



Work Programme 2011 – 2012

Rathenau Instituut

*Dynamiek kennis
verandering
interactie
de mens
technology*



The **Rathenau Instituut** promotes the formation of political and public opinion on science and technology. To this end, the Institute studies the organization and development of science systems, publishes about social impact of new technologies, and organizes debates on issues and dilemmas in science and technology.

Rathenau Instituut
Work Programme
2011 – 2012

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Foreword

Scientific and technological innovation contributes to human progress. Medical breakthroughs suggest many serious diseases are increasingly likely to be cured. Today it is hard to imagine life without the convenience of the Internet and such devices as mobile phones. And if we want the Dutch economy to remain competitive and innovative across the world, and to keep our welfare at the required standard, science and technology are simply indispensable.

At the same time, we know that science and technology often involve social, policy and political questions and dilemmas. What went wrong during the HVP virus vaccination campaign? Why was climate science criticised so strongly? What should the authorities do to create a public base of support for inter alia underground CO₂ storage and nanotechnology? Or how about questions such as: what new promising scientific areas are emerging and how does the Netherlands score in these areas? Is our scientific system designed as such to allow us to remain innovative and competitive over the coming decades? And: what can we learn from the way in which emerging Asian countries are shaping their science and technology policy?

The Rathenau Instituut is dedicated to these and other issues and dilemmas in the field of politics and policy, science and society. We carry out research, inform and advise politicians and policymakers, and contribute to social debates on science and technology.

The Rathenau Instituut Work Programme 2011 – 2012 is partly a continuation and extension of our previous work programme, but it also includes new themes and lines of approach. One example is the fact that we will be studying how the Internet is determining and increasingly often changing how we see the world. We will be exploring questions related to predicting medical science and anti-aging technology. Also, we will pay careful attention to the emphasis put on scientific excellence in the scientific world in past decades. What are the consequences thereof, for instance for the educational system and the social relevance of science?

These and other initiatives will help us contribute to properly founded and efficient science policy, the smooth proceedings of social debate on scientific and technological innovation and to the intensification of the innovative power of the Dutch economy.

I hope you will enjoy reading our new work programme.

Wim van Velzen,
board chairman of the Rathenau Instituut

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Summary and Reader's Guide

About the Rathenau Instituut

Mission

The Rathenau Instituut stimulates public and political opinion forming on science and technology. To this end, the institute studies the organisation and development of science systems, publishes on the social impact of new technologies, and organises debates on issues and dilemmas related to science and technology.

The Rathenau Instituut's biennial work programme describes which (research) themes and activities the institute will be dedicating itself to in the period concerned. In addition, the Rathenau Instituut designs the work plan in such a way as to provide space to address political and social events of the immediate moment. *Read more at page 18*

Trends

Scientific, social and political developments and trends steer the work of the Rathenau Instituut. Over the years to come three trends will largely determine the character of our work:

– **Shifting international and national relationships**

Increasing numbers of fields of science are in the process of globalising. Western countries are experiencing increasingly fierce competition from fast growing economies in Asia (China and India) and South America (Brazil). Attempts made in the Netherlands to steer and direct innovation at a central level is not leading to the desired results.

– **Legitimacy problems**

In the Netherlands, and also elsewhere in Europe and the western world, many citizens feel they are no longer properly represented by traditional political parties. Citizens today are becoming more assertive than ever demanding more often justification from persons in authority whose authority used to be taken for granted: politicians, administrators, judges, church and other social authorities. There is a growing need for evidence-based policy. Using science for policy purposes, however, does involve problems. The increasing science-policy entanglement is creating new vulnerabilities.

– **Unsuccessful (technological) systems**

We see how the Netherlands, along with other Western countries, is struggling with deadlocked (technological) systems. We continuously fail to solve persistent problems in a satisfactory manner: such as mobility (traffic congestion), farm animal health and welfare, victims of medical blunders at hospitals, problems with the introduction and usage of data files, incidents at the level of security and public order, problems concerning migration practice, and the declining quality of the educational system. It is often believed that these problems are insoluble because these systems require thoroughgoing and rigorous modernisation.

Challenges

Against the background of the type of problems described in the above, the Rathenau Instituut seeks to build and reinforce mutual trust between society, authorities, science and technology institutions, and substantiate the democratic arrangements governing their interaction. Upon request Rathenau can also adopt a mediating role in case of conflicts and controversies between parties in society, science and public administration. The institution's activities seek to strengthen its science and innovation policy. *Read more at page 21*

Selecting the themes

The Rathenau Instituut has two primary tasks. In technology assessment the institute explores, signals and advises on the impacts of science and technology. In science system assessment the institute studies the science system.

The Work Programme 2011-2012 consists of nine themes that are selected taking the following three criteria into consideration:

- 1 The themes involve new technological and/or scientific developments. This can involve the development of new fields of science and technology or new trends within the whole science system.
- 2 The themes are or will be politically, socially or administratively relevant; for instance because many citizens are directly or indirectly involved in the consequences of a certain technology or because a scientific development may change the way in which social issues are dealt with.
- 3 The themes are or will be the topic of discussion or opinion forming. In other words: they are not yet socially, administratively or politically 'ready' for introduction to society at large.

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Themes 2011 – 2012

Theme 1 – Autonomy in healthcare

Patients are often considered autonomous consumers responsible for their own health. In three sub-fields we plan to scrutinise the technological self-care options and the social questions they call up.

- **Predicting illness and death:** the Rathenau Instituut plans to map the many developments in the field of individual early diagnosis and self-care and find out the conditions under which they indeed add to better health.
- **The makeable family:** the Rathenau Instituut plans to study how the increasing birth technology options impact family planning and the resulting social questions.
- **Anti-ageing:** the Rathenau Instituut plans to map anti-ageing technology developments and find out the consequences thereof in how we deal with the ageing process.

Read more at page 26

Theme 2 – Digital modification of our world view

Society is becoming increasingly dependent on the digitalised supply of information. The question that follows is this: how is this information selected, processed and made accessible?

In the Digital Modification of our World View the Rathenau Instituut seeks to look behind the scenes of the Internet.

The leading questions include: what coding forms are used on the Internet, what interests are involved and how does this all change the way Internet users think and act?

We will focus on three individual topics:

- First of all, we will study how the Internet impacts the relationship between citizens and politics.
- A second theme is the impact of social networks on interaction among users.
- And thirdly we will study how in the near future persuasive technology and affective computing will (be able to) steer human behaviour.

With these three sub-studies the Rathenau Instituut seeks to stimulate social and political awareness of how the Internet is affecting our thoughts and actions. *Read more at page 29*

Theme 3 – Excellent science

Scientific institutions, financiers, universities and research institutes strongly emphasise scientific excellence; an ambition to which they tune their personnel policy, selection processes and finance models. Over the coming period we will critically study relevant current developments. For instance, we will be studying researchers' careers, dedicating special attention to the so-called tenure track system. The term 'scientific excellence' itself mandates critical reflection.

Also, we will conduct a follow-up study into how research groups function in medical science, also paying attention to research management changes at the level of University Medical Centres and hospitals. And, we will continue to study research careers and research assessment. Our purpose is to compare the Dutch situation systematically and empirically to other countries.

Read more at page 32

Theme 4 – The value of science

The world believes strongly in the capabilities of scientific research to stimulate innovation in practice. The outcomes and insights of scientific research are also frequently counted upon when it comes to solving social problems. Researchers, however, sometimes

experience tension between the pursuit of excellence and the expectation that research will contribute to the knowledge economy, innovations and solving social problems. In the recent past the Rathenau Instituut joined the national ERiC project and the European SIAMPI project, in which methods are being developed to evaluate the social contributions of research. We also studied the social impact of several research programmes. Over the coming time we will proceed on this line and increase our focus on evaluation methods to other policy instruments. It is our ambition to have a key role in discussions on research valorisation and the social value of science.

In addition, we will continue to pay attention to the social position of scientific knowledge in policy and social discussions. The Rathenau Instituut's capability to organise social debates is used on a regular basis in the event of social controversies in which the status of scientific knowledge and scientists' expertise is also under discussion. These controversies also indicate that the status of science and technology is not self-evident, neither in political decision making processes nor in social discussions. Over the coming time we will also engage our experience and competence to gain greater insight into the dynamics of controversies.

Read more at page 35

Theme 5 – Converging key technologies

Since the 1970s innovation policy has been tuned to stimulating the so-called key technologies such as biotechnology, information technology and materials science. Soon we learned that the development of one key technology depended strongly on the development of the other technology. This mutual influence is called technological convergence, also referred to as NBIC convergence. NBIC stands for nanotechnology, biotechnology, information technology and cognitive science.

In the past years the Rathenau Instituut dedicated great attention to the social meaning and dynamics of technological convergence. We will continue to do so in the years to come. We will participate in the European STOA project *Making Perfect Life*. In this project the dynamics of the NBIC convergence will be studied based on two megatrends: 'biology becomes technology' and 'technology becomes biology'.

We shall also study the scientific dynamics of technological convergence. What place techno-sciences (will) take up in the scientific landscape and handle the question as to how effective

an innovation policy based on a key technology really is. The outcomes will contribute to discussions on Dutch knowledge infrastructure. *Read more at page 38*

Thema 6 – Dreaming of a synthetic Eden

The growing world population is making an increasing call on the world's natural resources. This raises both local and global environmental problems and intensifies the worldwide struggle for raw materials. We see how a new idea of technical makeability is advancing. Examples include visions such as cradle-to-cradle, bio-based economy, synthetic biology, designer eco-systems and geo-engineering. Under the denominator 'Dreaming of a synthetic Eden' we wish to discuss the pros and cons of this new makeability ideal. How realistic is the vision of a bio-synthetic Eden, in which we go beyond the scarcity – or do things come to a stop at the beckoning perspective? The Rathenau Instituut will focus in particular on exploring the political and policy questions called up by geo-engineering, the bio-based economy and synthetic biology. *Read more at page 41*

Thema 7 – The brain as a scientific and social paradigm

The brain is the new *frontier* in science. Which is why the neurosciences are becoming a fast growing interdisciplinary field. The main driver is the wish to better control our behaviour by better understanding our brain. In this work programme the Rathenau Instituut plans to study the development of neurosciences as a new scientific area, map its influence within other scientific areas and social sectors, and highlight this influence socially and politically. By means of such communicators as publications, workshops and public meetings we wish to stimulate a broad public debate on the social effects of the development of the neurosciences. *Read more at page 44*

Thema 8 – Designing the Dutch knowledge infrastructure

In the publication 'Thirty years of research financing' (2007) the Rathenau Instituut referred to the emergence of new intermediaries between authorities and research financiers on the one hand and the executive organisations on the other. One significant function of this new organisation layer is the creating of focus and mass through research coordination. A recent study conducted by the Rathenau Instituut, however, points out that the total focus has not increased; neither has the international position of the Netherlands in the focus areas of intensified science and technology policy .

In the future we will continue to contribute to this discussion about the design of the Dutch knowledge infrastructure. A key task is to provide the discussion with objective information about how the knowledge infrastructure functions. In addition, we plan to intensify the discussion, and with it hopefully also the policy, along two lines.

- First of all we will use empirical studies of fields of research and sectors of knowledge.
One significant goal in this is to illustrate what the frequently used terms such as coordination, competition, management, focus and mass are taken to mean in the practice of research and innovation.
- Secondly, we want to strongly put the discussion on the Dutch knowledge infrastructure into the spotlight of the development of the European Research Area and also in the light of the emergence of new 'science countries'. The ambition is that the studies within this theme will steer the discussions on the development of the Dutch science system and give the different organisations a strategic framework.

We will systematically study the development of the European Research Area and the effect of European institutions (facilities, ESF, ERC, EIT, ERAnets, etcetera) on different scientific areas. Also, we will follow the emergence of Asian science systems.
Read more at page 46

Thema 9 – Urban society

The city is home to more and more people. While in 2007 half the world population was living in cities, in 2050 this number will be reaching 75 percent. At the same time, urban agglomerations are becoming increasingly important economic innovation centres. Metropolitan regions are more frequently involved in the international economic competitive struggle. We want to study the question as to whether spatial planning at this scale is still feasible. To the Rathenau Instituut 'Urban Society' is a new theme, which is why we plan to launch an exploratory study. During this exploration we will find out how urban development practice in the Netherlands is dealing with its various issues. Do urban developers succeed in integrating the required, wide pallet of social-scientific and technical-scientific insights? What tensions exist between the ambitions of economic innovation, sustainability and liveability? And do the authorities have sufficient administrative power to steer the creation and growth of a metropolis in the right direction? *Read more at page 49*

International activities

The Rathenau Instituut operates within a large international network of associate and parallel organisations. For instance, it is one of the driving forces behind EPTA (European Parliamentary Technology Assessment), the alliance of 18 European Parliamentary technology institutions that was founded back in 1990.

The Rathenau Instituut takes part in several international joint venture projects that are being financed from the European Commission's Framework Programme.

- The project Synthetic Biology for Human Health: Ethical and Legal Issues (SYBHEL) aims at mapping the important developments in this field, identifying the ethical and legal implications thereof and recommending regulation and policy at a European level.
- The purpose of Parliaments & Civil Society in Technology Assessment (PACITA) is to share the knowledge and experience with parliamentary TA in Europe with European countries in which parliamentary TA is not yet a tradition.
- Global Ethics in Science and Technology (GEST) maps the meaning of ethical considerations and debates in the science and technology policy in Europe, China and India, seeking to strengthen cooperation between the three regions in this field.
- SIAMPI: Social Impact Assessment Methods for research and funding instruments through the study of Productive Interactions between science and society aims at developing methods to assess the social impact of research.
- Within the EURECIA project the Rathenau Instituut is responsible for analysing how the European Research Council (ERC) influences the operation and position of national research councils. *Read more at page 51*

Other activities

- **Evaluation:** in this work programme period we reserve space for preparing the evaluation of the Rathenau Instituut.
- **25th anniversary:** in 2011 the Rathenau Instituut will be celebrating its 25th anniversary. Under the denominator DICHTERBIJ (CLOSER) we will be organising activities for different target groups spotlighting the changing relationships in the triangle in which Rathenau has always been operating: science and technology, society and politics.

- **Transfer of knowledge:** the Rathenau Instituut staff are frequently invited to (guest) lectures. This enables us to share the institute's knowledge and insight with (future) professionals who are professionally involved in the dynamics and embedment of science and technology. *Read more at page 54*

Methodological innovation and horizon scanning

Good methodology is essential to the quality of the Rathenau Instituut's work. In our activities we use many different analytical and communicative methods such as focus groups, citizen panels, statistics, scientometry, questionnaires, interviews, visualisations, debates and presentations. To bring science dynamics and international comparisons into focus, the Rathenau Instituut has developed its expertise in the domain of scientometry. Over the coming time we will also continue to work on social network analysis methods to map science and technology networks. And we will conduct agent-based modelling pilots whose purpose is to stimulate complicated policy problems. In these projects we will join hands with university researchers in this field. In addition, we will dedicate attention to reflection on information visualisation, for instance in graphics, diagrams, networks and photos.

Horizon scanning

One significant aspect of the Rathenau Instituut's work is the mapping of new developments and trends in science and technology. The institute will launch a project in which the internal experience of technology assessment and science system assessment is extended with methods and techniques already used for 'horizon scanning' and 'foresight' among other things. *Read more at page 55*

Communication

The Rathenau Instituut is an organisation with a public task. This requires us to be transparent and to justify our activities towards the authorities, stakeholders and society at large. The Rathenau Instituut uses different communication tools and methods to inform target groups and stakeholders about research outcomes, and initiate interaction and discussion with parties interested. Examples include publications, meetings, publicity, representational forms (e.g. theatre and film), digital communication and events. *Read more at page 58*

Work Programme

The Rathenau Instituut

2011 – 2012

Chapter 1

About the Rathenau Instituut

Mission

The Rathenau Instituut seeks to stimulate public and political opinion forming on science and technology. To this end, the institute studies the organisation and development of science systems, publishes on the social impact of new technologies, and organises debates on issues and dilemmas related to science and technology.

The Rathenau Instituut

The Rathenau Instituut is an independent organisation that has been organisationally incorporated in the Royal Netherlands Academy of Arts and Sciences (in Dutch Koninklijke Nederlandse Akademie van Wetenschappen or KNAW). The Rathenau Instituut informs and advises politicians and policymakers about the impact of technology and science on society and also about the nature and structure of the science system.

The institute focuses primarily on the Dutch Parliament, the government and policymakers at ministries and scientific institutions. The European Parliament and society (citizens, companies and social organisations) are also important discussion partners and target groups. The Rathenau Instituut's task is to describe the science system and bring developments in science and technology in focus in good time. The institute seeks to involve society in these developments and stimulate social debate. The institute not only collects information to this end, but clarifies it too. It demonstrates social, ethical, cultural and legal frameworks and sketches long-term visions. The Rathenau Instituut puts forward the various perspectives of parties interested and organises interaction between citizens, stakeholders and scientists, and also between politicians and society. The institute also seeks to get parties that do not normally communicate with each other, or no longer do so, around the table.

Cooperation

The Rathenau Instituut operates within a large national and international network of (colleague) research institutions, social organisations and other stakeholders. For our themes we work closely together with partners such as AWT, WRR, KNAW, NWO,

VSNU, GOGEM, STT, several university departments and faculties, CSG, RIVM, social organisations, patients' associations and international sister organisations.

Tasks

By virtue of the institute's decision Rathenau's tasks are the following:

- Contribute to the social debate and political opinion forming on issues related to – or resulting from – scientific and technological developments. This includes ethical, social, cultural and legal aspects. The institute contributes in particular to the formation of political opinions in both Houses of the States General, the European Parliament and parties involved in the scientific world. This task is carried out by Technology Assessment (TA).
- Increasing insight into how the science system works, to which purpose the institute collects missing data, integrates the available data and makes these accessible. This is the task of Science System Assessment (SciSA).

The research fields of Technology Assessment and Science System Assessment meet. For instance, knowledge of the science system adds to describing and understanding the impact of science and technology on society. New developments and applications are usually already visible within the science system, before they touch society. The synergy between both departments consists in data, analyses, research methods and networks being shared and that the results of one department provide input for the work carried out by the other department.

Work programme and current events

Rathenau's biennial work programme describes the (research) themes and activities to which the institute plans to dedicate itself over the coming period. The Rathenau Instituut designs the work plan as such leaving space to tackle current political and social events.

Social and political developments can make topics from previous work programmes politically or socially topical once again. This for instance is the case with nuclear energy. Sometimes, political and social developments require accelerated investigation and/or tailored research outcomes. During the previous work programme period this was the case with the Electronic Patient Record and vaccination against the HPV virus.

Finally, new themes can meet within Rathenau's field. This for instance is the case with techno-scientific topics that are given priority in a short period of time and which have not (yet) been adopted in the Rathenau Instituut's work programme.

Chapter 2

Trends

Scientific, social and political developments and trends steer the Rathenau Instituut's activities. This is why we start the work programme with a brief outline of the very developments that will primarily determine our work over coming years. Three main lines exist: shifting international relationships, legitimacy problems in western democracies and unsuccessful (technological) systems.

– **Shifting international and national relationships**

Increasingly fields of interest are globalising. Western countries are experiencing increasingly fierce competition from fast growing economies in Asia (China and India) and South America (Brazil). This partly means an intensifying international battle for access to raw materials. The Western world is no longer the self-evident centre of scientific and technological innovation. New, highly educated generations in countries such as China, Korea, India and Iran are creating an unprecedented capacity for innovation, whereby it remains to be seen whether the Western countries can keep up.

Attempts made in the Netherlands to steer and direct innovation at a central level are not having the desired outcome. The creation of the Ministry of Economic Affairs, Agriculture and Innovation emerges from the ambition to give innovation policy new impulse. At the same time elsewhere too different surprising and innovative developments are taking place. In the regions, for instance, many initiatives are being taken to ensure sustainable energy creation and consumption. The business community has largely internalised sustainability in its investment policy and technological development.

– **Legitimacy problems**

In the Netherlands, and also elsewhere in Europe and the Western world, many citizens feel they are no longer properly represented by traditional political parties. Citizens today are also more assertive than ever before demanding more often justification by those in authority whose authority used to be taken for granted: politicians, administrators, judges, church and other social services.

There is a growing need for evidence based policy. Through an appeal to science policymakers are apparently hoping to find an answer to the rising demand for public policy justification. In some fields (e.g. healthcare and climate policy) we even notice an increasing entanglement of science and policy.

Using science for policy purposes, however, does involve problems. On the one hand society has the same high expectations of science, on the other hand science itself is criticised on a regular basis. The increasing entanglement of science and policy means new vulnerabilities. See the discussion on the climate report of the IPCC or the social unrest about the vaccine policy for the HPV virus. Apparently, science too is unable to escape the wider authority crisis.

These major representation problems in our representative democracy, the fading authority of office holders and authorities, the emergence of social media allowing 'resistance' in sub-communities to flourish, and the increasingly stronger call for evidence based policy are linked. We have also established that scientific advisory practice in public administration hardly ever contributes to greater credibility and the authority of the public administration and science. Evidence based policy is required for many reasons, yet it does not provide a solution when it comes to tackling the authority and representation problem.

– **Unsuccessful (technological) systems**

We see how the Netherlands, along with other Western countries, is struggling with deadlocked (technological) systems. We continuously fail to solve persistent problems in a satisfactory manner: including mobility (traffic jams), animal welfare and animal health at cattle farms, victims of medical blunders at hospitals, problems with the introduction of data files, incidents in the field of safety and public order, problems concerning migration practice, and the declining quality of the educational system.

It is more often believed that these problems are insoluble because these systems require thorough modernisation – in other words: they have seen better days. Terms such as transition, shift of paradigm and sustainable change soon present themselves. Nevertheless, these persistent problems continue to frustrate the authority of the public administration and politics. Time and again they are seriously embarrassed because of incidents.

Challenges

Against the background of the problem described in the above, the Rathenau Instituut helps build and intensify mutual trust between society, authorities, science and technology and substantiate democratic processes. Upon request we also take on a mediating role in case of conflicts and controversies between parties in society, science and public administration. With our activities we seek to help strengthen national science and innovation policy.

Persistent problems in technological practice such as cattle breeding, water management, safety practice, mobility and the hospital receive systematic attention in combined projects of SciSA and TA. This combination gives birth to possibilities to properly link empirical research to policy research and the social debate. This combination allows us not only to determine facts about the nature and scope of specific problems within the system, but also link these in a well-founded manner to insights about the functioning of the system and the policy pursued. For innovation practice the same applies *mutatis mutandis*. We continue our investigation into the effects of current innovation policy. In addition, we explore new innovation practices in which new players present themselves, new networks develop and where other relationships come into existence between science, technology and entrepreneurs as in the field of ICT and the agricultural production.

In terms of representation in our democracy we want to conduct field studies into the contributions of ICT technology in particular to strengthening and improving representation in our democracy.

Selection of themes

During the work programme 2011-2012 we will be working on nine themes based on the trends which we have signalled. We select themes based on three criteria:

1 Science and technology

The work programme's themes concern technological and/or scientific developments. This can be the development of new science and technology fields or new trends in the science system. Previously for instance this meant adopting nanotechnology and synthetic biology in the Rathenau Instituut's work programme. Now we have reason to study the merging of key technologies, and the development of the Dutch knowledge infrastructure. Themes can also involve an unsuccessful techno-scientific practice, or one leading once again to fundamental questions because of a new scientific orientation. A good example in this work programme is the theme about the effect of neurosciences in the science system and also in society.

2 Social and political relevance

The work programme's themes must be politically, socially and administratively relevant. This relevance for instance means that many citizens are directly or indirectly confronted with the consequences of a certain technology, or that a scientific development interferes with the way in which social issues are dealt with. For instance, in the previous period the policy relevance of our work programme's themes was shown from the fact that ministries addressed us to guide knowledge chambers around the themes of human enhancement and privacy and tracking down. Relevance can also be the case because scientific and technological developments call up ethical dilemmas that remain too implicit and underexposed. This for instance is the case with the theme 'life course technology'.

3 Debate and opinion forming

The work programme's themes can be the subject of further discussions or opinion forming. In other words: the topics involved are socially, administratively or politically not 'ready' yet. We believe a follow-up discussion or further opinion forming is still possible and required within the work programme's themes. This for instance applies to the theme

'excellent science', which involves changes in the science system that are anything but stable. We also believe that discussions and further opinion forming on the unnatural/artificial distinction is necessary for the further development of a bio-based economy and that the proper use of the Internet as a window to the world requires a discussion about the possible manipulations of our digital sources of information.

TA and SciSA team up

For this work programme we have decided for the first time to integrate the sub-programmes of Technology Assessment (TA) and Science System Assessment (SciSA). Such is possible through converging developments in both fields. On the TA side we see that scientific developments are increasingly often involving social reactions within a short amount of time. One example is the attention paid at an early stage to the risks of nanotechnology for example or the prompt adoption of the initial brain research outcomes in social discussions about education. In these cases Technology Assessment can be strengthened through insight into the science dynamics.

So far the SciSA work programme was based on the idea of a clear-cut Dutch science system. From a policy perspective this is an attractive image, because a clear policy object exists. Research development, however, shows that this image does insufficient justice to important developments. The development of scientific knowledge becomes increasingly interwoven with other knowledge activities, which highly matters to understanding the value of science and where insights from Technology Assessment are pivotal. In addition, knowledge development spreads across more and more organisations. Finally, we see an increased international organisation of science, as a result of which the Dutch context is no longer dominant for all the organisations. In reaction to these developments, and during the SciSA research, we have let go of the system character opting for themes dedicated to the scientifically intrinsic developments and/or developments in the organisation of science. Especially when scientifically intrinsic developments are involved, SciSA and TA are working closely together.



Chapter 3

Themes in 2011 – 2012

Theme 1

Autonomy in healthcare

In the work programme 2009-2010 the Rathenau Instituut explored the development and deployment of medical self-care equipment. It proved that personalisation is an important trend in contemporary healthcare. Patients are more often being considered autonomous consumers responsible for their own health. However, not everyone is equally capable of handling this responsibility. Understanding medical information is not always an easy thing to do. In addition, the growing emphasis on self-care is causing a tension between individual choices and collective values such as affordability and solidarity.

In the new work programme we want to study in depth the trend of - technology driven - personalisation. This trend is supported by recent technological developments such as the use of biomarkers and early indicators of abnormality or illness, medical self-tests on the Internet and nanomedicine. These technologies increase the possibilities to monitor individual health risks and manage these individually. At the same time these technologies promise individual therapies. Developments such as anti-ageing technology mean that increasingly more facets of our lives are being looked at from a medical perspective.

These developments involve significant social questions. To what extent does healthcare personalisation contribute to the further medicalisation of daily existence, whereby the boundary between 'ill' and 'healthy' continues to fade – and how desirable is this? To what extent do we as a society want to carry the costs which individuals incur to optimise their health or wellbeing? Does the growing self-care market need to be regulated, whereby more and more private suppliers (e.g. of self-tests or diagnostic equipment) start competing with the public healthcare system? And does the growing responsibility for our own health mean that being ill is no longer considered a personal fate, but rather a personal failure?

In three sub-fields we plan to scrutinise the technological self-care possibilities and the social questions they call up.

1 Predicting illness and death

We are gaining more and more insight into individual health risks. Using biobanks with body materials linked to medical information, more large-scale research is being conducted into the relationship between biological features and patients' history of illness. This helps us better understand our physical and psychological condition, hereditary characteristics and the chances to develop disorders in the future. This knowledge makes the genetic profiling of newborn babies possible, or the use of biomarkers to detect diseases such as rheumatism or Alzheimer at an early stage. In addition, lab-on-a-chip technology, medical information on the Internet and a growing market supply of medical self-tests is allowing healthcare consumers to monitor and manage their own health.

The growing insight into individual health risks also makes it possible to personalise medication and give patients a more independent role, outside the conventional medical institutions. The Rathenau Instituut seeks to map the various developments

in the field of individual early diagnosis and self-care and find out the conditions under which they do indeed contribute to a better health.

2 The makeable family

Medical (birth) technology developments such as IVF (in vitro fertilisation), embryo selection and the preventive storage of ova create the possibility to control our own fertility and reproduction. The menopause predictor for instance tells women how long they will remain fertile. On request women can decide to have their ova stored. When it comes to treating infertility a range of technological options exist, from IVF and sperm injection or insemination (ICSI and IUI) to using donor gametes. What's more, pre-implantation genetic diagnosis means an option to separate embryos with serious deviations from viable specimen. These technologies increase the individual freedom of choice and allow people to control birth more than ever. The Rathenau Instituut wants to study how increasing birth technology options are interfering with birth control and the resulting social questions. Questions include: for whom and under which conditions should these technologies be available? Who will carry the costs? How far does family 'planning' go and how does this interfere with how we feel about having children?

3 Anti-ageing

The Netherlands is ageing rapidly. Usually this is considered a burden for society, because old people rely heavily on healthcare and with it on solidarity between the generations. Technological developments, however, are making another perspective possible. More and more tools are becoming available that promise to postpone the ageing population's burden or extend (healthy) existence. Diets, food supplements, hormone treatments and cosmetic surgery are already applied frequently. Future possibilities are being considered such as gene therapy, cloned organs, or a combination of biochemical and genetic techniques that could slow the ageing process. As a result of this, old age seems to be becoming more and more manageable. It is supposed to help old people better control their own health and life expectancy. The Rathenau Instituut plans to map anti-ageing technology developments and understand the changing consequences for how we deal with old age. Will anti-ageing ease the social 'burden' of the older generation? And how does it change the way we feel about old age and finiteness?



Theme 2

The digital modification of our world view

In the previous work programme (2009-2010) under the themes 'Digital Hyperconnectivity' and 'Prevention Society' we asked who may see what of whom. How does the ongoing digitalisation of the public space challenge the way in which we deal with personal data and the design of computer systems? We reached the conclusion that it is not only about protection of privacy, but also about new identity control forms and the effect thereof on social relationships. Within the theme 'The digital modification of our world view' we want to go deeper into the relationship between user and the way in which digital reality is constructed. How do social powers interfere with what we get to see and what it does to us?

Society is becoming increasingly dependent on the digitalised supply of information. This makes us wonder how this information is actually selected, processed and made accessible. Software codes include scripts that are making certain things possible or impossible, which means information is hidden, reframed or steered. See how Google uses its PageRank algorithm. Initially this algorithm was used to make sure the most quoted websites appeared on top of the page with the search results. Now commercial interests are interfering with this ranking. Another example is the number of social network sites that are increasing fast, whereby users themselves seem to be in control. Sometimes however, the software behind these applications has a far-reaching influence on the social interactions that are taking place. This is for instance the case with (free) services such as Facebook, Hyves or LinkedIn as well as (paid) dating sites like Parship or Relatieplanet. Personal profiles, social interactions and group development are being steered in a way invisible to the user because of commercial interests. Behavioural targeting has a key role in this.

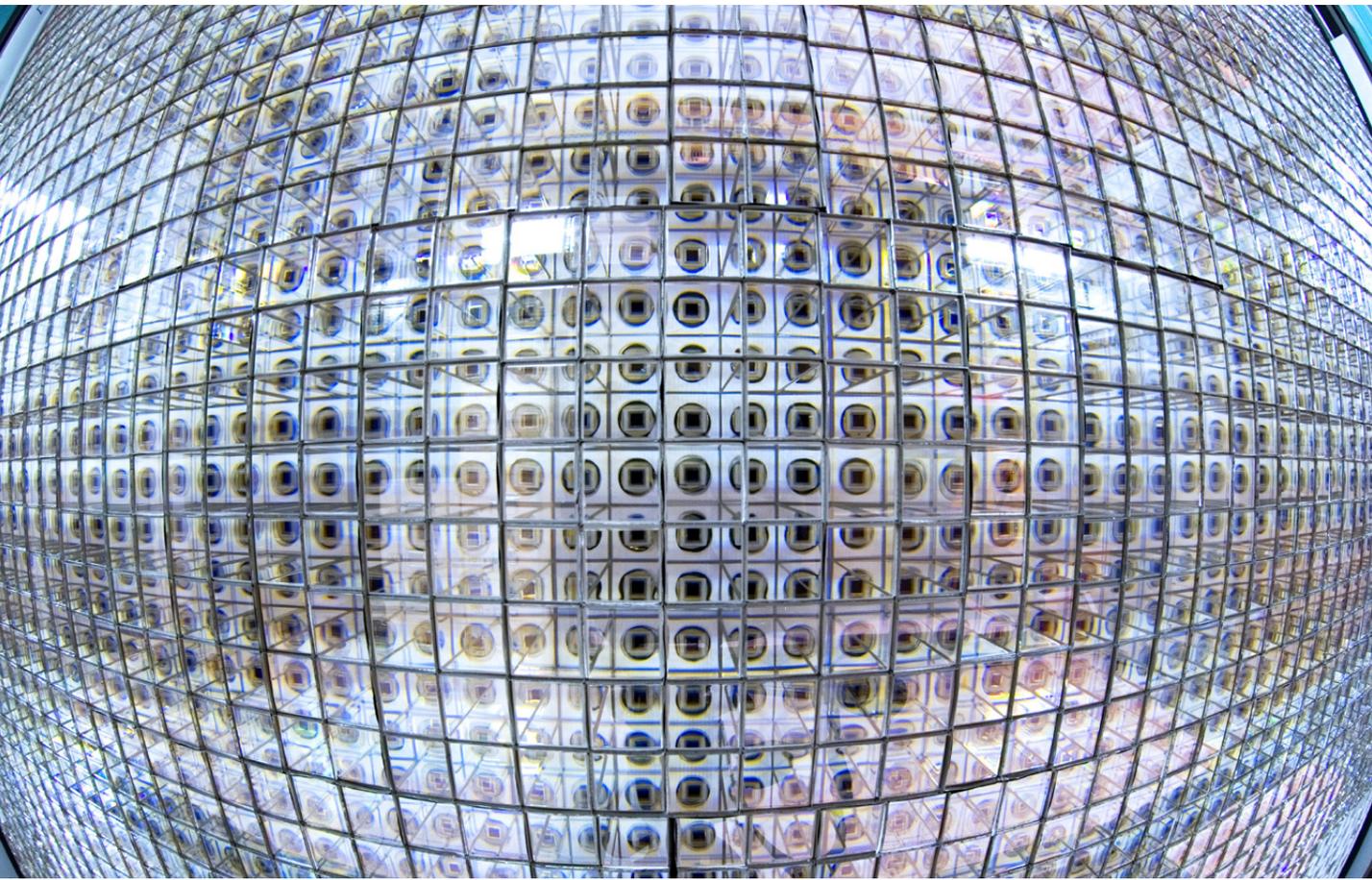
In 'The digital modification of our world view' the Rathenau Instituut wants to look behind the scenes of the Internet. Here, the leading questions are: which coding forms exist on the Internet, what are the interests involved and how does this interfere with the way Internet users think and act?

We focus on three subjects:

- First of all, we will study how the Internet influences the relationship between citizens and politics. Instead of the, what used to be a neatly arranged news offer, the Internet today is causing a wild growth of information supplied by different sources. How does this interfere with citizens' political opinion forming? Does it involve fragmentation of public opinion, and if so is this a bad thing? In this context we will also be paying attention to the increasingly popular 'stemwijzers' ('voting guides' - political tests that help you find the political party that you like most after answering several questions), each representing (in other words: coding) political standpoints in its own way. At the same time we wonder which opportunities are offered by the Internet to strengthen citizens' positions. Does citizens' rising web activism offer them more possibilities to exert influence on politics?

- Secondly, we plan to study the influence of social networks on the interaction between users. How are users' profiles built, how is users' attention drawn to possible contacts or relevant sources of information and what is the role of commercial interests in this?
- Thirdly, we want to explore how in the near future persuasive technology and affective computing will be steering human behaviour. Affective computing makes it possible to recognise, interpret and stimulate human emotions using ICT. One example is FaceReader which detects emotional facial expressions. This technique is already used for communication research or job interviews and could be applied in mobile phones in the near future. Persuasive technology – behaviour steering technology – takes yet another step. At the moment ways are being studied seeking to promote a better driving style or a healthier lifestyle using ICT or seduce people into a certain purchasing behaviour. This is about influencing people without the person in question being aware of what is going on. Here the Rathenau Instituut builds on the existing joint venture with TU Eindhoven.

With these three sub-studies the Rathenau Instituut plans to stimulate the social and political awareness of how the Internet is interfering with how we think and act.



Theme 3

Excellent science

Scientific institutions, financiers, universities and research institutions are strongly emphasising scientific excellence and are tuning their personnel policy, selection processes and financing models accordingly. Having compared science policy developments in six countries it turned out that the Netherlands in the 1990s was a trendsetter in adjusting the science system thus creating good conditions for the quality of scientific research.

This was followed by two major developments in how we feel about the quality of scientific research. First of all, universities and research organisations included scientific excellence in their institutional mission. A European study showed that in Europe approximately 1,000 universities have stated in their mission that they wish to join the international top. This strategic focus is mainly expressed in scientific productivity and the position on international rankings. The second major development is the emphasis on excellence of individual scientists and a shift in research financing and research management to researchers'

careers. In the Netherlands this is shown in the expanded innovation impulse and the introduction of tenure tracks in personnel policy.

Over the coming time we plan to critically study these developments. We will be studying researchers' careers, dedicating special attention to the tenure track system. This system is still in its infancy, however in different places we are already witnessing a tension between the requirements and wishes of institutional research management and policy tuned to individual careers of researchers.

The focus on scientific excellence also means pressure on selection processes due to increasing applications and the rising quality of proposals. For research financiers themselves this means considering the best form of selection processes. In a more general sense, it means asking questions about the position and function of finance organisations in the research and science policy, also in terms of the development of the European research space.

The attention paid to excellence has resulted in uniform institutional strategies, while through other paths more differentiation is aimed at. The term scientific excellence itself needs critical reflection. While initially it served as a distinctive feature for a limited group of researchers and research groups, today it has become a label for the wide middle group of the science system.

In the recent past and through different projects we have contributed to better research management. The project dedicated to research groups in medical science in particular has helped us gain better insight into the features of good research groups and research management options. We carried out a follow-up study into how research groups operate in medical science, also paying attention to changes in research management at the level of University Medical Centres and hospitals. Prioritised research areas, formulation of key issues and the national division of tasks is more often the case. We expect this to also change the dynamics of the research groups.

We will continue to investigate research careers and evaluate research. Research careers are the subject of research management within the institutions and of national policy as well as financing (innovation impulse, European Research Council grants). This is

why we will study scientists' careers and postgraduates' careers in particular. Why do they remain involved in science or not? Where do they go? To what extent are career decisions personal decisions, or are they based on external factors (economic crisis) or research group management?

In this period we will strive to compare the situation in the Netherlands systematically and empirically to that in several other countries. The Rathenau Instituut is already taking part in an international study into the impacts of the European Research Council. The ambition within this theme is to contribute to research management possibilities in order to facilitate excellent performance, categorise the boundaries of the strategic focus, and identify options for new strategies. Studies are conducted as much as possible in deliberation with the institutions involved. We discuss results in interactive workshops with researchers and research managers and share them through lectures and publications.



Theme 4

The value of science

Obviously the worldwide economic crisis has also had impacts on scientific research. Some countries are not economising on scientific research, and some authorities may decide to make additional investments. This means that scientific research is believed to stimulate innovation. The outcome and insights of scientific research is also relied upon in solving major social problems. Nevertheless, this trust is earmarked with expectations. If scientific institutions wish to keep this protected position, they will have to live up to the expectations.

Scientific institutions are responding to these expectations. The new NOW (Netherlands Organisation for Scientific Research) strategy for instance is called 'Growing with Knowledge'. With the Valorisation Agenda all science system organisations have undertaken to try to upgrade knowledge valorisation. Policy and instruments are very diverse when it comes to stimulating

valorisation and other social contributions of science. Little is known of the effectiveness of this.

Researchers, however, sometimes experience a tension between seeking excellence and expecting research to contribute to the knowledge economy, innovations and to solving social problems. At the same time, expectations of research impacts are on the increase, on the one hand fed by the promises of researchers and research organisations and on the other hand so much desired by social actors. The question is whether expectations are realistic and whether promises can be kept.

Recently the Rathenau Instituut participated in the national ERiC project and the European SIAMPI project, in which methods were developed to evaluate the social contribution of research. We also studied the social impact of several research programmes. These studies and projects have helped us better understand the development of the social impact, and the possibilities to organise and evaluate this impact.

We will proceed with this line, and extend the focus of evaluation methods towards other policy instruments. It is our ambition to have a key role in discussions about research valorisation and the social value of science. We do this along two lines. First of all, following case studies in the previous period, by conducting case studies into research valorisation in specific research fields. These studies contribute to understanding the value of science, the possibilities to organise valorisation processes, and enable the actors involved to tune research management accordingly. Secondly by studying the economic and social effects of special parts of the knowledge infrastructure such as science parks, large-scale research facilities and national programmes.

In addition to these studies into the valorisation of the scientific research, we will continue to focus on the social position of scientific knowledge in policy and social discussions. The Rathenau Instituut's capability of organising social debates is used on a regular basis in the event of social controversies in which the status of scientists' social knowledge and expertise is also often a point of discussion. Examples in the previous years are the controversies concerning CO₂ storage, HPV vaccination and the discussions about the IPCC report. We expect to continue to play this role on a regular basis in the years to come.

These controversies also indicate that the status of science and technology is not self-evident; neither in political decisions nor in social discussions. Although evidence based policy is widely accepted, we also experience that what is considered evidence, is a point of discussion whenever complicated problems are involved. Also, different ways of dealing with uncertainty in scientific discussions and decisions can lead to difficult use of scientific results for policy purposes. Over the coming time we will also be using our experiences and competences to ensure more insight into the dynamics of controversy resolution. This should allow us to contribute to improved strategies to involve science and technology in decision making processes. Also, we hope to contribute to renewed trust in the value of science and technology for our society.



Theme 5

Converging key technologies

Since the 1970s innovation policy has been tuned to stimulating the so-called key technologies such as biotechnology, information technology and materials science. It turned out quite soon that the development of one key technology depended strongly on the development of another key technology. Information technology and new materials for instance stimulate biotechnology, while biological insights inspire information scientists and materials scientists. This mutual influence is called technological convergence, also referred to as NBIC convergence. NBIC stands for nano-technology, biotechnology, information technology and cognitive science.

Convergence is making many new developments possible (e.g. molecular medicine, robotics, personal genomics) and is ensuring a new technological wave. In recent years the Rathenau Instituut devoted much attention to the social meaning and dynamics of technological convergence, especially in the fields of

nanotechnology, smart environments and synthetic biology (see also the report bundle *Leven als bouw pakket (Life as a DIY kit)*). This we will continue in the years to come. We will be joining the STOA project *Making Perfect Life* dedicating attention to the strongly advancing brain sciences (see theme 2). Also, we will study the scientific dynamics of technological convergence.

Reflecting on 'technology becoming biology' and vice versa

With the STOA project *Making Perfect Life: Bio-engineering* (in) the 21st century we are seeking to inform the European and Dutch parliaments about the social and political implications of technological convergence. In this project the dynamics of NBIC convergence are studied based on two megatrends: 'biology becoming technology' and 'technology becoming biology'. Convergence results in increasing numbers of technical possibilities to intervene in body and brain.

From the biotechnology debate we have become used to heavy debates on this trend. Convergence, however, also works in the opposite direction. Biology and insight into how the brain functions also inspire information technology and nanotechnology. Consequently, technology is developing character traits which we always associated with biological systems, such as learning behaviour or recognising and showing emotions. Examples include molecular structures able to convert light into a rotating motion or robots searching actively for natural food to turn it into energy. This type of skills is called 'living technology'. The Rathenau Instituut plans to use *Making Perfect Life* to contribute to early social reflection on the trend 'technology becoming biology'.

New interdisciplinary makeability

The Rathenau Instituut will also be studying the scientific dynamics primed by convergence. We will study the position which techno-sciences (will) take up in the scientific landscape. And we will explain how efficient innovation policy based on a key technology really is. To this end the Rathenau Instituut will study different new scientific areas. To what extent is convergence visible in research dynamics? What is the role of interdisciplinary cooperation and how can research organisations best organise this?

The policy relevance of these studies is shown from the importance of combining nanotechnology, biotechnology and information technology in foreign innovation strategies. Results might contribute to discussions about the Dutch knowledge infrastructure (see also theme 7).



Theme 6

Dreaming of a synthetic Eden

The growing world population is making an increasing appeal to the world's natural resources. This involves local and global environmental problems and intensifies the worldwide struggle for raw materials. Examples include China's increasingly active role in the raw material market in Africa. Except for fossil fuels, water and food, this more often involves substances such as rare metals or phosphates. A lack of these substances can put our economy and lifestyle under pressure. This was given attention in the work programme 2009-2010 (theme the Hunger for Raw Materials).

The debate on the sustainable handling of our natural resources and environment shows an interesting divide. On the one hand the limit of nature and its restricted makeability is emphasised. Here we refer to environmental disasters such as the recent discovery of 'seas of plastic' and the spreading of chemicals in our environment. On the other hand the technical makeability concept is making a strong arrival. One may imagine visions such

as cradle-to-cradle, bio-based economy, synthetic biology, designer ecosystems and geo-engineering. It seems as if the attractiveness and legitimacy of these visions grow as the raw material and environmental crises are felt more strongly. Under the denominator 'Dreaming of a Synthetic Eden' we plan to discuss the pros and cons of this new makeability ideal. How realistic is the vision of having a bio-synthetic Eden, in which we surpass scarcity– or does it stop at a beckoning perspective? We focus specifically on geo-engineering, bio-based economy and synthetic biology.

Geo-climate engineering

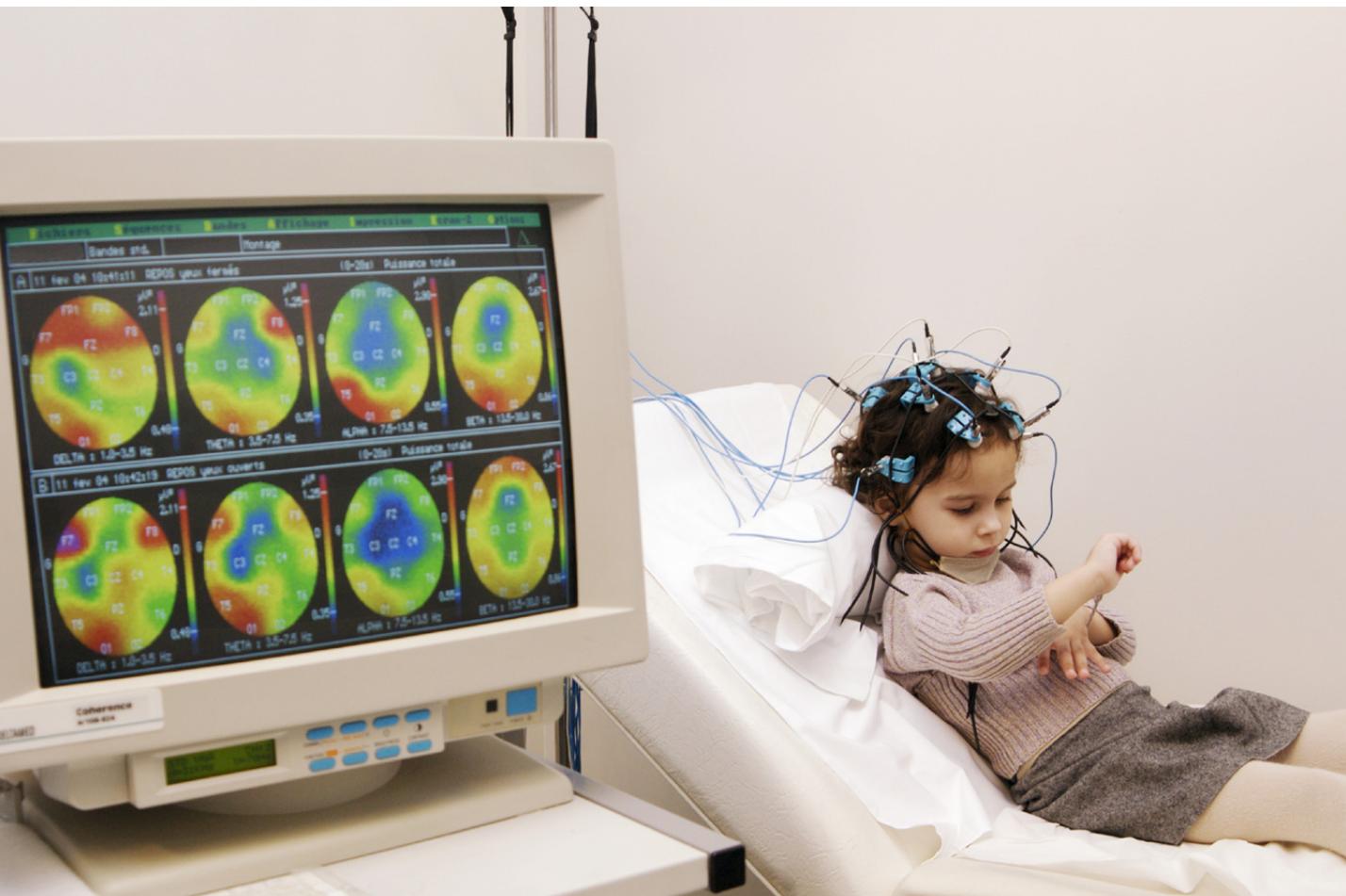
Until recently discussions about climate change involved the reduction of CO₂ emission and anticipating the negative effects, for instance by building higher dykes. In recent years a more extreme form of intervention was added to the international scientific and political agenda: geo-engineering – or: climate engineering. It involves major technological actions that should contain climate changes and the consequences thereof. Climate engineering seeks to interfere with the earth's climate system. Examples include making clouds whiter or placing mirrors in the sky, so that less sunlight will reach the earth's surface. Another example is the fertilisation of oceans to capture larger amounts of CO₂. So far geo-engineering has evoked the necessary discussion in scientific circles. The Rathenau Instituut wants to map the social geo-engineering issues and study the guidelines that should prevail for these sizeable technologies. This is about a complex international debate. For example, who determines the design principles when 'redesigning' nature? And should China or America be allowed to fiddle with the composition of the seawater if such involves consequences for other countries?

Bio-based economy and synthetic biology

The future perspective of an energy supply system based on renewable sources is gaining an increasingly more concrete social and economic meaning. Sun and wind are the most frequently mentioned sources. In recent years, however, there has been strong international focus on an economy using natural resources rather than fossil fuels: the bio-based economy. In the short term this will involve a large-scale deployment of natural materials and the optimisation of refinery processes. In the longer term this vision will be accompanied by a far-reaching technologicalisation of nature. See synthetic biology, that seeks to turn alga and microorganisms into 'living factories' providing socially desired

products such as biofuels.

The Rathenau Instituut plans to explore the political and policy issues called up by bio-based economy and synthetic biology. In this we wish to dedicate explicit attention to international affairs. Example: if all the richer countries would switch over to biofuels for transport purposes, this could have major consequences for food supply in the poorer parts of the world. How should we manage global deliberation on such exercises?



Theme 7

The brain as the scientific and social paradigm

The brain is the new frontier in science. Which is why neurosciences are becoming a fast growing interdisciplinary field. The most important driver is the aim to better control our behaviour by better understanding the brain. 'We are our brain' is the basic idea. The brain is becoming a new declaration model of who we are. This model is attractive partly because it creates more space for our interaction with other people and also with our environment. It makes us less determined than what was initially believed in the time of genetics. Neurosciences are marching strongly towards making a new paradigm for our understanding of (the relationship between) mind, body and (social) behaviour.

In this work programme the Rathenau Instituut plans to study the development of neurosciences as a new scientific area; map the influence thereof within other scientific areas and social sectors; and interpret this influence socially and politically. This results in the following individual topics:

- In the first place we want to empirically study the nature and dynamics of neurosciences. This involves questions such as: how are the neurosciences developing in the Netherlands, both intrinsically but also in terms of infrastructure, finance and cooperation? How are research organisations responding to the arrival of this new scientific area? Which international position should the Dutch neuroscientific research arena take? And how does the neuroscientific paradigm make itself felt in other scientific areas, such as the economy or educational sciences?
- Secondly, we will study how neuroscientific insights make themselves felt in society. Here two sectors are pivotal. For the legal domain we will verify how neuroscientific knowledge and techniques are used to explain and treat delinquent behaviour. How solid are these outcomes and to what extent do they already have a role in Dutch courtrooms? What are the consequences of this use for central terms within the criminal law system such as accountability, imposing penalties and treatment? For the neurotech market we will map recent developments. This is mainly about brain machine interfaces: interfaces between the brain (or the central nervous system) and the computer of another device. These applications vary from smart interfaces between humans and computers in gaming or neuroheadsets for neurofeedback among sportsmen to medical technologies such as deep brain stimulation or transcranial magnetic stimulation. This also involves questions about the possible risks of these applications and the necessity of the regulations.

By means of publications, workshops and public meetings we want to initiate a wide public debate on the social effect of the development of neurosciences. Together with the Scientific Advisory Council on Government Policy we maintain business contact because the Council too conducts studies in this field.



Theme 8

Designing the Dutch Knowledge Infrastructure

In the publication 'Thirty years of research financing' (2007) the Rathenau Instituut referred to the emergence of new intermediaries between the authorities and research financiers on the one hand and executive organisations on the other hand. This involves management bodies, different forms of top institutes and large programmes. One significant function of this new organisation layer is the creation of focus and mass through research coordination. A recent study by the Rathenau Instituut, however, shows that the total focus has not increased. Nor has the international position of the Netherlands strengthened in the focus areas of the science and technology policy.

So far new proposals have been submitted to upgrade the design of the Dutch knowledge infrastructure. The Science and Technology Advisory Council has advocated fewer management bodies and

interorganisational structures. The former Innovation Platform, however, established that coordination was insufficient, arguing in favour of more management. The Veerman committee argued in favour of more profiling of and competition between universities. As a reaction to this the VSNU stated that the Netherlands is too small for internal competition and in the international perspective would benefit more from the current interorganisational coordination. The discontinuation of the Innovation Platform has led to a plea for a new council that will have the possibilities to create more focus in Dutch research.

We will continue to contribute to this discussion on the design of the Dutch knowledge infrastructure. One significant task is to feed the discussion with objective information about how the knowledge infrastructure functions. In addition and along two lines, we plan to intensify discussion and with it the policy.

- First of all we will conduct empirical studies into research fields and knowledge sectors. In the previous period we already started in this field with studies into the knowledge system in the water sector and climate research. These studies are dominated by the way in which different knowledge organisations tune their research activities and contribute to economic, social and technological innovations. Over the coming time contributions will also follow from brain research (theme 3) and converging technologies (theme 2). These studies will feed the wide discussion about Dutch knowledge infrastructure and help organisations in those areas improve their strategies. An important target is to clarify what frequently used terms such as coordination, competition, direction, focus and mass actually mean in research and innovation practice.
- Secondly, we want to emphasise the discussion on Dutch knowledge infrastructure in the light of the development of the European Research Area and also in the light of the emerging science countries. The ambition is to make sure the studies within this theme direct the discussions about the development of the Dutch science system and provide the different organisations with a strategic framework.

We will systematically study the development of the European Research Area and the impact of European institutions (facilities, ESF, ERC, EIT, ERAnets, etcetera) on different scientific areas.

One main question in this is how these European institutions relate to Dutch science policy. Do these institutions supplement the Dutch facilities and financing options, or do they serve as competitors?

We will also follow the emergence of Asian science systems. The exceptional development of such Asian systems – which we described in the study 'Focus and Mass of Dutch Science' – presents itself in the development of worldwide specialisation patterns in science. Due to their strong economic growth, Asian countries have seized the opportunity to set down their own course that seems to be different to the 'normal' course of Western countries. This alternative path could serve as an example in designing the Dutch knowledge infrastructure.

We will share the results of these studies in separate publications and also during meetings that will vary from expert workshops to wider public meetings. In this Facts & Figures matters in which we present the main evidence on different policy themes to stakeholders from the science system.



Theme 9

Urban society

The city is home to more and more people. While in 2007 half the world's population was living in cities, in 2050 this number will have reached 75 percent. But this is not yet fact. Various opinions exist about the future development of the city. In the Netherlands too the number of townsmen continues to increase. At the same time urban agglomerations are becoming increasingly important economic innovation centres. The international economic competitive battle more often involves metropolitan regions. It is the Netherlands' ambition to join this global level. Parallel to this, the idea to consider the Randstad (the densely populated urban agglomeration of the western Netherlands) as one large urban agglomeration is winning ground. This has major consequences for spatial and urban planning. It is no longer about the planning of separate cities, but rather about regional or even larger connections. If we look beyond the borders, the Amsterdam-Brussels-Antwerp region could even be considered one large

metropolitan region. We want to find out whether spatial planning is in fact still feasible at this scale.

To the Rathenau Instituut 'Urban society' is a new theme. So we want to launch an exploratory study based on the idea that the city can be considered a technological artefact. In the developed environment and the way in which it is shaped a whole range of technical and social-scientific insights strikes down. Except for economic innovation, activities concerning a dynamic and sustainable mobility system, energy supply, high-quality food supply, a climate-resistant water system, high-quality green areas, safety and liveability are also involved. This also requires attention for the growing significance of regionalisation and shifting relationships between 'city' and 'countryside'. Urban and spatial planning therefore requires a multidisciplinary approach.

In our exploration we will work out how the practice of spatial and urban planning processes handles the many and varied issues it faces: to what extent does it succeed in integrating the required, wide pallet of social-scientific and technical-scientific insights; and how is this reflected upon at a political and policy level. Relevant questions in this context include: what tensions occur between the ambitions of economic innovation, sustainability and liveability, and: does the government have sufficient administrative power to guide the formation of a metropolis in the right direction?

Based on literature search and interviews with parties involved we will work out whether the Rathenau Instituut, using the selected approach, can make a useful contribution to the political and social debate on the formation of a metropolis.

Chapter 4

International activities

The Rathenau Instituut operates within a large international network of sister and related organisations. The Rathenau Instituut is one of the driving forces behind EPTA, the alliance of 18 European Parliamentary technology institutions that was founded in 1990.

European Technology Assessment Group (ETAG)

The Rathenau Instituut conducts technology assessments on behalf of the European Parliament. Within the latter this is coordinated by Science and Technology Options Assessment (STOA). To this end the Rathenau Instituut joins hands within the European Technology Assessment Group (ETAG), which since 2009 is made up of seven European parliamentary TA organisations. The parliament formulates the projects in which the different partners participate.

For the period 2010-2011 the Rathenau Instituut will in any case be responsible for the STOA project *Making Perfect Life*. The Rathenau Instituut will be guiding this project, which involves partners from Germany (ITAS and Fraunhofer ISI) and Austria (ITA).

Synthetic Biology for Human Health: Ethical and Legal Issues (SYBHEL)

SYBHEL focuses on 'global human health and wellbeing' as being one of the main future application areas of synthetic biology. The project coordinated by the Centre for Ethics in Medicine of the Bristol University is financed by the Framework Programme of the European Commission. In addition to the Rathenau Instituut the University of Zürich in Switzerland, the Knowledge Society Foundation in Hungary and the University of Deusto in Spain will also participate.

Parliaments & Civil Society in Technology Assessment (PACITA)

The purpose of PACITA, that is financed by the Framework Programme of the European Commission, is to share knowledge and experience of parliamentary TA in Europe with European countries in which parliamentary TA is not yet a tradition, and in this way contribute to its institutionalisation in Europe. The project is being coordinated by the Danish Technology Council.

Global Ethics in Science and Technology (GEST)

GEST too is being financed by the EC Framework Programme. Project coordination is in the hands of the Centre for Professional Ethics at the University of Central Lancashire. The purpose of the project is to map the significance of ethical considerations and debates in the science and technology policy in Europe, China and India, to substantiate cooperation in this field between the three regions.

SIAMPI

Within the theme Value of Science, the Rathenau Instituut is partner in the European project SIAMPI: Social Impact Assessment Methods for research and funding instruments through the study of Productive Interactions between science and society. The purpose of the project is to develop methods for the assessment of the social impact of research. To this end we and our partners will study the interactions between researchers and knowledge users and how this could lead to social impacts. In this project the Rathenau Instituut joins hands with the Royal Netherlands Academy of Arts and Sciences (KNAW), INGENIO (Spain), Maison des Sciences de l'Homme (France) and the Manchester Institute of Innovation Research (United Kingdom). SIAMPI is financed by the EC Framework Programme.

EURECIA

Until recently European financing of scientific research used to focus on large programmes and consortia. Through the European Research Council (ERC) programmes now also exist for individual applicants – until recently this was the domain of national research councils such as NWO in the Netherlands. Within the EURECIA project the Rathenau Instituut is responsible for analysing the way in which the ERC influences the effect and position of national research councils. Within the EURECIA project the Rathenau Instituut works together with researchers at the Manchester Institute of Innovation Research (United Kingdom), Institut d'études des Politique et Internationales (Switzerland), Wiener

Wissenschafts- Forschungs- und Technologiefonds (Austria),
Technische Universität Berlin (Germany), en ETLA (Finland).
The project is financed by the EC framework programme.

Chapter 5

Other activities

Evaluation

In our work programme we have reserved space for the preparation of the evaluation of the Rathenau Instituut itself. Evaluation will be carried out by an evaluation committee appointed by the Minister. The Rathenau Instituut will submit a report to the evaluation committee which will include a self-study into Rathenau's activities and working methods, an exploration of the direct effect of its activities at the administrative and policy levels and an image study into the effect of the institute's activities on how we are experienced by society.

25th anniversary

In 2011 the Rathenau Instituut will celebrate its 25th anniversary. On this occasion we will be launching several activities for different target groups. The umbrella theme in this anniversary year is CLOSER. With this theme we seek to draw attention to the changing relationships in the triangle in which the Rathenau Instituut has always been operating: science and technology, society and politics. In the past 25 years much has changed within this triangle. In the anniversary year we mainly want to spotlight how the different parties have come CLOSER; how technology has become increasingly 'intimate': technology closer to our bodies with more and more knowledge about ourselves, the user, and how science has become increasingly personal: science able to reveal to us time and again the biological foundations of illnesses and the foundations of our behaviour, our awareness... in short: who we are. How science continuously seeks to link up with society partly through society's pressure to carry out *socially* relevant work in the first place. And finally, how science and politics are becoming interwoven more frequently; one example is the recent uproar about the climate debate and the call for *evidence based politics*.

Activities on the occasion of the 25th anniversary include:

- A public activity dedicated to social engineering
- A talk show for scientists and governors on excellence versus social relevance
- A diner pensant for politicians and policymakers about evidence-based policy
- A special anniversary publication of the client magazine Flux

Transfer of knowledge

The Rathenau Instituut's staff are regularly invited to (guest) lectures. This allows us to share the institute's knowledge and insights among (future) professionals who within their professional practice deal with the dynamics and imbedding of science and technology, such as staff involved in innovative companies, research organisations and governments. The aim is to strengthen the competence to handle social and political issues related to science and technology. Together with the Top Institute for Evidence Based Education Research (TIER) we developed a Master module in the field of Evidence Based Science Policy tuned to science policy professionals. Over the coming time we will see how through courses and study programmes we can give further shape to this kind of knowledge transfer. In this we will be working closely with acknowledged studies.

Methodological innovation and horizon scanning

Good methodology is essential to the quality of the work delivered by the Rathenau Instituut. All of our activities are based on highly diverse analytical and communicative methods such as focus groups, citizen panels, statistics, scientometry, questionnaires, interviews, visualisations, debates and presentations. For each project we carefully consider the methods that lend themselves best to realising certain objectives. If required, we develop new methods which are preferably suitable for several projects. Partly thanks to the investments in new methods both in the field of TA and SciSA, the Rathenau Instituut has been able to build an internationally prominent position in these fields. Proof is the international interest in how the institute operates.

To map dynamic and international comparisons of science, the Rathenau Instituut has gained expertise in the domain of scientometry. Here the emphasis lies on accessibility, combination and analysis of large collections of heterogeneous data.

One example is the Semantically Mapping Science project, in which different databases that include information about the development of science are opened up and linked. The results of this work will lead to improved field studies. The results of improved statistical indicators for the comparing of science systems are also shown in Facts & Figures.

Over the coming time we will also continue to work on social network analysis methods to map science and technology networks. This will help us better understand the knowledge infrastructure, especially when it comes to the role and position of the different actors. Also, we will conduct agent-based modelling pilots. The purpose is to be able to stimulate complicated policy problems, such as the effects of different forms of financing on scientists' behaviour. In these projects we join hands with university researchers in this field.

Horizon scanning

One significant aspect of the Rathenau Instituut's work is the mapping of new developments and trends in science and technology. This not only involves new developments and trends that matter to current projects, but also new developments and trends that will determine the future social-administrative agenda. This requires concrete activities in which we systematically extend existing knowledge and experience based on a structured working method.

Against this background the institute will be launching a project in which its own experience in Technology Assessment and Science System Assessment will be intensified, adding methods and techniques that are already circulating for instance for 'horizon scanning' and 'foresight'. The central element of this project is to build files to generate reactions among parties interested, experts, policymakers and citizens in general. We will experiment by using social media to organise feedback at an early stage. In this way we hope to develop challenging scenarios of the drivers that are steering the future of science and technology. Also, we will dedicate serious attention to the visualisation of information, for instance in graphics, diagrams, networks and photographs. Choices will depend on the communicative purpose

of the visualisation (inform, engage, confront). Reflection on visual communication and the development of communicative impact analyses are important when working out methods to raise the level of transparency and impact of visual communication.

Chapter 6

Communication

The Rathenau Instituut is an organisation with a public task. Which means we must be transparent and justify our activities towards authorities, stakeholders and society. The Rathenau Instituut applies various tools and forms of communication to inform its target groups and stakeholders about research outcomes and to establish interaction and discussion with interested parties.

Publications

The Rathenau Instituut publishes policy and research reports on a regular basis to provide politicians and policymakers with information that is relevant to policy and to alert them to trends and developments. We gather experts' visions around a topical theme in collections of essays, so providing a quick overview for those involved and those interested in the theme in question. In our Reports to the Dutch Parliament, we provide members of parliament with tailor-made analyses and recommendations.

The factsheets entitled 'Facts and Figures' collect relevant information about the Dutch science system and make it accessible for those who are interested. Twice a year we publish the technology magazine Flux, a magazine for our clients and other interested parties.

Meetings

The Rathenau Instituut uses a range of participative and interactive methods such as focus groups, expert meetings, public debates, talk shows and forum discussions to promote interaction with citizens, policymakers, politicians and other involved and interested parties. What we are trying to achieve here is the exchange of thoughts or to initiate a debate to get the images, visions and standpoints of participants out into the open. The outcomes and results of these meetings form the input for ongoing studies and projects or follow-up research and projects. The Rathenau Instituut also participates in *NWO Spinoza debates*.

Publicity

The social and political debate on themes with which the Rathenau Instituut is concerned is largely conducted in the media. Opinion pieces by Rathenau Instituut researchers appear regularly in national newspapers. We are also frequently asked to respond to current developments by journalists.

The media are crucial in getting themes onto the agenda. They are also often the most appropriate channel for intervening in debates that threaten to get mired down in traditional differences of opinion. Our approach in such cases is often to inject aspects or insights into the discussion that have so far had insufficient exposure. We try to augment debates, contribute to the removal of black and white contrasts and to give discussions new impetus or a new turn. Visibility in the media and a good relationship with the press again have high priority in a work programme.

Digital communication

In 2010 the Rathenau Instituut launched its entirely renewed website. Points of departure for the new site are: informative, accessible, interactive and attractive. In the same year the Rathenau Instituut also started to publish a digital newsletter covering news from the institute and reactions to recent developments in science and technology. Also, we will give impulse to the use of social media for our institute.

Representational forms / experiential communication

We use representational forms and experiential communication to involve the public, press and politicians in science and technology in a highly accessible manner. Examples include forms such as: a television documentary, theatre, an interactive exhibition or installation, a serious game.

Events

The Rathenau Instituut organises events on a regular basis tuned to generating the attention of politicians, press and public for important scientific and technological trends and themes. In 2011 we will be launching several events for different target groups on the occasion of our 25th anniversary.

2011

List of current projects

Autonomy in healthcare

Emerging markets for body materials

Body materials are becoming valuable. Blood, ova and organs are sold in many parts of the world. Where does this happen and who is involved? What are the motives? What are the social consequences? The Rathenau Instituut plans to answer these and other questions using a number of concrete examples, in order to initiate the public and political debate about donation and payment for body materials.

In March 2011 researchers Ingrid Geesink and Chantal Steegers will be publishing the book 'Nier te koop – Baarmoeder te huur. Wereldwijde handel in lichaamsmateriaal' (Kidneys for sale – uterus to let. Worldwide trading in body materials) by publisher Bert Bakker. In the same period BNN will be broadcasting the television documentary 'Babyshopping', a co-production of broadcasting association BNN, producer Pieter van Huystee Film and the Rathenau Instituut. 'Baby-shopping' is about people visiting baby markets abroad, something that does not exist in the Netherlands.

In 2010 the researchers were involved in the presentation in the Netherlands of a book of scientific journalist Rebecca Skloot. The book describes American patient Henrietta Lacks, some of whose body tissue was removed for research purposes back in 1951 without her permission. The cells turned out to continue to split unrestrained, and to this day present an inexhaustible basis for scientific and commercial research. According to research conducted by the Rathenau Instituut, many Dutch people are unaware of the fact that their cells too can be used for research purposes in the Netherlands. The Rathenau Instituut believes decent information must be supplied about this matter.

Human enhancement

People are more and more able to change things they do not like about themselves using pills, brain stimulators, plastic surgery or gene therapy. But this development involves major social and ethical aspects. If health and intelligence are becoming a choice, does it mean you can decide not to join in? And do we not overlook the risks for instance of the new technologies?

The Rathenau Instituut maps the consequences of the development of human enhancement technologies for Dutch society and in

different ways draws attention to human enhancement. In 2010 a conference was dedicated to this topic which was organised for directors and heads of departments at the ministries of Justice and Home Affairs. The Rathenau Instituut also participated in a book called 'Enhancing Human Capacities' (Ter Meulen et al.) in which experts from Europe and the US share their views on the ethical and political implications of human enhancement. Rathenau contributed to the question as to how human enhancement issues can be dealt with at a European level.

Early in 2011 the final report of the human enhancement project will have been published which will map the arguments, considerations and standpoints of the Dutch public based on focus group research. The report forms the basis of the advice to parliament on the dilemmas of human enhancement and the policy options with the most support. With this public study we also seek to arouse social debate on human enhancement. Also, we will draw the attention of editors of general-interest magazines to this matter.

Medical self-care technology

New technological techniques also lead to the concept of personalised care: people have access to devices that allow them to help themselves without having to call in a doctor or care provider: from STD tests to blood pressure meters. Quite often devices can also be personalised, whereby doctors in some cases are able to read physical data at a distance: so-called telecare.

What are the consequences of these developments for healthcare, care providers and healthcare consumers? That is the key question in a project called Medical self-care technology. In 2009 we published the report 'Medical technology: also suitable for use at home'. This report emphasises that authorities should introduce a quality mark for self-care devices. Early in 2010 a debate was held with politicians, insurers, scientists, patients' organisations and health insurance companies. The resulting insights will be summarised in a report to parliament.

An expert meeting about this topic was held towards the end of 2010.

Digital modification of our world view

Social robots

Since the 1960s robots have been used to perform routine activities at factories. In the past ten years they also started to penetrate our living environment. These so-called social robots have made their entry in households, healthcare, traffic control and at police and defence departments. Their tasks vary from cleaning and supporting rehabilitation processes to shooting at hostile targets. How will the emergence of this new generation of robots change our lives?

Early in 2011 the Rathenau Instituut will be publishing the report 'Robots among the people' in which we specifically discuss robots in households, defence and police departments, transport and the healthcare sector. The report is intended for experts, politicians and policymakers. For a wider audience we will be preparing a more accessible version in the form of an essay.

The subject has already drawn media attention in radio and newspapers. Articles were published in De Ingenieur (The Engineer), regional newspapers and in Sociology Magazine. A scientific article on healthcare robots was published in Accountability in Research. The Rathenau Instituut has also organised meetings in cooperation with the Ministry of Economic Affairs and Science Centre Nemo, and prepared presentations for (inter alia) InnovatieLab Gezondheidszorg and the ITAS Institute for Technology Assessment and Systems analyses. A Knowledge Chamber called 'robotics and artificial intelligence' was organised for the top executives of the ministries of Public Safety and Justice and Home Affairs. In this Knowledge Chamber in September 2011 we will for instance discuss the possibilities of using robots in the field of surveillance, administration of justice, crowd control and examination of evidence.

Databases in the Picture

Increasing amounts of data about our daily lives are being stored in digital data files: whenever we use our credit card to pay for something, use the public transport chip card (OV-chipkaart) for travelling or visit the general practitioner. The digital storage of data makes new products and services possible, however it also involves risks associated with weak security.

The Rathenau Instituut has listed seven current examples of digital data systems: the public transport chip card, road pricing, the electronic patient record, the electronic child database, the Schengen Information System, clients' profiles on the Internet and the municipal records database. We studied how the design of these systems determines the targets to be reached and the risks involved. We studied in depth the data collected, and how these data are processed and exchanged, who is able to access these data and how citizens' rights are regulated. In November 2010 we published 'Databases – About ICT promises, hunger for information and digital autonomy'.

One main conclusion is that the authorities should strictly supervise the design and functioning of databases. The project will be completed in 2011 with a report to parliament.

Digitisation of public space

The information society is entering a new phase. We do not just visit the Internet: in our daily lives we leave many traces on that network– from credit card payments to images on street view and security cameras. So we are actually living on the Internet, with all accompanying privacy risks. This practice and the consequences thereof are described in the book 'Check in / check out', which the Rathenau Instituut published in 2010 in cooperation with NAI Uitgevers.

One of the main questions of the book is this: how do individual consumers and citizens control their data that become available through the Internet? The authors of the book argue that the time has come to empower consumers.

The book is a bestseller in the Netherlands and the Rathenau Instituut received many invitations to lectures about the digitisation of the public space, including an invitation from Shanghai (conference 'Designing the hybrid city') and Tokyo. Considering the major international interest in this subject we have decided to publish an English version of the book in 2011.

Excellent science

Management and performances of research groups

Good research requires talented researchers, however the quality of their working environment and management also matters. What is the best way to organise and steer research groups? To find out the Rathenau Instituut conducted several extensive questionnaires among group managers in Dutch health research.

So far research resulted in two publications. In autumn 2010 a questionnaire research was held among group managers in health research. The study was tuned to the aspects of academic management that interfere with scientists' motivation and performances.

Careers

In 2011 the Rathenau Instituut will be studying which factors are decisive in scientists' careers, and how these factors can be influenced. The research follows the report 'At the right time and the right place' conducted in 2010 on behalf of the Rathenau Instituut. It showed that so far scientists' careers depended mainly on the coincidental release of a position and considerably less on researchers' individual qualities. The report also showed that guiding young talented people is extremely important for the successful start of a scientific career.

Career opportunities in humanities are clearly worse than in the medical and beta-sciences. In these science fields talent is thinner on the ground. Which is why universities in these domains are setting up so-called tenure tracks more frequently. Hard agreements are made about the career paths of talented researchers.

The value of science

Public research into ideas on science and technology

How do people in the Netherlands feel about science and technology? Is it possible to segment the Dutch population on the basis of these ideas? To answer these questions research bureau Veldkamp, on behalf of the Rathenau Instituut, conducted public research. In four group discussions people with different backgrounds discussed technology in general and several specific new technologies such as nanotechnology.

The outcomes of these qualitative sessions have been used for quantitative research among a larger group of people. The results of this research will be presented in 2011.

Spinoza te Paard (Spinoza on Horseback)

In 2011 NWO, The Hague's pop temple Paard van Troje, NRC Next, Teleac and the Rathenau Instituut will be organising the talk show 'Spinoza te Paard' four times. Each time the winner of the Spinoza Prize will be presenting his or her scientific area to the public that may in turn respond instantly. The meetings cover a wide range of subjects, from insects and black holes to quantum mechanics. The meetings will be recorded on www.w24.nl

Evaluating research in context (ERiC)

How do you evaluate the social value of scientific research? That is what the ERiC (Evaluating Research in Context) project is about. The project is being carried out by the Rathenau Instituut in association with KNAW, VSNU, NWO and the HBO council.

Usually, only the scientific quality of research is evaluated. In 2009 the Rathenau Instituut completed four pilot studies in which the social relevance of research was also brought into focus. On the basis of this a method was developed together with research organisations to evaluate the social relevance. More than one thousand copies of the publications have already been distributed. In 2010 workshops were organised for scientist about evaluating the social value of research.

SIAMPI

The European SIAMPI project (Social Impact Assessment Methods for research and funding instruments through the study of Productive Interactions between science and society), just like ERiC, is about evaluating the social impact of science. Within the framework of this project, interaction between researchers and

social parties interested (stakeholders) is studied in different countries. Being one of the partners in this project, the Rathenau Instituut studies the interaction in the field of ICT and nanotechnology.

Science Parks

In science parks fundamental and applied research meet: and with staff at universities and companies working at the same location these parks are considered places where knowledge between these worlds can be effectively exchanged, which benefits innovation and economy.

In this project the Rathenau Instituut is studying what the interaction in fact looks like, especially when starting entrepreneurs are involved. Which networks do they use, and do these networks change depending on the phase in which the company finds itself? A number of foreign partners are doing the same in other countries (Japan, Israel, France, Finland). Attention is also paid to the coherence between social ties of parties involved and their scientific and technical results. The first Dutch publications on this project are expected early in 2011.

Investing in research facilities / Large-scale facilities

What is the economic, social and scientific impact of large-scale research facilities, such as scientific reactors, wind tunnels and radio telescopes?

In previous years the Rathenau Instituut studied how the financing of these projects – nationally and internationally– comes about, as well as the social and economic effects of projects.

The year 2011 will be dominated by research into scientific effects, whereby we will go into the pressing question: a technical four million euro investment for instance means losing forty research assistants. How may this impact a particular field of research?

Converging key technologies

New Technological Wave

Smart environments, brain chips and artificial life: the growing interaction between nanotechnology, biotechnology, information technology and cognitive science (NBIC convergence) is increasing our possibilities to interfere heavily with biological and cognitive processes. With the project The New Technological Wave the Rathenau Instituut is following on from the Social Dialogue Nanotechnology.

At the beginning of this dialogue in 2009 the Rathenau Instituut published the book *Leven als bouw pakket (Life as a DIY kit)*. The book discusses important boundaries which are shifting because of the NBIC convergence, such as the boundaries between intelligence and artificial intelligence or between life and artificial life. These developments are putting well-known issues such as privacy, safety and social equality in a new light.

The Rathenau Instituut proceeds to spotlight these insights among the public and politicians. In addition to the special issue of Flux in 2009, in 2010 the institute launched a website on nanotechnology and refreshed the Nano Newsletter. The Lower Chamber was supported during a working visit on nanomedicine.

Project completion focuses on the political discussion on the output of the Social Dialogue Nanotechnology in 2011. Prior to the political debate the Rathenau Instituut will draw conclusions from the discussions held on nanotechnology, NBIC convergence and related projects such as *Making Perfect Life*, the project dedicated to NBIC convergence for the European Parliament.

Synthetic biology

Expectations of synthetic biology are high. Using the tools of this new scientific area, bacteria and algae can ever more frequently be converted into little factories for the production of medicines and biofuels. Eventually synthetic biologists also want to make new, self-designed forms of life. As a result the advance of synthetic biology involves dilemmas and ethical questions. What is the status on the safety of human-made bacteria and viruses? Doesn't it become easier to make biological weapons with synthetic biology tools? And is it appropriate to create artificial life?

A few years ago the Rathenau Instituut added these questions to the political agenda and continued to follow developments afterwards. The institute was one of the two European participants in a project of the American J. Craig Venter Institute in which the social questions were mapped that result from synthetic biology. In association with the Netherlands embassy in Tokyo in 2010 synthetic biology developments were explored in Japan. In 2010 and 2011 and working together with the Genetic Modification Committee (COGEM), newsletters will be issued providing background information about developments in the synthetic biology domain.

With the existing and future project activities the Rathenau Instituut will continue to actively pay attention to developments and dilemmas in synthetic biology. 'Biosecurity' – possible abuse of synthetic biology for the making of weapons – was pivotal during a workshop with security officials, scientists and policymakers in October 2010 in The Hague (Netherlands). In Spring 2011 a report will be published on this topic including recommendations for policy. In the years to come the Rathenau Instituut will contribute to a European project on ethical and legal policy questions in the field of synthetic biology and healthcare. Also, the institute plans to carry out more public activities which is why it will study the social opinion forming on synthetic biology.

SYBHEL

The Rathenau Instituut is one of the participants in the European SYBHEL project (Synthetic Biology for Human Health: Ethical and Legal Issues). This project takes place from 2010 up to and including 2012 and is financed from the EC Framework Programme. The purpose of the project is to map future developments in the field of synthetic biology and healthcare dedicating special attention to ethical and legal implications. The Rathenau Instituut's task is to recommend policy at a European level. To this purpose the institute will be organising a European workshop in 2011 and an international workshop in 2012 with scientists, social organisations and policymakers. A final report will be presented on this workshop including policy recommendations.

Global Ethics in Science and Technology (GEST)

What is the role of ethics in science and technology policy in Europe, China and India? That is the key question of the project Global Ethics in Science and Technology.

Three partners in Europe– University of Central Lancashire, Karlsruhe Institute of Technology and the Rathenau Instituut – will be working together with the Chinese Academy of Science and Technology for Development as well as the Research and Information System for Developing Countries in India.

Three case studies will be set up to study the role of ethics in the field of nanotechnology, food technology and synthetic biology. The results will be translated into policy recommendations tuned to all three regions.

The Rathenau Instituut has the main responsibility for the execution of the case study on synthetic biology, but will also participate in other activities.

The project is financed from the EC Framework Programme.

Biosecurity

Developments in the field of (synthetic) biology are progressing rapidly. These also involve the risk of being abused, for instance by terrorists. Biosecurity should reduce this risk. But then, how do safety regimes interfere with scientific research? How is biosecurity translated into rules for laboratories and researchers? So far the safety of scientific research can be safeguarded in three ways: codes of conduct, safety regulations for working at laboratories, safety rules for restricting access to potentially hazardous substances. The fast development of life sciences, however, probably also involves new abuse options, and it remains to be seen whether the three current ways remain effective. The Rathenau Instituut is working on a report on this topic, scheduled to be published in 2011.

Dreaming of a synthetic Eden

Biobased economy

Can biological raw materials present an alternative to fossil raw materials? That is the central theme of the project *Biobased Economy*. The Rathenau Instituut wants to map the visions of the different Dutch players in this field, and analyse the social bottlenecks.

The study *Biobased Economy* will be published early this year (2011). One of the conclusions is that the advantages and disadvantages of biological raw materials sometimes are the same – especially when biofuels are involved – and that better ways exist for dealing with biological raw materials, but that they are not yet supported by government policy.

In October the study concept was discussed at the international conference 'Down2Earth – Conference on Agriculture, Climate Change and Food security', of the Ministry of Agriculture, Nature and Food Quality, the FAO and the World Bank.

In 2011 a trainee from the Rathenau Instituut will be studying the developments of the biobased economy in China.

Energy in 2030

How far can the Netherlands go and how far does it want to go with energy conservation, the use of sustainable energy (e.g. sun, wind and biomass)? And how many fossil fuels and uranium do we still need? To answer these and other questions, in 2011 the Rathenau Instituut will publish a book with the Dutch working title 'Het energieparadijs behouden. Omgaan met de controversiële energiebronnen van 2030' ('Protecting the Energy paradise. Handling the controversial energy sources of 2030'.)

One important conclusion from this book is that all energy sources have their own specific disadvantages, and that discussions on the matter continue to go round in circles. There is no such thing as the perfect solution: make a choice and find a way to handle the disadvantages of that choice, is the advice of the Rathenau Instituut.

Previously the Rathenau Instituut has published a report on this issue called 'Energy transition begins in the region'. In this report three regions were scrutinised being Rotterdam, Texel, and 'Energy Valley' – which seek to preserve their energy supply.

Following the new book, in 2011 an expert meeting will be organised for policymakers.

Geo-engineering

If restricting CO₂ emission is insufficiently controlling climate change, would it not be better to remove CO₂ from the atmosphere ourselves? For instance, can we manure the sea with iron, to make sure alga absorb more CO₂? Or can we stop the earth from heating up by stopping sunlight, for instance by using mirrors in the sky? Or can we make clouds whiter? These are geo-engineering questions.

Many ideas in this field involve practical or legal objections – clouds and CO₂ for instance do not respect national frontiers. Some solutions, such as fertilising oceans, are dangerous too because they seriously interfere with the natural ecosystems. The Rathenau Instituut is exploring the pros and cons of geo-engineering. A debate entitled 'Climate: can we fix it?' was held in The Hague towards the end of 2010.

The brain as a scientific and social paradigm

Transdisciplinary didactic and neurosciences

Brain and neurosciences are emerging. These scientific areas are expected to be able to contribute to better education and the way in which people learn things. In daily practice however, brain and neurosciences and education are insufficiently linked. This became clear in 2010 during the Rathenau Instituut's project Transdisciplinary Education Research. In 2011 an essay will be published about the expectations of researchers involved in brain science and didactics.

Imaging and neuro and cognitive science

How does scientific research change whenever a new device is developed? The Rathenau Instituut wants to find out by means of neuro and cognitive science. These scientific areas also involve inter alia MRI scan and EEGs: tools originally intended for diagnosis purposes. Today however they are also used for scientific research.

The question is this: how do these new technologies change the research field? Not only intrinsically, but also in terms of infrastructure, financing and cooperation. For instance, what does this mean for the frontiers of the research fields in question?

In 2011 the Rathenau Instituut will publish the first section of a report, about the role of neuro- imaging techniques in requesting money for cognitive research. Also, we will map the development of the neuro and cognitive science based on publications and interview with scientists, policymakers and students.

Designing the Dutch Knowledge Infrastructure

The development of the water research

To manage rivers and coastal areas, research into these waterways and areas is important. What clusters of researchers exist? Do they work together or not? And if so: in which fields do they join hands? Do they exchange data or develop specialisations together for example?

To find the answer to these questions the Rathenau Instituut conducts research at KWR, the scientific institute of the drinking water sector. This should lead to a water research model. Also, we will map whether – and how – water research contributes to innovation. The results are expected to contribute to the organisation of knowledge processes in the water sector.

Early in 2011 the Rathenau Instituut will publish on research programmes in river and coastal research. The publication will for instance show how interdisciplinary research in the field of water can be stimulated in practice.

Knowledge for Climate

The Rathenau Instituut is closely involved in the progress of the Knowledge for Climate national programme. This is one of the so-called 'multi-actor multi-measure programmes', also referred to as 'MAPs'. The Rathenau Instituut prematurely evaluates the effect of the programme on climate research, the different ways in which this research is organised and the effect thereof. Also, we analyse whether scientists, policymakers, private parties and people from the practice are working together successfully. Finally, we map what it means for a research field if a large part of the finance is

used within the MAPs. The programme is being continuously monitored. The first interim results are expected in 2011.

In addition, in 2010 the Rathenau Instituut made a social impact analysis of the climate research programmes Climate for Space and Knowledge for Climate.

Chemistry

The chemical sector in the Netherlands plans to grow strongly over the coming decades. Also, the sector wants to have an important role in society preservation, for instance by using fewer fossil fuels. To this purpose the Chemistry Management Group was called into existence. On this group's request the Rathenau Instituut will prepare a map of chemical research in the Netherlands. Where are the dynamics? What is the Netherlands' position in chemical research? In 2011 the Rathenau Instituut will provide the management group with a final report.

Focus and mass

Should the State invest more money in research (e.g. nano-technology), would this automatically mean more research in this field? And would this lift up the Netherlands' international position in these fields? These are the central questions of the project *Focus and Mass*. The answer to both questions is no, as became clear in 2010, because the Dutch science system usually manages to absorb additional investments. One of the reasons is that research institutions pursue their own focus and mass policy that does not necessarily correspond to the policy of national authorities.

On behalf of the Health Research Council, investments in medical research were analysed. This study is also used as input for advice to the minister of Public Health about the financing of medical research. In 2011 we will launch international case studies into strategic development in science and we will conduct field studies into the coordination of scientific research.

EURECIA

The Rathenau Instituut joins an international project dedicated to studying the effect of the European Research Council on national research systems.

The council is developing into one of the main financiers of research in Europe. How does this affect national research financiers? Do they adjust their programmes or strategies? Some national financiers seem to be surrendering their national role, others on the other hand seem to become more active internationally.

Facts and Figures

In 2011 Facts and Figures will be published at least twice. One publication will be dedicated to the scheduled research expenses of the departments based on the 2011 budget and the coalition agreement. (Until recently this overview was drawn up by the Ministry of Education, Culture and Science). The second publication will be about the public research finance in the Netherlands, and will be an update of a previous publication by the Rathenau Instituut ('Thirty years of public research financing in the Netherlands 1975-2005'). The publication will also include an international comparison, and will further discuss the different forms of project financing in 2009.

Science portal 'denederlandsewetenschap.nl' (Dutch Science)

In August 2010 the website 'denederlandsewetenschap.nl', a shared initiative of KNAW and the Rathenau Instituut, was launched officially. The site provides a list of facts and figures about the Dutch science system. The portal answers questions such as: who are responsible and involved in policy and advice on scientific research? Who are the main financiers? Which research programmes exist in the Netherlands? Which organisations are conducting research in the Netherlands, and which organisations are supporting research implementation?

The website is updated on a regular basis and news items are regularly added.

International activities

Making Perfect Life

During the project '*Making Perfect Life: Bio-engineering in the 21st Century*' that is financed by STOA, two megatrends are pivotal: 'biology becoming technology' and 'technology becoming biology'. Towards the end of 2010 the Rathenau Instituut presented a monitoring report in combination with a conference at the European Parliament which was attended by some 120 policymakers, scientists and politicians.

The report provides a conceptual framework to look at the current developments within the wide field of bioengineering and includes concrete examples of how ethical concepts and regulations become pressurised. The four domains of bioengineering research are: 'Engineering the body' (e.g. copying tissue and organs within the biomedical technology), 'Engineering the brain' (e.g. the development of interfaces between the brain and external devices to stimulate or interpret brain activity), 'Engineering living artefacts' (e.g. copying and changing living material within synthetic biology) and 'Engineering intelligent artefacts' (e.g. creating artificial intelligence for robots).

The conference was partly dedicated to molecular medicine, whereby diseases are diagnosed even before the symptoms have presented themselves. This changes our conceptual framework: being ill is no longer a matter of curing, but rather of prevention and personal responsibility. The conference also covered the latest developments in robotics, whereby machines are increasingly often taking over people's work. So who's to blame should anything go wrong?

During discussions it turned out that the attendees were concerned about the speed of the developments. Thinking about the legal and ethical effects of developments in the bioengineering field threatens to be overtaken by facts.

Making Perfect Life will be entering its final stage in 2011. This stage consists of case studies in which the Rathenau Instituut, again in cooperation with foreign partners, will explore in depth four concrete policy problems in the field of bioengineering regulations.

Parliaments & Civil Society in Technology Assessment (PACITA)

In this project knowledge and experience in parliamentary technology assessment will be shared with European countries that are not yet familiar with this tradition. The project involves parties from eight different countries including Spain, Denmark, Germany and the Netherlands. These countries work together with organisations in countries where parliamentary technology assessment does not yet exist (e.g. Bulgaria, Hungary, Ireland and Lithuania)

As part of this project training sessions, conferences, exchange programmes and such are organised. The Rathenau Instituut is one of the key participants, and has a major role in communicating the project results. The project is financed by the EC Framework Programme.

Other activities

World Wide Views on Global Warming

In 2009 the Rathenau Instituut held a forum allowing almost one hundred Dutch citizens to share their views on global warming. The purpose of the forum was to allow people who do not always join public discussions to share their opinions. Also, the Rathenau Instituut held a debate on climate change (Balie, Amsterdam).

Following these activities the Rathenau Instituut mapped the scientific consequences of climate change, the positions of the different participants in the debate, and how politics and media are tackling these uncertainties.

This research's outcomes were published in April 2010, in the report called 'Room for climate policy: understanding the interaction between climate politics, science and media'. The report was used for a hearing in the Lower Chamber and was translated into English for the European Parliament. Also, a scientific article was published in *Current Opinion in Environmental Sustainability* based on the report and written by Jeroen van der Sluijs, Rinie van Est and Monique Riphagen, 'Beyond consensus: reflections from a democratic perspective on the interaction between climate politics and science'.

Europe's technological borders

Immigrants may be confronted with various technologies including DNA tests, X-rays, body and iris scans and speech prints. And with European databases of personal data and fingerprints. Because of these technologies European borders are changing slowly but surely into technological borders. This involves risks. Technology for instance is liable to error, while the deployment of large-scale databases encourages the discrimination of population groups. Also, the human measure of policy is threatened, as is described in the Rathenau Instituut's book called 'The Migration Machine'. The book received much attention and was praised by the European Data Protection Supervisor for its 'outstanding analysis'.

In late 2010 the Rathenau Instituut published the English adaptation of this publication: *Migration and the New Technological Borders in Europe*. A new chapter was added on developments in the European migration policy. The book was presented to the European Parliament. A scientific article about this subject– 'Greedy information technology' – was published in the *European Journal of Migration and Law*.

Strategic agenda for ethics in agriculture

Demand for food is high and will only continue to grow. Agricultural land, however, is becoming scarce because of the population pressure and climate changes. Can technological innovation provide a solution to this problem?

That is one of the subjects in the Strategic agenda for the ethics policy which the Rathenau Instituut prepared for the Ministry of Agriculture, Nature and Food Quality and also for NWO. Jan Staman, managing director at the Rathenau Instituut, mapped the developments that will take place between now and 2012 in agricultural production including the related ethical issues.

In 2010 an article was published in the daily newspaper *Trouw* on the exploration (titled: Eating less meat is better, but how to persuade the Dutch people?) that aroused intense discussion.

Vaccination

People seem to be somewhat losing faith in vaccinations and the related institutions. During recent vaccination campaigns against cervical cancer and the Mexican flue, historically low numbers of people showed up. Where does resistance come from?

To get a clear picture the Rathenau Instituut organised a meeting inviting supporters and opponents to join in. Based on this (private) meeting recommendations were prepared for vaccination policy. These are submitted to all the participants, and are particularly meant for the National Institute of Public Health and the Environment (Dutch RIVM).

Police

In 2011 the Rathenau Instituut will once again launch several activities for senior police officers, including a meeting on the digitised public space.

Animal testing

On behalf of the Ministry of Health, Welfare and Sport, in 2011 the Rathenau Instituut, together with the Altena Institute, will be organising a meeting on animal testing trends. What does politics want to do about animal testing and does it want to do it? Do we accept monkey tests to study the ageing process? The background of the meeting is that the European Parliament is working on new regulations in this field. This will put animal testing on the new government's agenda.

European project on joint and open programs

The Rathenau Instituut is contributing to a European project on joint and open programs of R&D activities (JOEP = Investments in Joint and Open R&D Programmes). The Netherlands is one of the participants in a consortium of eleven countries. The Rathenau Instituut maps the Dutch landscape of joint and open programmes and tracks down existing data sources.

Modelling the knowledge dynamics

Can developments in science policy be captured in a model? To answer this question, in 2011 the Rathenau Instituut will organise the workshop Modelling Science. The workshop is a follow-up of a similar meeting that was held back in 2009. An umbrella model of the entire science is yet far away, however workshops such as this one will bring part models closer.

The Rathenau Instituut joins hands with the Virtual Knowledge Studio of KNAW and the Cyberinfrastructure for Network Science Centre of the Indiana University to produce a book on the modelling of science.

Bibliometric Software Tools

During the project Bibliometric software Tools, the Rathenau Instituut developed a software toolbox ('SAint') for scientometric and bibliometric analysis. One of the possibilities is to map which scientists are publishing intensively and which publications are most frequently quoted. The first version was published in spring 2009. Today this toolkit is used widely and has supported the analyses of many publications or even made these possible for the Science System Assessment department. The number of external SAint users is also growing continuously.

At the moment SAint is being developed into the next stage. In 2011 a new version will be ready which for instance will be able to process even larger data sets. SAint is available for researchers.

Exhibition Knowledge Maps

Knowledge maps reveal the coherence between scientific subjects. Examples include maps showing the interaction between physics, chemistry and biotechnology in the field of nanotechnology, based on scientific publications in this field.

These maps are interesting to people involved in scientific areas, including policymakers. At the same time, they show a wider audience how scientific research is developing. To this purpose, the Rathenau Instituut plans to prepare a number of maps and exhibit these in a visually attractive manner at a museum.

Discussions were held with an interested museum and according to plans the exhibition will take place sometime in 2011.

Also, a meeting will be held about maps for policymakers and scientists.

Evidence based science policy

The Rathenau Instituut, together with TIER, the Top Institute for Evidence based educational Research, developed the module Evidence Based Science Policy. It is an academic programme intended for people involved in science and research policy organisations.

We challenge module participants to reflect on ways of increasing the effectiveness of science policy, and how to evaluate the scientific and social research output. The module is scheduled for 2011.

Client magazine Flux

Flux is Rathenau's client magazine published twice a year. Early in 2011 Flux's theme will be 'Science captured in big promises'. The file in this Flux issue is about tensions and issues on the interface of science and policy and also on the interface of science and society. Is it true that public faith in science is fading? Flux's spring issue 2011 will be dedicated to the Rathenau Instituut's 25th anniversary. Theme will be CLOSER.

Anniversary

In 2011 the Rathenau Instituut will be celebrating its 25th anniversary. Theme will be CLOSER. Science and technology are coming closer and closer in the sense that technology seems to be intervening in our daily lives more often. Examples include smart phones which have started to represent us and our identity, the advance of social media, but also social engineering and persuasive technology aimed at influencing behaviour.

Science, technology and policy seem to come closer and closer. One may think of the importance attached to evidence based policy.

In the jubilee year we will in different ways be giving attention to these themes launching activities targeting different target groups. We will develop a serious game about the subtheme 'intimate technology', and a dinner pensant themed 'evidence based policy'.

Who was Rathenau?

The Rathenau Instituut is named after Professor G.W. Rathenau (1911–1989), who was successively professor of experimental physics at the University of Amsterdam, director of the Philips Physics Laboratory in Eindhoven, and a member of the Scientific Advisory Council on Government Policy. He achieved national fame as chairman of the commission formed in 1978 to investigate the societal implications of micro-electronics. One of the commission's recommendations was that there should be ongoing and systematic monitoring of the societal significance of all technological advances. Rathenau's activities led to the foundation of the Netherlands Organization for Technology Assessment (NOTA) in 1986. On 2 June 1994, this organization was renamed 'the Rathenau Instituut'.

