

Work Programme for 2019-2020

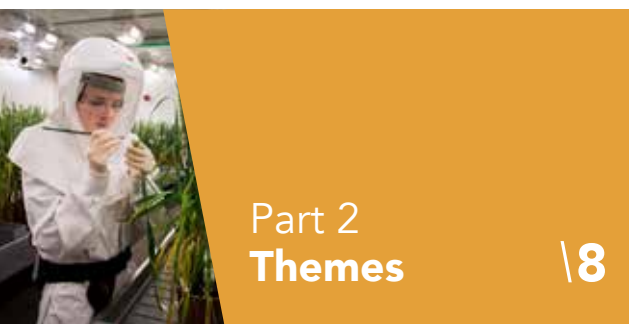


Contents



Foreword **3**

Position and tasks **5**
Method **6**
Cooperation **6**
Focus on governance and actors **6**
Focus on the future **6**
About this work programme **7**



Digital society **9**
Making perfect lives **12**
Knowledge for democracy **15**
Robust knowledge ecosystems **18**



Relationship to previous work programmes **22**
Board **23**
Programme Panel **26**

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Photograph on previous page: A patient takes a stroll with Zora, the robot caregiver.

Photograph: Dmitry Kostyukov / The New York Times / Hollandse Hoogte

Foreword

Maybe you remember the Netherlands Organisation for Technology Assessment or NOTA. In 1994, it was renamed 'the Rathenau Instituut', in honour of the renowned Dutch researcher Gerhart Rathenau (1911-1989). In the late 1970s, Professor Rathenau showed us the enormous impact that the emerging field of computer automation would have on everyday life. His warning served as a wake-up call for the Netherlands. People all over the country purchased PCs and got to know the upsides and downsides of computers. And look at us today. We all work with computers now and are connected to one another by them.



The Rathenau Instituut studies how science and technology changes our lives. In recent years, we have studied the impact of algorithms, artificial intelligence, blockchain and other digital technologies. It is only now, however, that society in general has become aware of precisely what is changing. This wake-up call is a wake-up light – the kind that eases you into wakefulness gradually. We are growing more and more aware that digitalisation has become a powerful force. It has changed the way we eat out, order a taxi, monitor our health, seduce someone – and countless other activities.

We are aware that new technologies also raise new dilemmas for society. Examples include the impact of online misinformation on democratic decision-making, genetically manipulated crops, or how e-health influences our relationship with healthcare professionals. We at the Rathenau Instituut believe that it is our task to address dilemmas of this kind in evidence-based public debate.

In twenty years' time, you'll be reading a foreword written by someone who will recall 2018 as the year of our digital awakening as a society. Our awakening has come just as we find ourselves facing a new generation of technology. How that new generation will impact society is, of course, something that we cannot predict yet. Our researchers will be keeping a close eye on everything, with our new work programme as a guide.

Gerdi A. Verbeet

Chair of the Board of the Rathenau Instituut



Part 1 Introduction

The Rathenau Instituut sets the agenda for, encourages and supports decision-making and policy. In this part, we introduce our organisation and our work programme.

Schiphol plans to continue its facial recognition trials in 2019. Passengers will be able to check in without showing a passport or boarding pass.
Photograph: Pim Ras/Hollandse Hoogte

Focused on the future

Research and dialogue on the impact of science, innovation and technology on our lives: that has been the Rathenau Instituut's mission for more than thirty years. The Dutch Parliament and society as a whole have charged us with a specific responsibility, one that is set out in our founding document. Below we describe the societal context, our position, our roles and our methods.

The Rathenau Instituut occupies a unique place in the Dutch knowledge landscape because it combines a profound understanding of the knowledge ecosystem with expertise on how science, technology and innovation are embedded in society. The Rathenau Instituut plays three roles in this context.

Position and tasks

First of all, the Rathenau Instituut's role is to set the agenda for public and political debate concerning the societal aspects of science, technology and innovation. We note trends in all three areas and explore the impact that have or will have on people, industry, institutions and government. We have positioned ourselves in the vanguard of new developments in that sense. We conduct research with that in mind and engage with a broad spectrum of stakeholders, ranging from ministries to industry and from environmental and patient organisations to scientific experts, both Dutch and international. We operate independently and our knowledge and our societal perspective on science, technology and innovation mean that our work complements that of advisory councils and other organisations. We bring together knowledge institutions, public authorities, politicians, civil society and other stakeholders without taking over their roles.

The Rathenau Instituut also encourages public and political debate on science, technology and innovation – some of it controversial. We examine all aspects of new scientific and technological trends as well as the diversity of opinion to which such trends give rise. We identify any existing tensions. We do not limit ourselves to the rational, technical or functional aspects, but show what stakeholders regard as important. In doing so, we help to ensure that new technologies and innovations are properly embedded in society. For example, biotechnology can increase food production while alleviating pressure on natural resources, but it also raises concerns about other values, for example how we treat animals and ecosystems, and who decides what we eat.

Finally, the Rathenau Instituut provides expertise and information in support of political decision-making and policymaking about science, technology and innovation. We know how the broader Dutch knowledge and science system operates and are therefore better placed than any other party to integrate and provide access to available data and to collect any missing data. We have been given the task of furnishing information – either on request or on our own initiative – to the Government and Parliament of the Netherlands and to the parties that populate the Dutch knowledge landscape.

Method

To fulfil the above roles, the Rathenau Instituut combines two types of expertise: expertise about the Dutch knowledge landscape (consisting of all Dutch research universities, universities of applied sciences, public knowledge organisations, businesses and civil-society organisations, which interact to generate new knowledge) and expertise about specific research practices and about how science, technology and innovation are embedded in society. This combination allows the Rathenau Instituut to analyse issues in-depth and break them down into manageable elements. One example of such an issue is artificial intelligence (AI), a socially disruptive force worldwide, and how the Netherlands should respond to it by generating new forms of expertise.

The Rathenau Instituut always publishes its research reports in open-access form and makes them available to the public on its website, where they can be perused by all. Another distinctive feature of our method is to actively involve specific target groups in our research, for example by organising dialogue sessions, consultations and networking campaigns and by delivering keynote speeches and appearing on radio, TV, online and at festivals.

Cooperation

In everything that the Rathenau Instituut does, we show how science and technology can contribute to 'public value creation', also referred to as 'the good life' or 'a just society'. What counts as public value creation is, of course, always open to debate in a democratic society, as a matter of principle. Certainly in a representative body like the Dutch Parliament, which is made up of so many different parties, it is important to express the many and varying opinions on the subject. Guidance can be found in the broad consensus that has emerged in many domains, for example regarding the Dutch Constitution, the Universal Declaration of Human Rights, the Council of Europe and the United Nations' Sustainable Development Goals. They have the commitment not only of governments but also of knowledge institutions, industry and civil-society organisations. By cooperating with others in the Netherlands and internationally, we learn how they are interpreted worldwide. In each case, the Rathenau Instituut will examine how certain trends and developments in science or technology can make a positive contribution to the individual human rights and public values that have been defined.

Focus on governance and actors

The United Nations' Sustainable Development Goals and the EU's Societal Challenges identify tangible, quantifiable goals (for example food and energy for all), but also process goals (such as good governance). The work undertaken to achieve these goals differs from one region to the next and is increasingly regarded as a process in which not only state actors but also cities, universities, industry, the public and other parties in society have a role to play. In each study that it undertakes, the Rathenau Instituut will explore which form of governance suits the rapid advances in science and technology that it is addressing.

One promising model involves 'ethics by design', i.e. focusing on socially desirable outcomes in the research phase. In Europe this is referred to as 'responsible research and innovation' and is part of the 'open science' approach. Another method is to enact new legislation that allocates responsibility across the full spectrum of civil society and puts checks and balances and oversight in place. Because it has become so much easier to communicate and share information with one another, new forms of IT can support such innovations. We will also be looking at the impact of IT on democratic processes in the years ahead.

Focus on the future

How can we take the rights of future generations into account in science and technology decision-making? We aim to study this by involving young researchers, the youth branches of political parties, the UN Youth Ambassadors Programme, or the Worldconnectors Round Table in our research. Other useful methods are foresight or scenario studies.

The time scale is another important factor when deciding which research to undertake. The length of time needed to carry out basic and applied research goes beyond a single cabinet period. By gathering facts and figures over the course of many years and by testing the associated assumptions, we continue to fuel the debate about the amount of time needed for science to produce socially relevant and economic results.

About this work programme

This work programme identifies the areas that we intend to emphasise in our research in 2019 and 2020. We are zeroing in on relevant and urgent societal aspects of science, technology and innovation. That allows us to carry out separate projects within a broader framework and provide access to the body of knowledge that we have accumulated over our thirty-year history. We drafted our 2019-2020 work programme in consultation with various experts and stakeholders who are represented on the Rathenau Instituut Programme Panel. We also consulted the Netherlands Scientific Council for Government Policy (WRR) and the Royal Netherlands Academy of Arts and Science (KNAW), among other organisations. We further invited the public to submit suggestions to our 'digital post office box' for new research and new issues to explore.

The work programme described in this document describes four interrelated themes that the Rathenau Instituut intends to address in 2019 and 2020. Within each of the four themes, we also identify the focus of our dialogue with society and a number of other topics that we intend to study to continue building our knowledge and expertise.

1. Digital society: shaping our own digital future
2. Making perfect lives: examining new care options
3. Knowledge for democracy: expert and public input into decision-making
4. Robust knowledge ecosystems: the knowledge society of the future

Over the next few years, we will use up-to-date data acquired in our own research to drive these urgent debates. It became clear during the consultations preceding this work programme that stakeholders want our input in these domains. We will update our existing expertise by conducting new studies and explore new domains that we believe will become relevant to elected officials and policymakers in the medium to long term. How the Rathenau Instituut will set to work and with whom will be decided in the next few months.



Part 2 Themes

These are the themes that the Rathenau Instituut will be addressing in 2019 and 2020: Digital society; Making perfect lives; Knowledge for democracy; and Robust knowledge ecosystems.

A pollen technician studies genetically modified crops at a seed farm.
Photograph: Alex Lentati / Evening Standard / eyevine / Hollandse Hoogte

1 Digital society



Customers pay for their purchases with their phones at Amazon Go, a supermarket with no cash registers. The Dutch grocery chain Albert Heijn is also experimenting with cashierless shops in the Netherlands. Photograph: Elaine Thompson / AP Photo)

Over the past thirty years, the Rathenau Instituut has studied the influence of computers and digitalisation on many different areas of society. The pace of innovation is faster than ever and requires new research to understand the impact of these new technologies; at the same time, we are in urgent need of informed political decisions and dialogue across every level of society.

It has become clear in recent years that digitalisation is far from being a mere series of new gadgets; it has in fact triggered a societal transition that raises new questions about security, online discrimination and exclusion, influence and autonomy, and the power and responsibility of the companies that develop digital technology. The difference between online and offline is fading. As a result, we increasingly live in a digital society – without knowing precisely what that means. Digital technologies are changing the way teachers teach, how doctors and patients talk to each other, what politicians debate, and how people share news. Behind the scenes, algorithms and artificial intelligence work in ways we often don't even recognise. Our society is being utterly transformed.

The role of the Rathenau Instituut

How do we ensure that society is able to steer its own course, come up with its own solutions, dare to ask questions and, where necessary, make demands on government and industry? How can digitalisation lead to an inclusive society? And how can it provide opportunities to address societal challenges in such areas as climate change, food safety, healthcare and public administration? These are the questions that we are considering in our 'Digital society' programme.

Dialogue

Over the past several decades, the Rathenau Instituut has developed conceptual frameworks for discussing emerging technology in relation to what is important to us in Europe: our values and human rights, which we have seen enshrined worldwide even if they are interpreted locally in different ways. We have investigated the effects – both visible and less visible – on society as a whole, including power imbalances, control over technology, security and justice. Over the next two years, we will engage with groups in society to learn what they need to make choices. It goes without saying that we inform politicians, shed light on these developments, and clarify which choices this requires of them. In addition to the national level, we concern ourselves with local politics. We also work with other institutes to inform the European Parliament and other international forums.

Research

The Dutch government has expressed its support for a digital future in which everyone can participate. What does this mean for the existing rules? What does it mean for international agreements and for cooperation between local authorities and how they coordinate with national government? What responsibilities will industry bear? How is responsibility shared in the event of public-public and public-private partnerships? What does the promise of new technology mean for our responsibility as individuals? How do we become technologically adept citizens? And who will help us if we fail? Within the 'Digital society' theme, we are conducting new research on three topics:

a) Intelligent devices in everyday life

The use of intelligent devices, from physical robots to digital systems and social media, is radically changing many sectors and social practices. Artificial intelligence (AI), which is self-learning and makes decisions based on large quantities of data, is expected to undergo a major leap in development. Besides expectations, this prospect also raises even more questions about privacy, autonomy, security, possible control over algorithms and power imbalances. The biggest challenge of all will be to use intelligent devices to develop responsible social practices. In the years ahead, the Rathenau Instituut will investigate how some of these practices – including healthcare, education, energy supply, policing and the administration of justice – may change as a result of new digital technologies.

We want to offer political officials, professionals and the public courses of action that will allow them to influence new developments based on public values.

b) Immersed in digital technology

We tend to see computers as a screen and keyboard that give us access to the digital world through our fingers and eyes. New technologies, however, are changing the way we interact with computers and the (digital) world. People already log in to their smartphone by fingerprint or facial recognition. Speech recognition allows us to talk to computers. The voice-based virtual assistant 'Alexa' that has been integrated into Amazon's smart loudspeaker has already become a household fixture in the United States. In the Netherlands, Google Assistant is growing steadily in popularity.

We are also seeing the rise of 'immersive' technologies, the 3D feature film being only one recent example. Augmented reality (hearables and smart glasses) and virtual reality are forecast to become increasingly important, both at work and in daily life. Laboratories are making rapid progress developing the potential of brain-computer interactions. The Rathenau Instituut wants to examine the societal significance of these new emerging technologies. We are looking at the situation in the home, but also at the influence that these technologies are having on public space. Will Amazon (through Alexa) tell us what kind of carrots to order from which store? Do we want billboards that address us personally as we walk down the street and tip us off about a nice jacket that's on sale in the shop round the corner?

c) Digital security, human rights and international relations

Hang up! Shut it down! Call your bank! The internet makes things easy and convenient for criminals too, who can now break into your house from the comfort of their own homes, wherever they may be. Cybersecurity is one of the issues defining global relations and many also now see it as the driver of economic growth. The big American and Chinese tech companies have already redefined themselves as AI firms, organisations that possess vast quantities of data and are capable of making high-level decisions based on that data. AI is also increasingly regarded as the key to future military power.

The strategic awareness that a global AI race is under way may well result in 'AI nationalism', a new form of geopolitics in which countries strive to set up national champions in AI and block takeovers by foreign firms. Competition for scientific knowledge and talent is also rising. The fear is that an international AI race will frustrate any adequate global governance of AI.

We are monitoring developments at international level, where the United Nations, the Council of Europe, the European Union and other international organisations are pushing to develop frameworks, regulatory measures, privacy arrangements, cybersecurity regulations, consumer rights and standards for a safe Internet of Things. Companies are publishing ethical codes and looking for ways to satisfy their duty of care. We want to understand how democratic decision-making can take place in this arena, and how digitalisation can be used to achieve common goals.

2 Making perfect lives



A newborn being placed in an MRI scanner at Utrecht University Hospital. Brain researchers have recently been given permission to scan healthy infants' brains and compare them with premature infants, for example. Photograph: Marcel van den Bergh / Hollandse Hoogte

The Rathenau Instituut has been studying the ethical and societal impact of medical research and health technology for many years. This programme builds on our previous work. Dutch society has widely differing views on these issues, something that is reflected in political debates.

Questions about life and death are not purely individual matters for humans – after all, we are social beings. Nevertheless, autonomy over our bodies and self-determination are among society's great assets. That explains the tendency in political debate and in the media to focus on the tension between individual needs and collective values, and also why there is so much emphasis on the different ways that groups in society judge what is good. Every new technology has its own specific features, but all new technologies raise the same questions, again and again. Innovations that we have examined in recent years include germline genetic modification, human-animal hybrids, human embryo research, regenerative medicine, the organ trade and risk assessment and legislation surrounding new technology.

The role of the Rathenau Instituut

It is the Rathenau Instituut's aim to reveal how public values and specific interests evolve along with new technologies, to give voice to patients' experiences (in addition to those of medical and ethical experts), and to show how new patterns of inclusion and exclusion can emerge. We shed light on new medical research and what is already possible in clinical practice, but also on the need for new frameworks.

Dialogue

We initiate dialogue ourselves where necessary but note that many of these issues are already being discussed in society. It suits us to document the arguments and to ensure that societal and political debate is sensitive to various aspects. Where there is no debate, we use our expertise to support an inclusive discussion by others. We cooperate with the Health Council of the Netherlands and the Ministry of Health, Welfare and Sport, among others.

In recent years, our research has revealed the vulnerability of human beings in this area and shown that, in addition to moral considerations, economic interests also play a role: there is a lot of money to be made from our longing for a meaningful life and for perfection.

Beauty, health, fertility, life and death are subjects that rouse feelings of uncertainty in us. A new concept of health is also emerging in which the boundary between illness and health is becoming blurred. The focus now is increasingly on the quality of life. We are also being told to take control of our own health. But who is protecting us and our collective health when we ourselves cannot anticipate the risks or simply change our behaviour overnight, even with tools to monitor ourselves and with access to medical data, health coaches and apps? In the next two years, we intend to address these images of ideal health.

Research

We will continue to examine cutting-edge technology and what is already feasible in the Netherlands and worldwide. How soon can we expect new inventions in the lab to be available? What do people in different countries think about the associated ethical, societal and legal issues? How much of our lives do we want to open up to biotechnological and medical improvements? As a society, do we understand the consequences and risks of these new technologies? How do we reconcile individual autonomy and the right to self-determination on the one hand with public values and economic and commercial interests on the other? And how do new technologies change our perception of a good and healthy lifestyle and the limits of life itself? We are also examining how new technologies are changing institutions within the healthcare and care system, and how we are redefining the concept of 'quality of life' based on new scientific insights, including in the field of nutrition. Within the 'Making perfect lives' theme, we will be conducting new research on three topics:

a) Individual perfection for birth, body, and long life

Innovations in medical technology make pregnancy feasible even when it seems biologically impossible. For example, somatic cell nuclear transfer could be used to breed children who have more than two biological parents. Researchers in China were the first to clone two macaques and to edit the DNA of human twins in such a way that their new traits will be passed to their offspring.

Artificially produced sperm and egg cells show how much life, body and technology are becoming intertwined. Our legal and moral frameworks were established long before these techniques were introduced. Do they need an update or are they still fit for purpose? The same question arises in a completely different area, specifically in regenerative medicine. This generic name covers a range of techniques that can improve the well-being of the chronically ill and compensate for the physical limitations of the elderly, but can also be used to keep our bodies looking good for longer. These techniques may offer a solution when there is a shortage of tissue donors (ranging from gametes to livers), commercial trade is questionable, the revenue models are unclear and diverging interests are at stake. Or can organs produced by 3D printers solve the dilemmas surrounding organ donation and transplantation? Our knowledge of the building blocks of life, health, ageing and human behaviour has increased enormously in recent years. We have medical research to thank for this, but the social sciences and humanities have also played an important role, for example studies on happiness and well-being and data-driven behavioural research. Much of this knowledge is in the hands of commercial enterprises. All these technologies challenge existing frameworks. In the years ahead, the Rathenau Instituut will continue to keep track of the relevant trends and developments.

b) Prevention and care in transition

Regional hospitals are failing, university hospitals are merging, medical care is increasingly being provided at home, and the elderly are living on their own for longer with the help of e-health technology and robot caregivers. The healthcare of the future is taking shape today. How can we comprehend these changes and what role do research findings and new technologies play? It is proving difficult to prevent disease by encouraging people to eat healthier, quit smoking and take more exercise, and the likelihood of their succeeding evidently depends on their income and socio-economic context. DNA profiles and apps can help by personalising our lifestyles, but digital technologies focusing on e-health and health behaviour raise questions about security, effectiveness and who is responsible.

Is lifestyle medicine causing us to medicalise normal behaviour? Does our health belong to us, to the healthcare professional, to the app or to the industry that is driving these advances? How is our perception of depression being changed by face scans on our phone, for example? How does the role of care professionals change when they rely on technology to reach a diagnosis and set out a course of treatment? How do we divide up the responsibilities? What leeway is left for such concepts as solidarity, care and autonomy? The Rathenau Instituut is assessing the consequences for society of these rapid changes in prevention and healthcare across various dimensions, such as public values, educational needs, and affordable and futureproof care.

c) Health, lifestyle and sustainable food

The Netherlands has a rock-solid position in agriculture and nutrition, both economically and in research. But how do we ensure that the health of people, animals and the environment takes precedence in this context? In the light of urbanisation, climate change, technological advances, the renewed interest in animal welfare and the globalisation of food chains, farmers and the public are becoming increasingly uncertain about 'the current system'. The issues are diverse: can genetic engineering solve the problems in agriculture, how much are individuals themselves responsible for choosing healthy and sustainable food and which technology can help them do so, and what does the transition to a sustainable food system mean for our agricultural policy?

By tracking the science, the Rathenau Instituut aims to help us transition to an agri-food system that is sustainable for the ecology, for farmers, for industry and for the public. We will kick off our work in this area in 2019 by partnering with the organisers of 'It's the Food my Friend', an annual series of debates on agriculture and food in Amsterdam. We will use the series to highlight our ongoing research, for example on ammonia emissions, CRISPR-Cas and the Potarei hybrid potato seed project. We are working with international partners to prepare a project on the global ethics of sustainable and healthy food.

3 Knowledge for democracy



A ballot box being emptied at a polling station in Nijmegen after the consultative referendum on the Dutch Intelligence and Security Services Act.
Photograph: Marcel Krijgsman / Hollandse Hoogte

From the 1980s onwards, the Rathenau Instituut has devoted much of its research to the role of science and evidence in political decision-making. We have also gained considerable experience engaging in public dialogue on controversial issues. We will continue to use our expertise in the years ahead to increase the public's involvement in decision-making. We will focus on decision-making in which not only scientific evidence but also interests and differing values play a role.

Knowledge is no longer the exclusive domain of experts. Digital access to knowledge and information and the endless ways in which we can disseminate our own ideas and opinions are shifting the political and public debate to different forums. These changes are forcing experts, knowledge institutions and public authorities to find new and responsible ways to generate knowledge for policy. Increasingly, that also means organising channels for stakeholder and public input, for example by asking better research questions, by making use of their expertise and knowledge, and by ensuring that they too have access to results.

The role of the Rathenau Instituut

Research conducted by the Rathenau Instituut and others in recent years has shown that the Dutch place a great deal of trust in science, and that they expect politicians and policymakers to base laws, rules and decisions on research findings. People would like to be involved in decision-making themselves, but they are also realistic about their role in relation to experts. However, as the controversies surrounding air quality, noise pollution standards, ammonia emissions and the use of geothermal energy have shown, when people do not trust the authorities and do not accept a decision, they also call the underlying science into question. How can we broaden our understanding of citizen engagement and ensure that scientists, public authorities and politicians have realistic expectations of it? Conversely, how can we ensure that the public trusts decision-makers to take its interests into account while they still can? Some disaffected citizens have rejected processes of this type. How do we get them to engage in the right way?

Dialogue

The Dutch have considerable trust in science, but as soon as researchers work for government or industry, public trust declines, controversy sometimes arises, and expert opinions are not enough to soothe public fears. At the same time, however, cooperation between researchers and government or industry is critical to tackling societal issues – and in fact, society demands it.

We want to explore the conditions under which public trust in science is maintained, including when researchers cooperate with other parties. The emphasis in our research is on evidence-informed policies. What demands does public trust place on policy-driven research by universities and public knowledge institutions, and on the use of such evidence by policymakers? And what can the public reasonably expect from evidence-informed policies addressing societal issues? With the help of citizen focus groups, we want to investigate the conditions that foster public trust in policy-driven research. We will link the results with earlier studies by the Rathenau Instituut on research integrity and on knowledge for policy. In this way, we aim to make a constructive contribution to the debate on the role of science in a knowledge-driven democracy.

Research

What happens if new research findings lead to mistrust or controversy? How can debate be productive in an age of agenda-setting online news media, filter bubbles, trolls and video manipulation? Can digitalisation help build trust within society? These questions are central to the 'Knowledge for democracy' theme. We are studying input by experts and the public in policymaking and political decision-making. We are also examining research organisations that have a public task, such as the Royal Netherlands Meteorological Institute (KNMI) and the Netherlands Institute for Public Health and the Environment (RIVM), whose mission is to use their expertise in support of society. Society's current challenges call for a strong and knowledge-driven democracy. We will conduct new research on three different topics within the 'Knowledge for democracy' theme:

a) Futureproof democracy

In what direction should democracy develop to gain sufficient trust and support from the public in the future, and how could digital technology support this? The political landscape is becoming polarised in many countries, with polarisation evidently being aggravated by the digitalisation of personal interactions and public media.

The way in which technology is deployed in economic production and societal processes around the world, including in the Netherlands, is giving rise to new disparities in 'knowledge, power and income', in status, and in opportunities. The way in which technology is used to disseminate news and information is further leading to diverging worldviews and opinions. The question for the Rathenau Instituut is what role technologies can play in futureproofing democracy. Factors to be considered include how technology can be used to get people more involved in democratic processes and to bolster their trust in such processes, and what institutional and organisational changes this entails. We are also looking at how to improve popular representation in parliament and in municipal councils.

b) Evidence for ministries

Ministries are knowledge-intensive organisations. They have access to data on which to base policymaking and implementation, and if they do not they contract researchers to generate the data for them. In addition, ministries play a role in government's relationship with knowledge institutions on behalf of specific sectors (such as agriculture or water) or a broader societal interest (such as healthcare or safety). The benefit to society of public knowledge institutions depends largely on the way in which ministries use their research results as a basis for their policy. An initial survey has shown that ministries do not all operate in the same way in this respect. This raises the question of how ministries can learn from one another. The aim of our project is to help government make better use of research data, particularly when it comes to the challenges facing society.

c) New technology, new questions, new risks, new politics

Biotechnology is a familiar topic of studies addressing the ethical and social impact of new science and technology. It has also given rise to specific regulatory regimes, for example regarding genetically modified organisms. The result is an innovation system in which risk is an overriding concern. In other technological domains, scientists have themselves imposed a collective moratorium on the development of certain applications, such as killer drones. This could, however, lead to lock-ins that prevent responsible innovation.

We see how innovators and governments involved in developing and supporting new technology attempt to escape old regimes and create more latitude by calling technology by a different name. Experience shows that reframing the topic in this manner does not eliminate critical questions about responsible innovation, ethical issues and risks. Political and public discussion remains necessary. The aim of this project is to support public debate and political decision-making on new forms of technology, and to explore options for appropriate regulation. Within this context, we are collaborating in a large European consortium that is addressing the concept of 'precaution', and with the Ministry of Infrastructure and Water Management within the framework of a new regulatory regime for new biotechnology.

4 Robust knowledge ecosystems



Construction of a photovoltaic power station at Roodehaan industrial estate in the Province of Groningen.
Photograph: Kees van de Veen / Hollandse Hoogte

The Rathenau Instituut has spent the past few years mapping out the Dutch knowledge and innovation landscape in all its breadth. We have shown that dozens of organisations and institutions are engaged in innovation and knowledge generation, from living labs to universities and from businesses to the Netherlands Forensic Institute. To support political and public discussion of the future of our knowledge society, it is important to have a solid grasp of how knowledge is generated.

Research and innovation are an indispensable part of our society. They make it possible to guarantee safety and security in a changing global society, to develop a circular economy, to understand societal trends, or to push back the boundaries of our knowledge. We have seen that the Dutch greatly value science.

The role of the Rathenau Instituut

We have noted greater variety in research in recent years, with the focus shifting to collaboration between disciplines, organisations and researchers. New areas of research, new technologies and the demands arising from the challenges facing society have led to greater diversity in research (knowledge cocreation, open science, citizen science) and new alliances (such as public-private partnerships and living labs). What is this asking of existing organisations? The Rathenau Instituut tracks these developments and asks what types of knowledge will be required by our knowledge society going forward, in the light of national and international challenges.

Dialogue

In early 2019, we will join fellow institutes in organising debates on the future of knowledge. The Rathenau Instituut operates in an international network and assembles Facts and Figures about investment in research, internationalisation, and the impact of science on society. These reports examine long-term trends in the Netherlands and compare them with those in other countries. What do we need going forward and who will bear the responsibility? Can taking a broader view of the importance of knowledge, expertise and education in a knowledge society give us a framework for a differentiated approach to science and innovation? And what data do we need to integrate this approach into policy?

Research

How can we get knowledge ecosystems to function properly? What new forms of research are evolving? How can we design research in such a way that it can tackle the scientific and societal issues of the future? What role do the authorities and others play in that regard?

These questions are central to our 'Robust knowledge ecosystems' programme. We are studying trends in the demand for knowledge and how international and Dutch knowledge institutes function and are financed. We are also investigating how to produce effective policy on basic and applied research. We will undertake new research on four different topics within the 'Robust knowledge ecosystems' theme:

a) New knowledge ecosystems

Some knowledge ecosystems have grown organically over time, such as those focusing on water and health. Others are newer and owe their emergence to the arrival of open innovation strategies in industry and regional policy. We have noted that all sorts of public and private parties are growing increasingly interested in regional knowledge ecosystems. This has resulted in 'Economic Boards' for specific regions as well as 'valleys' and 'campuses' focusing on specific areas of science and technology. At times, these initiatives also lead to the founding of new research institutes. The role of industry is evolving and new strategic partnerships are emerging between industry and universities. The practice-based research undertaken by the 'lectorates' at Dutch universities of applied sciences is also often linked to regional interests, with many new hybrid forms of practice-based research and higher education emerging.

The aim of this project is to gain a better understanding of dynamic regional knowledge ecosystems, and to determine how regional research and innovation policy can help address scientific and societal challenges and how organisations can boost these knowledge ecosystems. The concept of the knowledge ecosystem gives us a more effective way of assessing the impact of knowledge organisations on society and on basic knowledge generation.

b) Differentiation in higher education and research

The growing economic and societal significance of science makes the question of how to organise higher education and research an urgent one. Digital higher education, 'lectorates', open science, student mobility, industrial doctorates and university colleges represent new options and express new needs. They call for reflection on the current governance of higher education and research.

This project aims to propose options for futureproof governance and to support relevant political decision-making in the light of the public functions of higher education and research institutions. Topics currently on the agenda are the funding and interdependence of education and research. We are also examining the position of universities of applied sciences in that context. Sixty percent of all Dutch students enrolled in higher education are attending a university of applied sciences. Part of our research will be to explore how the system of research universities and universities of applied sciences has evolved in other countries.

c) Open science, open to society

A movement is under way across Europe advocating more openness in research and innovation. This trend, which has been embraced in the Netherlands, is meant to provoke a fundamental paradigm shift in the way basic research and applied R&D operate. The underlying principle is to involve stakeholders in all phases of the research process, from agenda-setting to use of results. Facilitating this requires researchers, public institutions and industry to share data, results and facilities.

The purpose of this project is to look at the trend towards 'open innovation, open science, open to the world' (the 3 O's) from the standpoint of public interest in scientific knowledge. More specifically, how do public organisations and NGOs benefit from access to knowledge? To what extent are they themselves able to conduct research? We will further be examining the limits to openness. How should we view the move towards open science given the current state of geopolitics, which tends to favour closed markets and may make it more difficult to share information, even as universities are internationalising and entering into public-private partnerships with global players?

d) Expertises and transitions

The robustness of knowledge ecosystems depends on whether there is enough expertise available to respond to challenges. Can we develop front-edge technologies and turn digital capabilities into reliable services in different sectors? Can we develop environmentally friendly production processes and design climateproof adaptations? People nowadays are expected to concentrate knowledge from different domains when addressing a growing number of issues, to combine analysis, design and governance, and to collaborate in flexible organisational contexts. What does that mean for the expertise that we require, and for how we educate professionals? Should institutions of higher professional and vocational education and training be involved as well?

The purpose of this project is to analyse the meaning of technology-driven transitions. In this context, we want to look at specific knowledge ecosystems, such as university hospitals and high-tech sectors, and at the expertise needed to address such challenges as the circular economy and energy transition.



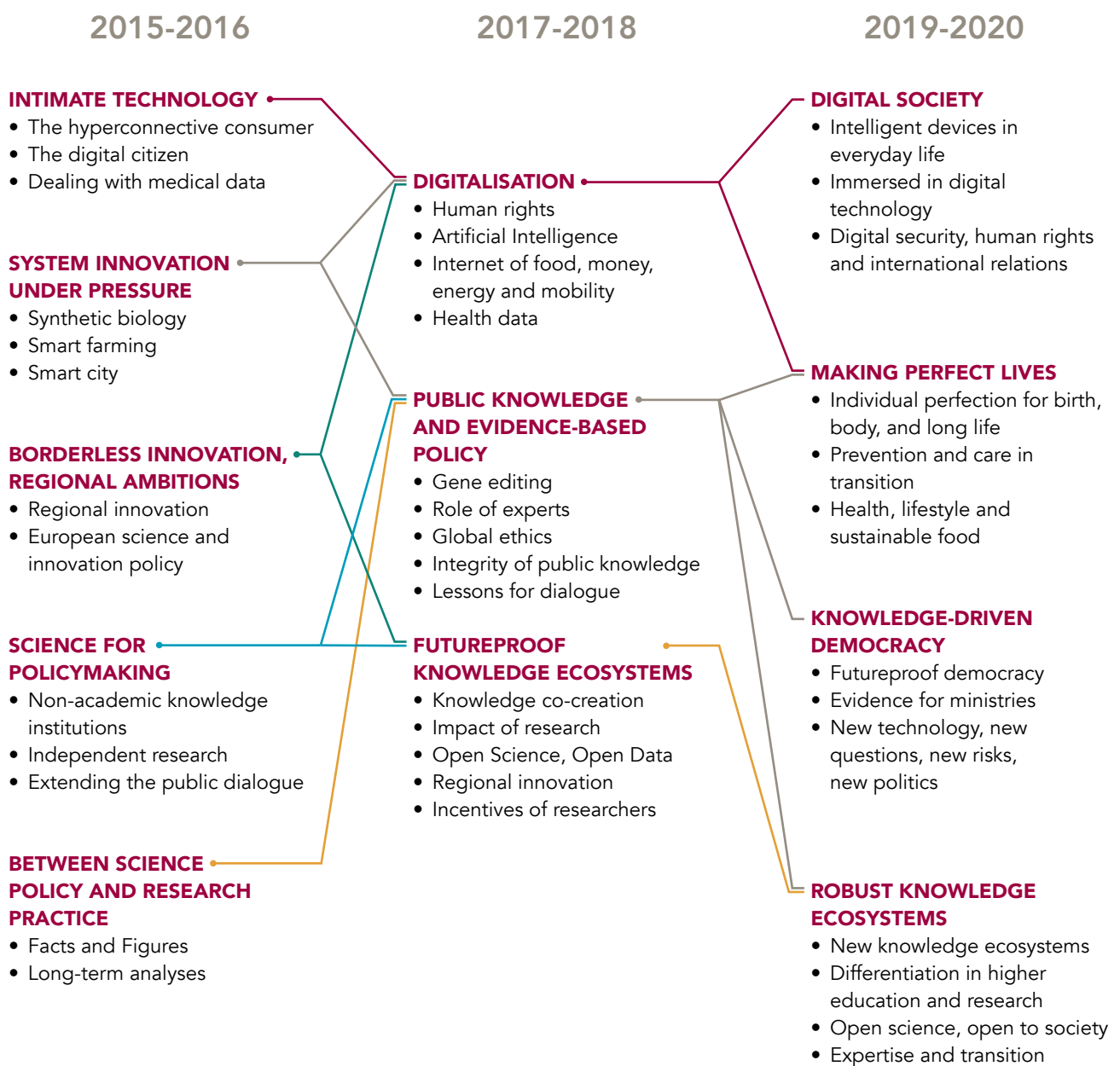
Part 3 Appendices

In this part, we show how the 2019-2020 work programme builds on previous work programmes. We also list the members of our Board and Programme Panel.

A demonstration of security cameras with facial recognition at the Consumer Electronics Show in Las Vegas.

Photograph: Gene Blevins / Polaris

Relationship to previous work programmes



Board

The following individuals are members of the Rathenau Instituut Board:

Gerdi Verbeet (chair)

Gerdi Verbeet chairs the National 4 and 5 May Committee and is a supervisory director of charity organisation Novamedia.

Gerdi Verbeet (born 1951) was president of the Dutch House of Representatives from 2006 to 2012. She now uses the experience she gained in national politics for the benefit of other organisations. Verbeet was a political adviser from 1996 to 2001 and a member of the House of Representatives from 2001 to 2006, where she focused on sport, elderly policy and the national old-age pension. She chaired the Standing Parliamentary Committee for Justice and the Thematic Committee on Elderly Policy. She was elected president of the House of Representatives in 2006, only the second woman to hold this post. After two terms in the House (2006-2012), she took on a range of new roles, some of them board positions, including the chair of the Board of the Rathenau Instituut. Verbeet also chairs the Supervisory Board of Novamedia and is a supervisory director at Siemens. On 1 June 2015, she was appointed chairperson of the National 4 and 5 May Committee, which organises the national ceremonies commemorating the war dead and celebrating Liberation Day.

Prof. W.E. Bijker

Wiebe Bijker is professor of Technology and Society at Maastricht University and the Norwegian University for Science and Technology in Trondheim.

Wiebe Bijker (born 1951) is professor of Technology and Society at Maastricht University and a part-time professor at the Norwegian University for Science and Technology in Trondheim. He is also a member of the Health Council of the Netherlands and chairs the board of NWO-WOTRO Science for Global Development. Bijker studied physics and philosophy. He was president of the Society for Social Studies of Science, as well as the director and chairman of the Board of the Netherlands Graduate Research School on Science, Technology and Modern Culture (WTMC). Bijker was also a member of the Board of the Society for the History of Technology and helped to establish the European Master's Degree programme in Society, Science and Technology (ESST) and the Research Master's Degree programme in Cultures of Arts, Science and Technology (CAST).

Prof. Madeleine de Cock Buning

Madeleine de Cock Buning is president of the Dutch Media Authority.

Madeleine de Cock Buning (born 1966) is a managing and supervisory director and legal expert. In 2009, she was appointed to Board of Commissioners of the Dutch Media Authority, which monitors compliance with the Dutch Media Act. She has been its president since 2013. She also holds appointments as professor of Copyright and Media Law at Utrecht University and as professor of Digital Politics, Economy & Societies at the European University Institute, School of Transnational Governance in Florence, Italy. In addition, she holds several other ancillary positions, including honorary judge of the Court of Appeal in The Hague, chair of the Advisory Committee on Copyright for the Ministry of Security and Justice, and – since 15 January 2018 – chair of the European Commission's High-Level Expert Group on Fake News and Disinformation.

Prof. Roshan Cools

Roshan Cools is professor of Cognitive Neuropsychiatry at Radboud University Medical Centre.

Roshan Cools (born 1975) was appointed professor of Cognitive Neuropsychiatry at Radboud University Medical Centre in 2011. Since 2007 she has been a principal investigator with the Donders Institute for Brain, Cognition and Behaviour at Radboud University. Cools studied experimental and neuropsychology in Groningen and completed a Master's in experimental psychology at the University of Cambridge, where she obtained her PhD in 2003. Before returning to the Netherlands, she worked as a postdoctoral researcher at the University of California, Berkeley. In 2015, she was awarded a VICI grant by the Netherlands Organisation for Scientific Research (NWO). Cools has been a member of the Advisory Council for Science, Technology and Innovation (AWTI) since 2014.

Dr Hans Dröge

Hans Dröge is a supervisory director for the Brabant Development Agency.

Hans Dröge (born 1956) worked for Unilever Netherlands until the end of 2013. He currently advises organisations and start-ups and other firms on technology, innovation and sustainability. Dröge is also a member of the supervisory board for the Brabant Development Agency. He studied pharmacology. After graduating, Dröge began his career at the Unilever Research Laboratory, held various supply chain positions, and returned to R&D in 2009. He was responsible for Unilever's global R&D infrastructure and the operationalisation of its current R&D strategy. He was also in charge of Unilever's external relations with the political, government and business communities in the Netherlands.

Edwin van Huis

Edwin van Huis is the director of Naturalis Biodiversity Center, Leiden.

Edwin van Huis (born 1958) has been general director of Naturalis Biodiversity Center in Leiden since 2011. Before that, he was director of the bureau XPEX, which he co-founded and which develops experience concepts for profit and non-profit organisations. Between 1996 and 2008, Van Huis was director-general of the Netherlands Institute for Sound and Vision and managing director of the Rijksmuseum Amsterdam. Van Huis is a biologist and business analyst.

Prof. Erwin Muller

Erwin Muller has been dean of the Faculty of Governance and Global Affairs (FGGA) at Leiden University and professor of Safety, Security and Law at the same faculty.

Erwin Muller (born 1965) is editor-in-chief of the Kluwer Series *Handboeken Veiligheid* and of *Tekst en Commentaar Openbare Orde en Veiligheid*. He is also chair of the Supervisory Board of Lucas Education, vice-chairman of the Supervisory Board of Avans University of Applied Sciences, and a member of the Supervisory Board of GGZ Noord-Holland-Noord. Before that, Muller was vice-chairman of the Dutch Safety Board and director of research for the Institute for Criminal Law and Criminology at Leiden University. He was also the director of the COT Institute for Security and Crisis Management, a member of the Dutch Council for Public Administration, the vice-dean of the Faculty of Law at Leiden University, the director of the Netherlands Police Academy, and the director of the Netherlands School of Public Administration.

Prof. Peter-Paul Verbeek

Peter-Paul Verbeek is professor of Philosophy of Technology, University of Twente.

Peter-Paul Verbeek (born 1970) is professor of Philosophy of Technology and co-director of the DesignLab at the University of Twente, where he is also vice-dean of the Faculty of Behavioural, Management and Social Sciences. He is a member of the Royal Netherlands Academy of Arts and Sciences, of the Dutch Council for the Humanities and the Centre for Ethics and Health. Between 2011 and 2013 he was president of the Young Academy (part of the Royal Netherlands Academy of Arts and Sciences), and between 2013 and 2015 he was president of the Society for Philosophy and Technology. His research focuses on the relationship between man, technology and society. He has written a number of popular books, including *What Things Do*, *Moralizing Technology* and *De grens van de mens*.

Prof. Marijk van der Wende

Marijk van der Wende is distinguished professor of Higher Education at Utrecht University's Faculty of Law, Economics and Governance.

Marijk van der Wende (born 1960) is a guest researcher at Harvard University in the United States, and is working on a project focusing on 'higher education in China in the age of Globalisation'. She was dean of Amsterdam University College (University of Amsterdam and VU Amsterdam) from 2009 to 2015, and dean of Graduate Studies at Utrecht University from 2015 to 2017. Since 1 November 2017, she is Distinguished Professor of Higher Education at Utrecht University's Faculty of Law, Economics and Governance. Her research focuses on the impact of globalization and internationalization on higher education systems, institutions, curricula, and teaching and learning arrangements. She has accumulated vast experience in the field of educational innovation.

Dr Melanie Peters (official secretary)

Melanie Peters is the director of the Rathenau Instituut, The Hague.

Melanie Peters (born 1965) has been the director of the Rathenau Instituut since 1 February 2015. Peters has a broad background in science, business and the public sector, combined with extensive experience in the Dutch and international political and social arena. She trained as a food engineer (Wageningen University) and toxicologist and obtained her PhD in biochemistry (Imperial College, London). Peters worked as an academic researcher at the University of Texas in Austin and headed a research group at the Shell Research and Technology Centre in Amsterdam. She has held various positions at the interface of science, policy, politics and society at the Ministry of Agriculture, the Dutch Consumers' Association and as director of the Studium Generale programme at University Utrecht.

Programme Panel

The members of the Rathenau Instituut's Programme Panel represent different segments of society. The panel meets several times a year, discusses new trends and developments, and advises the Rathenau Instituut on its work programme. Gerdi Verbeet, chair of the Rathenau Instituut Board, also chairs the Programme Panel. Director Melanie Peters is the panel's official secretary. The members are listed below in alphabetical order.

Annet Aris

Annet Aris teaches digital strategy at INSEAD Business School in France.

Marien Baerveldt

Marien Baerveldt builds innovative learning communities at Utrecht University and is a team and process supervisor at Hosted Beings.

Rob Bijl

Rob Bijl is deputy director of the Netherlands Institute for Social Research (SCP).

Marc Chavannes

Marc Chavannes is a journalist and emeritus professor of journalism (University of Groningen).

Felix Cohen

Felix Cohen is the former director of the Dutch Traffic Safety Association.

Wim Deetman

Wim Deetman is chairperson of the supervisory board of ProDemos.

Linda Duits

Linda Duits is a researcher and publicist and teaches Media Studies, Social Sciences and Gender Studies.

Bas Eickhout

Bas Eickhout is a member of the European Parliament.

Bert Fokkema

Bert Fokkema is part of an international team at Shell that develops policy and internal standards for corporate social responsibility.

Yuri van Geest

Yuri van Geest is the founder of ExOxo (corporate transformation) and co-author of the bestseller Exponential Organisations.

Peter Giesen

Peter Giesen is a reporter for national newspaper de Volkskrant.

Rob J. Hamer

Rob Hamer is the director of the Unilever Vlaardingen R&D laboratory and endowed professor of Food Chemistry at Wageningen University & Research.

Rob van Hattum

Rob van Hattum is the executive science editor for broadcasting association VPRO and the Chief Science Officer at NEMO science museum.

Janneke Hoekstra

Janneke Hoekstra is the head of the Faculty of Engineering at HAN University of Applied Sciences.

Yori Kamphuis

Yori Kamphuis is the co-founder of Coblue and Storro.

Annette Klinkert

Annette Klinkert founded the firm city2science.

Laurien Koster

Laurien Koster is the independent chairperson of the Kinderrechtencollectief and a supervisory director at Oxfam Novib.

Chris Kuijpers

Chris Kuijpers is the director-general for Governance and Housing at the Ministry of the Interior and Kingdom Relations.

Willem Lageweg

Willem Lageweg holds a number of board and supervisory positions, for example with Triodos Bank, Close the Gap, and the Institute Positive Health.

Joana Gomes Neto

Joana Gomes Neto is a student member and a Master's degree student in Molecular Biology & Biotechnology at the University of Groningen.

Dirk Pilat

Dirk Pilat is deputy director of the Science, Technology and Innovation Directorate of the Organisation for Economic Co-operation and Development (OECD) in Paris.

Jeanine van de Wiel

Jeanine van de Wiel is Global Regulatory Affairs Manager at DSM for food ingredients and health.

Lynn Zebeda

Lynn Zebeda is the co-founder of the Dr. Monk innovation studio.

The **Rathenau Instituut** supports the formation of public and political opinion on socially relevant aspects of science and technology. It conducts research on this subject and organises debates on science, innovation and new technology.

www.rathenau.nl

Rathenau Instituut