finance is the last factor in this presentation of data and, this time, I have even condensed the data to one comprehensive table.

TNO receives money from two sources: the government, and the sponsors. TNO's sponsors are: industries, special governmental executive bodies and international organizations (e.g. Euratom). Moreover, TNO has the last few years carried out investigations, or given advice, for the account of other countries, and for that of the Netherlands technical aid agencies for developing countries.

The table gives the figures for 1955 and those for 1965; the growth is thus specified, and can easily be read from the respective columns. The government subsidy enables independent and progressive research to be carried out, aiming at the future. TNO's contract research focuses on a given question in a specific formulation and tries to find the effective answer. These two types of research must be in equilibrium; the questions tend to stimulate free research, and from this independent research a reputation is built up and questions arise that refer to future possibilities. Whether the equilibrium is reached, is hard to judge. One thing, however, is certain. In the field of health research the relationships are entirely, and also basically, different from those in industrial research; this applies to any given branch of industry or any institute that by virtue of its management or due to accidental conditions is concerned with either the one field or the other.

I hope that the above data may be of some use to those concerned in management problems; for example government agencies or groups in the process of building up research organizations. Furthermore, this contribution may also be useful for anyone seeking aid from science for specific problems. I am in any case very grateful to the editor of Industrial Research and Development News for the space granted in its columns.

REVENUES OF THE TNO ORGANIZATIONS

in Nfls 1,000

	subsidies		other revenues 2)		total 2)
	1955	1965	1955	1965	1965
Central Organization 1)	4,884	24,842	774	4,574	29,416
Organization for Industrial Research	6,607	26,242	5,043	15,305	41,547
Organization for Nutrition and Food Research	895	4,656	265	2,357	7,013
National Defence Research Organization	3,328	18,580	638	1,619	20,199
Organization for Health Research	1,870	9,310	86	1,864	11,174
totals	17,584	83,630	6,806	25,719	109,349

1) agricultural research excluded

2) excluded are figures relating to internal accounting for work done by one TNO organization for another.

CENTRAL ORGANIZATION TNO

- 1 National Council for Agricultural Research (co-ordinates 32 foundations)
- 2 Statistics Department
- 3 Patent Department
- 4 Economic Technical Department
- 5 Institute of Applied Physics TNO and TH
- 6 Institute for Organic Chemistry
- 7 Institute for Physical Chemistry

- Organization for Nutrition and Food Research TNO
- 1 Central Institute for Nutrition and Food Research
 - 1a Researchgroup for Meat and Meatproducts
 - 2 Institute for Cereals, Flour and Bread
 - 3 Institute for Fishery Products

- National Defence Research Organization TNO
- 1 Physics Laboratory
 - 2 Medical Biological Laboratory
 - 3 Chemical Laboratory
 - 4 Technological Laboratory
 - 5 Institute for Perception

- Organization for Health Research TNO
- 1 Research Institute for Public Health Engineering
 - 2 Institute of Medical Physics
 - 3 Radiobiological Institute
 - 4 Central Institute for the Breeding of Laboratory Animals
 - 5 Department of Clinical Research of Medicaments
 - 6 Netherlands Institute for Preventive Medicine

- Organization for Industrial Research TNO
- 1 Industrial Liaison Department
 - 2 Institute for Building Materials and Building Structures
 - 2a Technical Centre for Fire Prevention
 - 3 Central Laboratory
 - 3a Analytical Centre
 - 4 Central Technical Institute
 - 5 Forest Products Research Institute
 - 6 Instrumentum
 - 7 Ceramics Research Institute
 - 8 Plastics Research Institute
 - 9 Leather Research Institute
 - 10 Metal Research Institute
 - 10a Technical Foundry Centre
 - 10b Technical Centre for Metalworking
 - 11 Northern Regional Technical Institute
 - 12 Rubber Research Institute
 - 13 Netherlands Ship Research Centre
 - 14 Paint Research Institute
 - 15 Institute for Packaging Research
 - 16 Fibre Research Institute
 - 17 Institute for Mechanical Constructions
 - 18 Project of Liquid-State of Sodium
 - co-ordinated foundations:
 - 19 Experiment Station for the Utilization of Potatoes
 - 20 National Institute for Malting Barley, Malt and Beer
 - 21 Research Institute for Printing and Allied Industries
 - 22 Metrological Institute Bemetal
 - 23 Netherlands Ship Model Basin
 - 24 Institute for Textile Cleaning
 - 25 RAI Research Institute for Road Vehicles

TNO Committees and Working Groups

- Central Organization TNO
- 1 Committee for Fishery Research
 - 2 Committee for Hydrological Research
 - 3 Committee for Industrial Air Pollution
 - 4 Internal Committee for Co-ordination of Road Safety Research
 - 5 Working Party on Technical Aids for the Handicapped
 - 6 Committee for Research on Side-Effects of Pesticides

- Organization for Health Research TNO
- 1 Radiological Unit
 - 2 Research Committee on Occupational Health
 - 3 Working Group for Atherosclerosis Research
 - 4 Working Group for Caries Research
 - 5 Working Group for Tuberculosis Research

- FIGURE 1 : TNO Head Office
- FIGURE 2 : Model experiment in towing tank
(Netherlands Ship Model Basin)
- FIGURE 3 : Equipment for unit processes
(Central Technical Institute TNO)
- FIGURE 4 : Instruction course on Low Cost Automation
(Industrial Liaison Department TNO)
- FIGURE 5 : Remote measurement of human exertion
(Institute of Medical Physics TNO)