



National Institute for Public Health  
and the Environment  
*Ministry of Health, Welfare and Sport*

## **Evaluation of RIVM Strategic Research 2007-2010**

*Results and lessons learned*

RIVM Report 000201201/2012

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## Colofon

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This investigation has been performed by order and for the account of the Director General RIVM, within the framework of RIVM Strategic Research

## Abstract

### **Evaluation of the Netherlands National Institute for Public Health and the Environment (RIVM) Strategic Research 2007–2010**

Results and lessons learned

This report evaluates four years of the Netherlands National Institute for Public Health and the Environment (RIVM) Strategic Research (SOR). The purpose of the SOR budget is to furnish the RIVM with the expertise and quality that it requires, thus enabling it to undertake its duties for commissioners effectively both now and in the future. The evaluation describes the results of the 2007–2010 Strategic Research Programme. During this period, approximately €50 million was spent on SOR for a total of more than 80 projects grouped under six research themes.

#### **SOR results**

The report describes which intrinsic goals have been achieved for each theme, such as gathering new knowledge about genomics and quality of care, and developing new models for the assessment of health risks. In addition, an indication of the scientific and social impact of these themes is presented. Scientific impact is determined according to publications in scientific journals, while social impact is judged according to use of the results in practice.

The projects that have been executed have yielded a great many tangible products, including more than 350 scientific publications and a large number of reports, databases and presentations at international meetings. The research has resulted in more than 100 follow-up assignments from commissioning bodies.

Some of the projects continue in 2011 or thereafter because of later initiation, for example; the remaining results of these projects have not been included in this evaluation.

#### **Lessons learned**

The way in which the programme proceeded has also been evaluated, including in particular any stumbling blocks during its implementation. Among other effects, these obstacles resulted in a number of projects taking longer than had been planned. In response to this, a number of points for improvement have been adopted, such as those relating to project management.

Key words:

strategic research, innovation, scientific impact, societal impact, future



## Rapport in het kort

### **Evaluatie van het Strategisch Onderzoek RIVM 2007-2010**

Resultaten en lessen voor de toekomst

Dit rapport brengt verslag uit van vier jaar Strategisch Onderzoek RIVM (SOR). Het SOR-budget is bedoeld om het RIVM te voorzien van de benodigde expertise en kwaliteit, zodat het nu en in de toekomst de taken voor de opdrachtgevers adequaat kan uitvoeren. De evaluatie beschrijft de resultaten van het programma 2007-2010. In deze periode is ongeveer 50 miljoen euro aan SOR besteed aan in totaal ruim 80 projecten, gegroepeerd onder 6 speerpunten.

#### **Resultaten SOR**

De evaluatie beschrijft welke van de inhoudelijke doelen per speerpunt zijn gehaald, zoals nieuwe kennis vergaren over genomics en kwaliteit van zorg, en nieuwe modellen ontwikkelen om gezondheidsrisico's te beoordelen. Daarnaast geeft het rapport een indicatie van de wetenschappelijke en maatschappelijke impact van deze speerpunten. De wetenschappelijke impact wordt bepaald op basis van de publicaties in wetenschappelijke tijdschriften en de maatschappelijke impact op basis van het gebruik van de resultaten in de praktijk.

De projecten die zijn uitgevoerd, hebben een groot aantal tastbare producten opgeleverd, waaronder meer dan 350 wetenschappelijke publicaties en een groot aantal rapporten, databases en lezingen op internationale congressen. De resultaten van het onderzoek hebben geleid tot meer dan 100 vervolgoopdrachten van externe opdrachtgevers.

Een deel van de projecten loopt nog door in 2011 of daarna, bijvoorbeeld omdat ze later zijn gestart; de resterende resultaten van deze projecten zijn niet in deze evaluatie meegenomen.

#### **Lessen voor de toekomst**

Ook is verloop van het programma geëvalueerd, in het bijzonder knelpunten bij de uitvoering. Deze knelpunten hebben er onder andere toe geleid dat een aantal projecten langer hebben geduurd dan gepland. Naar aanleiding hiervan zijn verbeterpunten benoemd, bijvoorbeeld voor het projectmanagement.

Trefwoorden:

strategisch onderzoek, innovatie, wetenschappelijke kwaliteit, maatschappelijke betekenis, toekomst



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## Summary

The National Institute for Public Health and the Environment (RIVM) in the Netherlands has a dedicated budget for the initiation and performance of strategic research. Through its Strategic Research Programme, the institute is able to anticipate upcoming research issues, to ensure the quality of its scientific work and to participate fully in long term international research networks. The Strategic Research Programme is organised into four-year programme and budget cycles. The 2007–2010 programme comprises six strategic research themes, which together cover 85 individual research projects. Most of the projects of the 2007–2010 cycle were completed by December 2010, or will be completed in 2011 or 2012, so most of the research-based results and other outputs are currently available .

RIVM is responsible for the results of four years' strategic research, as included in this report, which presents and assesses the outcomes and provides recommendations for future programmes, based on lessons learned.

### **Strategic research in numbers**

Between 2007 and 2010, approximately €50 million was spent: 353 peer-reviewed papers were published or accepted; further output consisted of 12 theses, 127 (letter) reports, 445 presentations at international congresses, 94 tools, 56 databases, 25 websites and many other tangible or non-tangible products. Altogether these are considered satisfactory results from four years of hard work.

The scientific output and the (new or existing) scientific networks contributed significantly to RIVM's scientific standing. The scientific quality of the publications was generally sufficient, indicated by the fact that the benchmarks for output (standards) were met in most instances. Through Strategic Research (SOR), RIVM is able to maintain and strengthen its international scientific position. The strategic research budget is used for cofinancing projects commissioned by international organisations, the European Framework Programmes, for example.

### **Societal impact**

Eventually many of the results will be translated into societal effects. The success of numerous projects is already visible via more than 100 follow-up assignments, proving the usefulness of SOR's work. And, of course, because it takes time to implement fully the results of long-term research (formulating guidelines and new policies), more assignments will follow.

Overall, from 2007 to 2010 substantial progress was made in many areas, satisfying results achieved, new threats explored, and initial steps taken into novel subjects of growing importance like risk perception and more integrated and highly inclusive assessment approaches. A number of projects were just in time to address current issues, for instance during the outbreaks of Q fever and new-variant swine flu, and societal concern about pollution from the Corus steel plant.

### **Some critical observations**

Certain criticisms have been made. Despite the success of many projects, not all the initially formulated objectives of the research themes have been reached and not all the themes have been equally successful. Several success factors have been identified. Availability of qualified personnel is crucial and some project leaders encountered difficulties in this regard. Suitable data are also indispensable but sometimes problematic to obtain. These issues caused delay in some of the projects.

#### **Outlook on 2011-2014**

A new cycle, 2011–2014, has started. Although the 2011–2014 research themes were chosen long before the results presented here were available, they seem appropriate in relation to the conclusions of this evaluation. Within the new themes more attention is being paid to risk perception and risk communication, and, in the new strategic themes, social sciences in general, meeting the changing requirements of today's society. The demand for novel and really integrated approaches is still growing, because of the increasing complexity of commissioning bodies' questions: a new theme was dedicated to this need. The new research themes anticipate new developments, which were not as visible in 2007 as they are now: the accelerating development of technology, the increasing importance of ageing and constantly changing threats, like those from infectious diseases.

With the results of 2007–2010 and the promising new themes, RIVM looks forward confidently to the future.

# 1 Introduction

## 1.1 Introduction

The National Institute for Public Health and the Environment (RIVM) in the Netherlands has a dedicated budget for the initiation and performance of strategic research. Through its Strategic Research Programme (Strategisch Onderzoek RIVM, SOR), the institute is able to anticipate upcoming research issues, to ensure the quality of its scientific work and to participate fully in long term international research networks.

The Strategic Research Programme is organised into four-year programme and budget cycles. The 2007–2010 programme comprises six strategic research themes, which together cover 85 individual research projects. The evaluation is based on the results achieved in December 2010. Most of the projects of the 2007–2010 cycle were completed by December 2010, so most of the research-based results and other outputs were available at that time. In judging the results, however, it should be taken into account that a considerable number of outputs were still to come.

## 1.2 Significance of strategic research

RIVM is the Netherlands' largest government scientific institute in the areas of public health, environment, safety and nutrition. Its primary task is to support the Dutch government in making science-based policy by providing sound and independent counsel. RIVM's advice typically reflects a large body of scientific evidence and often builds on full risk assessments.

In addition, RIVM undertakes various executive responsibilities in the fields of national health and the environment. RIVM's other (international) commissioners include public bodies such as the World Health Organisation (WHO), the European Commission (EC) and various European Union (EU) agencies.

Thanks to its strategic research, the institute is able to anticipate situations that may arise in the future, such as outbreaks of infectious disease, increases in chronic illnesses or changing health risks due to ageing populations or global warming. By laying strong scientific foundations, RIVM will be able to answer questions high on the agendas of policymakers five to ten years from now. The dedicated annual budget for strategic research averages approximately €13 million.

Long-term funding, provided by the Strategic Research Programme, is also crucial to safeguard the institute's lasting scientific quality. Building international scientific partnerships, participation in international collaborations and publishing research articles in high-ranking, peer-reviewed journals all require more staff, investment and financial certainty than short-term, demand-driven projects can provide on their own. RIVM, as a whole, needs a strong reputation in order to attract high-quality scientists, who in turn are essential for gaining scientific authority, required for supplying independent science-based policy advice.

Public health and the quality of the environment are central to RIVM's public tasks. Private companies or universities may choose to bypass some lines of research, although society could benefit from their results. The Strategic

Research Programme enables RIVM to pursue public projects, even if success cannot be guaranteed in advance.

### **1.3 Purpose of this report**

RIVM reports annually on the progress achieved within its Strategic Research Programme. The completion of this four-year cycle is the right time to evaluate the outcomes. RIVM is accountable for the results of four years' strategic research, as presented in this report. This report presents and assesses the results and provides recommendations for future programmes.

The evaluation covers:

- description of the results' significance;
- research output (e.g. papers, presentations, other products);
- scientific impact;
- societal impact;
- finances;
- lessons learned from project and programme management;
- outlook for recently started programme, 2011–2014.

The evaluation is primarily intended for the parent of RIVM (Ministry of Public Health, Welfare and Sport) and the RIVM's Scientific Advisory Board (CvT). In addition, the results are of interest to commissioning bodies (mostly Dutch ministries) and scientific institutes. The results of individual projects are summarised in a separate report (Results and significance of RIVM Strategic Research, 000201102/2011)

### **1.4 Sources**

The sources for this evaluation are the annual reports, compiled by project leaders from 2007 to 2010. By the end of 2010 approximately 40% of the projects had not yet been completely finished, partly because a number of projects started after 2007. Therefore, the results presented refer only to part of the outcome. This is still considered to be the right moment to evaluate, because most of the work has been carried out and the new 2011–2014 programme has already started. In the 2011 annual report, the subsequent scientific outcome of the 2007–2010 cycle will be reported.

### **1.5 Reading guide**

Chapter 2 summarises the scope of the six research themes.

Chapter 3 describes the results and their significance, by research theme. In an appendix, the significance of the project results are noted.

Chapter 4 lists the research output, presenting and analysing its quantitative measures.

Chapter 5 comprises lessons learned and managerial aspects.

Chapter 6 lists the general conclusions and provides an outlook for the 2011–2014 cycle.

## 2 2007–2010 research themes, programmes and projects

### 2.1 Choice of research themes and selection of projects

RIVM's strategic research is developed along six carefully chosen research themes. They serve as the Strategic Research Programme's overall framework. Research themes must align with RIVM's strategic areas and should anticipate future developments. The themes were chosen in close consultation with RIVM's Scientific Advisory Board. Their aims are described in the next six sections.

After the formulation of the six SOR themes, a bottom-up selection process was started: a call for preproposals was issued. Selected preproposals were developed into full proposals. After review, a selection of the proposals was accepted, often after modification or budget reduction. This process allowed for the creative input of all RIVM researchers, but did not guarantee full coverage of all designated aims mentioned in the theme descriptions.

Most themes have grouped various projects into distinct research programmes. All research themes and programmes are summarised in the following sections. Appendix 1 provides a full list of the programmes and projects of each theme.

Much of RIVM's research is multidisciplinary so overlaps between themes and programmes do occur. Theme coordinators meet frequently to ensure that all research keeps the right focus.

### 2.2 Risk assessment, perception, consumer behaviour and understanding (RPC)

#### *Theme purpose*

Studies of risk assessment, risk perception and consumer behaviour are highly relevant to many issues in society today. Research within this theme affects one of RIVM's core competences and is therefore important to most if not all of the institute's divisions. The theme offers many opportunities for interdivisional cooperation.

#### *Programmes*

Research projects within this theme are grouped into two research programmes:

- animal experimentation, focussing on properly estimating risks and on reduction of our dependence on laboratory animals;
- risk information and its quality.

### 2.3 Emergency response functions and safety (ERF)

#### *Theme purpose*

In today's world, governments need to prepare for emergencies. Whether these involve chemical, biological or radiation exposures, or other types of crises, all such emergencies require sensible preparation for an adequate response. In recent years, bioterrorism and infectious disease outbreaks have attracted attention. Other needs include modelling of environmental risks from chemicals or radiation, and research into toxicological effects in humans. At least two RIVM divisions must be fully up to date on safety and emergency response functions.

#### *Programmes*

Research projects within this theme are grouped into three programmes:

- risk assessment methods in emergencies;
- clinical toxicology;
- measurement and modelling.

## **2.4 Infectious diseases (INF)**

#### *Theme purpose*

This theme includes research into questions ranging from genetic characteristics of infectious agents to effective epidemiological interventions. Food safety issues are relevant as well. Research within this theme will help reinforce RIVM's expertise in areas such as immunology, vaccination and genetics. Given RIVM's task to coordinate the prevention and control of infectious diseases, effect studies and modelling are also highly important.

#### *Programmes*

Research projects within this theme are grouped into three programmes:

- genomics;
- immunology;
- modelling.

## **2.5 Chronic diseases, intervention and lifestyle (CIL)**

#### *Theme purpose*

Chronic diseases and lifestyle changes constitute increasingly important issues and require policymaking at local, national and international levels. Some knowledge about preventive interventions could be implemented more fully, and new types of prevention should be developed. High-risk groups need to be identified early on and receive special attention. Links between lifestyle and health are being debated more frequently, and people are encouraged to adjust their behaviour. Food quality, obesity, diabetes, cancer, medical screening and quality of life are just a few of the topics emerging together more and more, and the trend will most likely continue. Growing expertise on these interfaces will be needed at RIVM.

#### *Programmes*

Research projects within this theme are grouped into four programmes:

- modelling chronic diseases;
- healthy ageing;
- quality of care;
- economic evaluations.

## **2.6 Medicines and functional foods (MFF)**

#### *Theme purpose*

Medicines and novel foods are increasingly intertwined, and RIVM needs to acquire more expertise in this area. Straightforward risk assessments are moving towards risk-versus-benefit and chain approaches. It is also becoming more important to understand system functions in care. In addition, consumer behaviour and understanding need to receive proper attention.

#### *Programmes*

Projects within this theme are all closely related so no separate programmes are identified.

## **2.7 Environmental quality and health (EQH)**

### *Theme purpose*

Monitoring remains vital in many environmental areas, such as particulate matter. Risk assessments for encouraging healthy environmental conditions or evaluating economic activity are becoming increasingly important. More research is required to identify behavioural scenarios and risk perceptions. Complicated risk assessments and environmental health impact assessments need to be developed. The EQH theme reflects the diversity of RIVM's Environment and Safety Division, but other divisions are also involved in assessing environmental health effects.

### *Programmes*

Research projects within this theme are grouped into three programmes:

- risk assessment;
- Environmental Health Impact Assessment (EHIA) and measurement;
- modelling.





## 3 Evaluation of results and their significance

### 3.1 Evaluation of the themes and programmes

In this chapter the results of each theme are evaluated. They are compared to the original aims, as described in chapter 2. The evaluation has been made in close cooperation with the theme coordinators, all of whom have accompanied the research themes and tracked the progress of projects during 2007–2010.

Subsequently, in each section the results and outcome of the theme are summarised, after which the evaluation is presented.

In a separate report (Results and significance of RIVM Strategic Research, 000201102/2011) the results of the individual projects are summarised.

### 3.2 Risk assessment, perception, consumer behaviour and understanding (RPC)

#### *Results*

The 'Risk assessment, consumer behaviour, perception and understanding' projects have led to valuable research output in the fields of estimating risks, reduction of the use of laboratory animals, and information for consumers. The RPC theme comprises ten projects covering a wide range of research areas, including modern tools for risk assessment, like toxicogenomics and proteomics, PBPK modelling, effects of nanoparticles, development of alternative (less animal-demanding) toxicity tests, consumer behaviour and development of performance indicators for quality improvement of intensive care facilities. Six projects are still continuing in 2011 or beyond. All project titles are listed in Appendix 1.

#### *Experimental (animal) studies in risk assessment*

Risk assessment is a major RIVM activity. Adequate and more innovative tools are urgently needed. Progress has been made on the development of new risk assessment techniques, like proteomics. This is a relatively new and promising technique, and has been shown to be useful for cancer and prenatal Down's syndrome screening. An important step forward has been made putting the proteomics technique into practice. This is also the case with the toxicogenomics technique: a proof-of-principle has been achieved. Healthy food is essential for a healthy life without chronic disease. To improve dietary risk assessment, new methods have been developed allowing better estimation of dietary exposure than previously available. This is important because the current diet in the Netherlands differs considerably from what is desirable, and it is expected to become even worse in the near future.

For several reasons animal testing in risk assessment needs to be replaced with alternative tests. Three different models have been developed, which may contribute to reduced use of laboratory animals. In addition, in-depth studies have been performed to establish the presumptive toxic effects of exposures to nanoparticles, which are being used increasingly in a wide range of consumer products. Cytotoxic effects were indeed found, especially with silver nanoparticles.

*Information to consumers*

Socio-technological and epidemiological trends have been urging deeper and broader thinking about the implications of web-based and mobile technologies for (public) health and health care. Online information searching behaviour has been studied and e-tools and e-services for patients have been developed.

To support health care professionals and institutions in performing better, performance quality indicators and performance schemes must be developed and implemented. Fifteen barriers to using performance data for systematic quality improvement were identified. This identification is the starting point for the development of a quality improvement programme.

*Evaluation*

The number of projects within this theme were relatively small. The emphasis of the theme was on risk assessment, more specifically alternatives to animal testing. Although progress has been made on this issue, more efforts are needed to implement these tests in regular guidelines. Nevertheless, the aims of the theme concerning risk assessment were meant to be wider: not only alternatives to animal testing, but also the development of new techniques and approaches. These wider aims have not been fully met, although interesting progress has been made on the proteomics technique. The results of the work on risk perception and consumer behaviour are modest, simply due to a lack of projects on this topic. As mentioned before, this dearth of projects was the effect of the bottom-up selection process. At the time that the theme was formulated, this topic was novel for RIVM but nowadays it appears to be more important.

### **3.3 Emergency response functions and safety (ERF)**

The 'Emergency response functions and safety' theme was a new topic for RIVM and many projects had to start new research lines. Progress has been made, among others, in areas of early-response measurement techniques, integration of real-time measurements with dispersion models for nuclear incidents and protocols and tools for aftercare of disaster victims. The ERF theme comprises eight projects, focussed on risk assessment in all phases of the safety chain. Three projects are continuing in 2011 or beyond. All project titles are noted in Appendix 1.

*Risk assessment in emergencies*

During large-scale emergencies quantitative risk assessments are a decisive factor in the determination of an effective countermeasure strategy in the early response and aftermath. An improved response in nuclear accidents is now possible, based on the integration of real-time measurement from monitoring sites, with the existing dispersion model combined with techniques using spatial mapping of radioactivity.

Two methods for testing and sampling of volatile organic substances in early response were developed; these had already been used in recent years, during major incidents that occurred in the Netherlands. Moreover, using knowledge acquired in EQH, a protocol for response in developing countries was developed for the United Nations Environment Programme (UNEP).

*Measuring and modelling*

In an emergency, rapid response is crucial, whatever is happening: bioterrorism attacks, chemical assaults or nuclear accidents. All require adequate assessment methods. Often the agent or the extent of exposure to the substance is unknown. To help in acute situations new screening approaches were adopted, combining different analytical techniques. A new micro array technique was developed to screen effectively for bio threat bacterial pathogens. This technique also proved valuable in a more regular (non-bioterrorism) context and has already been employed in the assessment of Q fever epidemics in the Netherlands. In addition, a coherent package of rapid assessment methods for disaster situations, including a checklist and a decisionmaking procedure, was put together.

At the other end of the safety chain, realistic models for estimating risks are important in prevention, without unnecessary obstruction of spatial developments, as is sometimes the case with current guidelines. New criteria for the evaluation of technical measures in a quantitative risk assessment have been developed.

*Clinical toxicology*

Progress has been made in human clinical toxicology. For instance, interesting results have been obtained about the cellular effects of amphetamine and cocaine; these were contradictory to what had previously been assumed. The outcomes from this project help to provide more insight into individual susceptibility in the case of exposure to xenobiotics and the mechanism involved. This knowledge is being used to improve the information supply of the National Poisons Information Centre.

*Evaluation*

This theme produced some new techniques that have already proven their value in practice over past years within ERF and beyond. The number of projects was small and therefore the whole spectrum of emergency response functions has not been covered. As mentioned before, the lack of projects in this theme was caused by the bottom-up selection process. Progress has been made in the fields of radiation, biological threats, specific xenobiotics and volatile substances, but hardly at all on other chemical threats, for example. Most results refer to early- response functions, but also to the prevention side of the safety chain.

**3.4 Infectious diseases (INF)**

The 'Infectious diseases' projects have led to progress in mathematical modelling, genomics and immunology. Nineteen projects have been carried out. Twelve are still continuing in 2011 and beyond. All project titles are noted in Appendix 1.

*Modelling*

Progress in mathematical modelling is extremely relevant to the control of infectious diseases. Modelling can be used to estimate the risk of infectious diseases in certain populations, in relation to different intervention strategies. The construction of mathematical models is in full development. The results of the projects are promising: actually, the outcomes have already proven their value for policy development, as was demonstrated during the influenza pandemic in 2009. Preliminary results were used directly to take decisions about control measures. The results of another project contributed to the use of molecular data in mathematical modelling to increase our understanding of the

transmission and dynamics of infectious diseases, e.g. hepatitis B. The significance of the participation rate in screening programmes for chlamydia has been established, which affects the effectiveness of the screening. In addition, the transfer of patients between hospitals appears to be capable of explaining many hospital MRSA infections, work that may contribute to the prevention and control of MRSA.

#### *Immunology*

The response of individuals to infectious agents determines to a certain extent the morbidity and mortality of these diseases. Immunity is being raised by exposure to infectious agents or vaccines. These immunological reactions are complicated and differ from individual to individual. The results of the SOR projects have contributed to knowledge and understanding of immunological reactions. This is important for designing immunisation programmes and for diagnosis and treatment of infectious diseases. For instance, more information on the role of hereditary factors in the immune response of children with 'wheezing' has been obtained, understanding of 'memory immunity' has increased and a contribution has been made to the development of serological diagnostic tests for zoonotic helminth infections (worms). The latter is relevant because of the assumption that helminths modulate the host immune response and affect allergies. In general, with the results of the SOR projects, the toolbox needed to assess state-of-the-art parameters of vaccine-induced and infection-induced immunity has been modernised.

#### *Genomics*

Genetic markers of pathogens may help to clarify trends in infectious diseases. When this theme started in 2007 sequencing of the whole genome of (micro) organisms was quite innovative. The results of the SOR projects have contributed to RIVM using sequencing in disease control. Much information has been acquired on (changes in) different pathogens. This helps, for example, to fight tuberculosis and whooping cough, which still constitute a worldwide threat. New information on methods to reduce the infectivity of norovirus and MRSA have appeared to be also applicable to other kinds of viruses.

#### *Evaluation*

RIVM plays an important and coordinating role in fighting infectious diseases in the Netherlands. The focus of the theme was on modelling, immunology and genomics and this has generated many results applicable to all these topics. Since the start of the theme, a number of infectious disease outbreaks have occurred. Striking examples were Q fever and the influenza pandemic. Some of the tools developed have already proven their utility because they were been put into practice during these outbreaks. Generally speaking, the aims of the theme have been met, although not all the projects have yet been completed

### **3.5 Chronic diseases, intervention and lifestyle (CIL)**

The 'Chronic diseases, intervention and lifestyle' projects have led to progress in the fields of modelling, healthy ageing, quality of care and economic evaluations. Seventeen projects have been carried out. Seven are still continuing in 2011 and beyond. The results of most projects are mentioned, even if they are not yet finished. All project titles are noted in Appendix 1.

### *Modelling chronic diseases*

Modelling tools are of the utmost importance in answering the questions of RIVM's commissioners. An appropriate set of tools and methods is necessary to provide adequate answers to complicated questions. This set of instruments needs to be maintained and upgraded on a regular basis, not only to meet the changing needs of commissioners, but also to reflect and absorb developments in knowledge about health and its determinants. The RIVM Chronic Disease Model (CDM) plays an indispensable role in much of RIVM's work. Two projects contributed to RIVM chronic diseases modelling skills. The CDM has been adapted for the evaluation of socio-economic status aspects. In addition, the model has been the starting point for the development of a user-friendly software tool for health impact assessment, within the framework of a European project. This greatly enlarges the potential use of the model and has simultaneously exposed and promoted RIVM's modelling skills in an international setting.

The potential of public health modelling has been demonstrated by the cardiovascular diseases and diabetes project. Information has been gathered on lifestyle factors and risk factors, which is important to the improvement of prevention programmes. The results have already contributed to new guidelines on treatment of cardiovascular diseases in the Netherlands. Because nutrients, additives and food items can lead to both health benefits and health risks, policymakers need a method that quantifies health gains or losses caused by changes in dietary intake. Through SOR, RIVM participated in two EU projects, in which a method and a web-based tool featuring risk-benefit assessment questions on foods were developed.

### *Healthy ageing*

Healthy ageing is a societal issue of increasing relevance. Important information on the interrelationship between healthy ageing on the one hand, and overweight or underweight on the other hand, has been acquired. Although many people are aware of the risks of overweight, underweight among the elderly is also a serious problem, because it appears to be a significant risk factor for premature death. This knowledge is important for the formulation of clinical guidelines and will also be incorporated in the above-mentioned Chronic Disease Model. On the molecular level, information on the effect of diet has been obtained, which aids understanding of how healthy ageing can be influenced by gene-diet interactions.

### *Quality of care*

Every euro can be spent only once, so information on quality of care together with cost implications is useful for decisionmakers. Firstly, adequate performance indicators that are representative of the underlying quality of the healthcare system are needed. More information on this topic has been gained, which showed that the empirical testing of theoretical relationships is possible and necessary. Otherwise, indicators may not be as useful as hypothesised. In addition, progress has been made on the relationship between the health of the elderly and health expenditures, based on trends in health and on disabilities connected with chronic diseases. Results also showed that, even though disease is increasing in the population, self-reported health remains constant, indicating that being ill does not necessarily mean feeling ill. This information is important for forecasting health status and for future policy determination, leading to more accurate decisionmaking.

*Economic evaluations*

It is evident that economic evaluations are important for decisionmaking, so adequate methods are crucial and need constant improvement. A toolkit has been developed to facilitate the incorporation of future unrelated health care costs in economic evaluations. In addition, new methods of communication and valuation of uncertainties of outcomes in economic evaluations have been developed. These significantly improve the existing instrumentation and its usefulness for policymakers.

*Other*

More research has been carried out on a range of topics related to chronic diseases. RIVM runs several cohorts, and cooperates with other organisations that maintain cohorts. The data the cohorts yield are important for epidemiological studies on the relationship between lifestyle and the development of chronic diseases. New information has been obtained by performing cohort studies on the relationship between lifestyle factors, chronic diseases and cancer. Children were a specific target group in one study, because childhood lifestyle lays the foundation for the development of chronic diseases later in life. Remarkable results came from a study on common chronic health problems in children, a problem that deserves more attention in future research, because such problems appear to be widespread and can seriously affect development.

Adequate data are the basis for all epidemiological public health studies. It was concluded that it is possible to obtain reliable data on the health of children by using questionnaires completed by parents. This means a large saving compared with professionals obtaining data. In addition, a step forward has been made in extracting valid data on the occurrence of diseases from general practice registries.

*Evaluation*

CIL is a wide-ranging theme, with a relatively large number of projects and a variety of subjects, their link being 'chronic diseases'. Many satisfactory results have been obtained. An important achievement that benefits many RIVM tasks is the upgrading of the RIVM Chronic Disease Model. New research has been carried out on food quality, obesity, diabetes and cancer. In lay terms, such information can be helpful to promote a healthy lifestyle to the general population.

However, some of the aims of this theme have not been achieved. Although new information that may in the future contribute to the development of novel prevention techniques was gained, the ambition of developing new prevention techniques themselves has not yet been fulfilled.

**3.6 Medicines and functional foods (MFF)**

The 'Medicines and functional foods' projects have led to increased information on the safety of drugs and functional foods. Nine projects were carried out. Five projects are still continuing in 2011 and beyond. The results of most of the projects are noted, even if they are not yet finished. Two projects that started in 2009 and 2010 are not discussed. One project was terminated because it proved unfeasible. All titles are noted in Appendix 1.

To obtain safe medicines, adequate methods for risk analysis and risk assessment are vital. An overview of existing experience with the use of tools for quality risk management in the pharmaceutical industry has been compiled. In addition, in-depth insight into the possibilities, limitations and pitfalls of several risk analysis methods has been gained. More specifically, observations were made on the possibilities of reducing costs of expensive laboratory tests to assess unbranded copies of branded medicines, within the precondition of maintaining safety.

Several studies on specific medicines resulted in useful data on side effects. For instance, chronic statin (cholesterol-reducing medicines) use may have adverse effects on health; possibly leading to rheumatoid arthritis as well as systemic lupus erythematosus. An in vitro test has been developed that may be used to assess undesired immune response to therapeutic proteins and side effects of vaccination. In addition, the spin-off from a study on medicines for use in children is included in a quality guideline on the development of paediatric pharmaceuticals.

Functional foods and dietary supplements are being increasingly introduced to consumer markets. Claims, safety, efficacy and product handling of these foods and supplements, in alternate or combined use with pharmaceuticals, are especially important. To inform consumers, professionals and policymakers a prototype of a food-pharma database has been developed. Functional foods might be interesting as a replacement for drugs, if sufficient effectiveness can be proved. Results from one of the projects within this theme did not, however, demonstrate the feasibility of replacing statins with phytosterols.

#### *Evaluation*

The number of projects within this research theme is relatively low. Most results relate to specific subjects, like side effects of drug use. This is useful information that may contribute to more tailor-made use of drugs. The other products, like the newly developed in vitro test and the overview of experience with risk assessment tools may be useful. The results on functional foods are also interesting. Nevertheless, the overall result of this theme is unsatisfactory. Important theme objectives were to contribute to the development of risk-benefit analysis and to chain approaches. These goals have by no means been achieved. Similarly, no attention has been paid to consumer behaviour and understanding related to medicines and functional foods.

### **3.7 Environmental quality and health (EQH)**

The 'Environmental quality and health' projects have carried out research in the fields of risk assessment, environmental health impact assessment and measurement methods. Twenty-two projects were carried out. Four projects are still continuing in 2011 and beyond. The results of most projects are mentioned, even if they are not yet completed. Only one project, starting in 2010, is not discussed, because it was just a preparatory study for a project begun in 2011. All project titles are noted in Appendix 1.

#### *Risk assessment*

Assessing a wide range of environmental risks is an important task in RIVM's core business. Existing risk assessment methods need to be permanently updated, and new methods are required to assess new risks. Because of the wide range of environmental risks, a variety of assessment methods are needed. Within this theme, RIVM has developed new methods and testing procedures,



and improved existing methods. To improve the assessment of personal exposure to electromagnetic fields, personal monitoring studies were performed; this should yield better exposure measures in future health studies. Standard procedures of risk assessment of fungal metabolites, necessary to assess biological control agents/biocides, are not yet available, though there have been advances in their development. In addition, progress has been made in more efficient developmental effect toxicity testing, with the potential of using fewer experimental animals.

Risk assessment does not only apply to individual risk factors; usually a combination of risk factors occurs. Generic methods meant for a broad array of policy fields have been researched, for instance to be used in the assessment of chronic impacts or disaster management. A small-area health statistical approach developed here could be readily applied in the assessment of the Corus smelters (steel industry), in work commissioned by the Ministry of Infrastructure and Environment.

Regarding methods to be used at the local level and integrated testing strategies aiming to reduce animal testing, good progress has been made. However, the ultimate aim of abolishing animal testing is still not in sight.

Interesting results have been obtained on the assessment of climate and ozone change effects, related to the role of sunlight and UV exposure in cancer causation.

#### *Interface risk assessment and environmental health impact assessment*

Modelling is an important instrument in estimating the health effects of different risks. Although much is already known about the risks of ionising radiation, more data are needed on low levels of radiation, because they are ubiquitous. By extrapolations more insight has been gained. To assess possible health effects related to medicines and chemicals, the applicability of a new approach, pharmacokinetic/pharmacodynamic modelling has been tested, with promising results.

#### *Environmental health impact assessments*

Environmental health problems are increasingly complex and uncertain. Impacts are embedded in a wide societal context. To assess and compare health impacts, new ways are urgently needed and current methods need improvement. To develop adequate methods, a wide variety of expertise is necessary. For this, close collaboration with other experts in the Netherlands and abroad has been established. Together steps have been taken with the development of full-chain environmental health impact assessment methods, meant to support policymaking. Work was targeted on human health as well as ecosystems. A versatile assessment methodology and appraisal framework has been developed and tested on different stress factors. Monetary factors have also been considered.

Of course, uncertainties exist with all methods and scientific findings, often substantially affecting adequate decisionmaking. To improve existing methods, new techniques for uncertainty assessment have been developed. Results on air pollution have been implemented in RIVM's Chronic Disease Model.

More detailed information has been gained on the risks of particulate matter. Its potential risk has been known for a long time, but scientific research indicates

that the actual health risk depends on the specific characteristics of emission sources, so more details of underlying mechanisms are needed. Different health effects appear to depend on size, fraction, composition as well as oxidative potential of the particulate matter. New insights on, for instance, ultra-fine particles were obtained both in a hybrid epidemiological/toxicological design as well as through expert elicitation. The results are to be incorporated in existing environmental health impact assessments.

It is important to know people's perceptions of risks, because they may differ from expert judgements. As this is essential to anticipate deliberations and risk communications, further data have been acquired, through a multicountry survey, on laypeople's estimations of different risks. These observations give policymakers an opportunity to make proposed measures more tailor-made.

#### *Measurement methods*

Adequate environmental and health policy depends on appropriate information. RIVM invested in measurement methods and instruments adequate for the assessment of a wide range of parameters. An example is the Leaching Assessment Device, developed to intercept the drainage flux from the soil surface to the water-saturated zone to the groundwater.

Climate and air quality monitoring is especially relevant because climate changes will have important consequences for spatial planning and the economy. RIVM has, through its strategic research, contributed to the national focal point for international collaboration on climate monitoring at Cabauw, which resulted in advanced techniques such as a new remote sensing instrument. This technique has also been used to collect information on the relationship between meteorological and atmospheric parameters, and the amount of night-time light on the ground. This information is relevant to establish the adverse effects of artificial light at night. In addition, an operational system for air quality smog modelling and forecasting has been delivered.

Noise exposure may cause annoyance, hypertension, sleep disturbance and cognitive and learning effects in children. Nationwide maps of background noise from different sources are available now, as well as more information on, for example, tonal aspects of noise from motorways and wind turbines. Perception of noise has been researched, in a study performed in the Rotterdam-Rijnmond region.

#### *Evaluation*

Risk assessment and assessment of the impact of different risks on human and environmental health constitutes one of the core businesses of RIVM. Models need to be updated and permanently improved, while maintaining cost-effective state-of-the-art monitoring demands constant attention. The aim of this theme was broadly worded, to allow a wide variety of projects to fit in. Consequently, a varied array of different projects were executed. Most were successful and their results have contributed extensively to these RIVM tasks. New data has been obtained on individual risk factors as well as integrated approaches, and new monitoring skills and facilities have been developed. Uncertainties regarding the environmental burden of disease (EBD) were assessed and methodology was improved. A few steps on the subject of risk perception, an aspect of growing interest and importance nowadays, have been made.

Despite the large-scale outcome, the results of the theme can still not be considered completely satisfactory because the focus of most projects was on single pollutants or just a few aspects of the full causal chain. More sophisticated, integrated approaches to meet new and more complicated commissioners' questions are still needed. Risk perception needs much more attention in order better to assess the actual societal impacts of risks (this subject would also fit into the RPC theme, as mentioned earlier in this section). The progress on this topic in both themes is too modest.

### **3.8 Achievement of strategic and innovative goals of the themes**

As the aims of most themes were described in broad general terms, it is hard to evaluate their overall results. On the one hand, the general description of themes provides room for new ideas and much creativity, which may generate good, novel results. On the other hand, the broad theme description, combined with the bottom-up submission of proposals, does not guarantee full coverage of all relevant fields and issues.

Overall, from 2007 to 2010 substantial progress was made in many areas and numerous satisfactory results have been achieved, although not all themes were equally successful. Many new instruments have been developed, new threats have been explored, and initial steps were taken into new subjects of growing importance like risk perception and more integrated and highly inclusive assessment approaches. Most projects dealt with individual issues, however. The coherence between projects within themes is not always obvious, reflecting the diversity of RIVM itself. In addition, real integrated approaches are still to be developed.

The latter still remains a challenge and a highly topical issue. In the meantime new problems demand new knowledge and solutions. Infectious diseases are not stable but tend to change, the population is growing older, new approaches to communicating with people are needed and the speed of technological developments is increasing; these provide many new opportunities for RIVM's core business.

From the start of 2011, new themes have been determined, adapted to new developments and designed to meet the upcoming needs of commissioners. The new themes are listed in section 6.3.

## 4 2007–2010 in numbers

### 4.1 Introduction

This chapter presents a quantitative evaluation of results and expenditure. The themes are compared by assessing their product numbers. Additionally, the results of the total Strategic Research Programme are compared to the results of the previous programme, 2003–2006.

### 4.2 Scientific papers: quantity indicators

The numbers of published and accepted scientific papers and theses are presented below. Appendix 2 provides an internet link to all publication references in peer-reviewed papers. This reference list will be updated on a regular basis.

#### *2007–2010 Strategic Research Programme*

From 2007 to December 2010, 353 SOR-related scientific papers were published or accepted for publication in international peer-reviewed journals, of which 308 were in journals with impact factors. Impact factors represent the scientific quality of journals, and it is preferable to publish in journals with (high) impact factors. More than 80% of the SOR-related papers appeared in journals with impact factors, a high proportion, compared with the less than 60% of non-SOR RIVM papers published in journals with impact factors. Obviously, SOR contributes considerably to the scientific output of RIVM.

Two thirds of the SOR-related papers had RIVM staffers as their first, second and/or last author, signifying the research's particular importance for the institute. By December 2010, another 100 papers had been submitted for publication to editors of similar journals. Twelve PhD theses were completed by 2010 and a thesis will be defended in 2011. Table 4.1 presents a breakdown of these numbers by theme.

*Table 4.1 Publications 2007–2010*

Theme	Number of projects (#)	Accepted for publication and published (P)	Publications per project (P/#)	Accepted and published <i>1st, 2nd or last author</i>	Theses
RPC	10	32	3.2	26	4
ERF	8	13	1.6	12	1
INF <sup>1</sup>	18	43	2.4	35	
CIL	17	143	8.4	69	1
MFF	10	24	2.4	23	
EQH	22	98	4.5	71	6
Total	85	353	4.2	236	12
2010	72	147	1.6	110	10
2009	66	107	1.7	77	
2008	67	65	1.1	38	1
2007	59	34	0.8	11	1

<sup>1</sup> In this evaluation, two closely related projects, 230426 and 230146, are considered as one project

The number of published papers gradually increased during the period. Remarkable differences appear between themes. The CIL numbers are by far the highest, mainly due to two projects, which together accounted for almost 70% of the CIL publications. On the other hand, the MFF and INF numbers are rather low, particularly MFF because 70% of the publications came from only one project. The ERF numbers are extremely low. This may be due to the fact that most ERF projects were started from scratch and did not emerge from existing research lines. Until the 2007–2010 Strategic Research Programme, research on this topic was extremely limited at RIVM. This was also the case with MFF.

In this regard, it should also be noted that a considerable number of projects started after 2007, with finishing planned for after 2010. This is especially the case with INF projects (7), but also a significant number of MFF (3) and RPC (3) projects were intended to be completed after 2010.

### 4.3 Research quality indicators

In 2002, consultations with RIVM's Scientific Advisory Board led to the selection of quality indicators for strategic research. These were based on methodology developed at the Faculty of Veterinary Medicine of Utrecht University. They were used for the 2003–2006 Strategic Research Programme and, with minor modifications, have been applied for the current cycle as well.

The methodology is based on the impact factors of all journals in which papers were published. It measures the quality, not the quantity, of the output. For every research theme, the average impact factor is calculated from journals that accepted and published the papers. Scores are compared with a theme-specific benchmark ('standard'), which is the average impact factor of all reference journals relevant to that particular theme, based on the input of the project leaders (excluding journals with impact factors >15). The comparison leads to assessments on a five-point scale, where 5 is highest, 1 is lowest and 3 represents an average acceptable score. A more detailed explanation of the methodology is given in Appendix 3. A list of reference journals by theme is given in Appendix 4.

A number of observations have been made on the use of this methodology:

- Assessment scores should be seen as indicative only. Impact factors vary greatly not only because scientific fields differ, but also because researchers set the standard against which they are measured by providing the lists of reference journals.
- Assessment scores do not take into account the quantity of the output, just the quality of the journals in which the output was published. One paper in a top journal may seem to outperform 20 papers in less outstanding but still highly respectable journals. Therefore, Table 4.2 should always be evaluated together with the number of papers published (Table 4.1).
- RIVM's primary purpose is helping answer policy questions. While achieving high research quality is greatly valued within the institute and elsewhere, it will not always be possible. That may be true in particular for research that is aimed at developing new methods.

Table 4.2 presents average impact factors and assessment scores for all research themes 2007–2010.

*Table 4.2 Indicators of scientific quality per theme: average journal impact factors*

Journal Impact Factor	RPC	ERF	INF	CIL	MFF	EQH
Average 2010	4.097	3.003	5.287	6.603	2.834	2.802
Standard 2009	4.207	3.079	4.180	3.948	3.521	2.612
Assessment Class 1–5	3	3	4	5	2	3
Average 2009	3.735	3.348	4.193	5.422	2.830	3.296
Standard 2008	3.946	2.915	3.957	3.846	3.492	2.390
Assessment Class 1–5	3	4	3	5	2	5
Average 2008	3.786	2.543	5.501	8.807	2.913	3.305
Standard 2007	3.569	2.764	3.932	3.466	3.163	2.217
Assessment Class 1–5	3	3	5	5	3	5
Average 2007	4.787		3.937	4.508		2.626
Standard 2006	3.650	2.598	3.878	3.321	3.160	2.043
Assessment Class 1–5	5		3	5		4

Notwithstanding the observations on the use of this methodology, the overall results of comparing the themes are:

- CIL (143 publications) and EQH (98 publications) both combine a high number of accepted and submitted publications and a high assessment (Class 3–5).
- The assessment of MFF (24 publications) falls from Class 3 to Class 2 in 2009 and remains low in 2010. The output in numbers of publications is also low.
- The remaining three research themes, RPC (32 publications), ERF (13 publications) and INF (43 publications) fluctuate between the assessment Classes 3 and 4, which meets the standard, while the number of publications are low (ERF) to intermediate (RPC and INF).

Of course the above statements refer to a relative comparison of the themes. Section 4.8 provides a general discussion on the results, including a comparison with the results of 2003–2006.

Because an important aim of SOR is to contribute to the scientific quality of RIVM, another analysis of the scientific output was made. The scores of the impact factors of SOR publications were compared with the impact factors of non-SOR publications. A statistical analysis showed that the median impact factor (which is considered the best indicator) of SOR publications (3.62) was significantly higher than of non-SOR publications (2.92). This indicates the relatively high contribution to the scientific quality of RIVM.

#### 4.4 Other research output

Strategic research also produced many other tangible outputs: 127 (letter) reports have been written, 445 presentations have been made at international meetings, 38 websites have been built, 79 databases have been set up and 94 tools (such as computer models) have been created. Table 4.3 presents a breakdown of these numbers per theme.

Table 4.3 Other output

Theme	Number of projects	Reports	Letter reports	Presentations at international meetings	Tools (e.g. models)	Databases	Websites
RPC	10	3	1	46	12	1	1
ERF	8	3	1	18	8	0	0
INF	18	1	5	79	13	5	1
CIL	17	11	5	95	14	16	10
MFF	10	1	2	20	1	1	1
EQH	22	79	15	187	46	56	25
Total	85	98	29	445	94	79	38
2010	72	39	6	141	34	18	6
2009	66	23	8	125	24	25	10
2008	67	27	9	104	19	19	14
2007	59	9	6	75	17	17	8

Apart from the above-mentioned outputs, progress reports also mention a great variety of tangible and non-tangible products, such as organisation of meetings, internal reports, poster presentations, project proposals, interviews, questionnaires and abstracts for meetings.

The number of presentations at international meetings is strikingly high. Again, remarkable differences appear between themes. EQH's number of presentations at international meetings is by far the highest, even if the number of projects is taken into account; 30% came from two projects, both on the subject of climate (climate change and climate monitoring). The projects of ERF and MFF appear to feature less at international meetings. The productivity of EQH is the highest in all categories: many tools, databases and websites came from this theme, while the production of ERF and MFF is generally low.

#### 4.5 Impact of strategic research on society

According to the Scientific Advisory Board, applied research carried out at the institute should not only have strong scientific merit but should provide value for society as well. In order to properly assess that value, the Board has asked the institute to develop straightforward and cost-effective indicators by which to measure the Strategic Research Programme's impact on society, and to begin monitoring that impact as part of the 2007–2010 programme cycle.

As yet, no general consensus exists on the best methodology by which to assess the impact of research on society. For RIVM, a definition proposed by Eijssackers (presentation WUR, 2007) seems the most applicable: research has an impact on society when its outcomes can be used by governments, industry, non-governmental organisations or the general public because they:

- could lead to direct applications;
- offer solutions to social problems or address social developments;
- answer questions that arise in society or fulfil societal needs.

Also, research should address a significant problem or issue, i.e. serve a general interest.

##### *Advisory Council guidelines on health research impact indicators*

In December 2007, the Advisory Council on Health Research (De Gezondheidsraad, GR), a body advising the Dutch government on health and health services research, published a report on assessing the impact of research

on society. Entitled 'Research that matters' (Onderzoek dat ertoe doet), it offered a list of indicators that gauge the impact of health research. The Council stressed the limited experience with applying such indicators and warned against putting too much emphasis on numerical values as yet. The Council, rather, presented its list as a rough guide that should be experimented with. In setting up such experiments, users should select their own indicators based on the general list.

From the Advisory Council's general list (see Appendix 5), RIVM has selected a short list of indicators that seem most suitable for measuring the impact of the institute's Strategic Research Programme. In making the selection, RIVM applied the following rationale:

- RIVM's strategic research has a particular focus – it is primarily targeted at demand that will most probably materialise in the near future (3–5 years).
- Many factors contribute to measurable health impacts, and typically it will be difficult to attribute such impacts directly to the Strategic Research Program itself.

#### *RIVM strategic research impact indicators*

Obviously all RIVM research, including that carried out as part of the Strategic Research Programme, should ultimately have positive effects on society. Such effects, however, will usually become visible only at a much later time. All selected indicators may be called indirect: we may assume that, when third parties apply RIVM research outcomes, or when RIVM is asked for advice based on the fruits of its work, there will most probably be future impact. Following the same line of thinking, follow-up assignments were added as indicators because they can be seen as clear signs of outside interest in RIVM research results.

Some indicators on the list of the Advisory Council on Health Research could indeed be very meaningful when applied to RIVM as a whole. These include, for example, contributions to professional education, informing the public through authorised websites, and references to research in public media. However, it would be very difficult to directly attribute performance on such indicators to strategic, long-term research. Therefore these indicators were not deemed suitable for measuring the societal impact of the Strategic Research Programme. The Advisory Council also presented a list of indicators for assessment of the economic impact of health research. For similar reasons, these indicators were also deemed not very suitable for measuring the impact of RIVM's strategic research.

In the end, the following process- and product-based indicators were identified. For all these indicators, performance is assessed and quantified annually:

- follow-up assignments from primary clients;
- follow-up assignments from secondary clients;
- use of outcomes in guidelines, regulation, policies etc.;
- requests for advice from third parties;
- participation in international bodies.

#### *Performance scores of Strategic Research Programme 2007–2010*

Table 4.4 presents performance scores for selected societal impact indicators for all research themes.



Table 4.4 Performance scores – societal impact

Theme	Number of projects	Follow-up assignments from primary commissioners	Follow-up assignments from secondary commissioners	Use of outcomes in guidelines, regulation, policies and so on.	Requests for advice from third parties	Participation in international bodies	Summary scores
RPC	10	14	5	10	2	19	<b>50</b>
ERF	8	7	2	4	11	7	<b>31</b>
INF	18	3	6	8	21	10	<b>48</b>
CIL	17	16	27	22	37	17	<b>119</b>
MFF	10	6	1	14	3	8	<b>32</b>
EQH	22	15	14	65	45	40	<b>179</b>
Total	85	61	55	123	119	101	<b>459</b>
2010	72	25	21	40	40	29	<b>155</b>
2009	66	20	8	36	30	26	<b>120</b>
2008	67	10	14	35	30	28	<b>115</b>
2007	59	6	12	12	19	18	<b>67</b>

The follow-up assignments are listed in Appendix 6.

Within the Strategic Research Programme, the various research themes differ significantly in terms of budgets and numbers of projects. As yet, there is no absolute standard to which a theme's performance can be compared. For now, the scores can be used only to compare individual research themes and to monitor the Strategic Research Programme's impact over the years. Some in the field have experimented with methodologies that use weighted performances. Weightings could be based on differences between areas of research, for example. At this point, no weightings have been applied to calculate scores for RIVM's Strategic Research Programme. The rightmost column in Table 4.4 presents societal impact summary scores for each of the research themes; in the four bottom rows the total summary scores are presented by year.

As might be expected, the total summary scores (as well as the scores of most individual themes, which are not presented here) have risen between 2007 and 2010. The rise is especially remarkable between year 1 and year 2. Most projects already generate societal impact prior to completion. The differences between themes are obvious. Even if adjusted for the number of projects, the summary score of EQH is by far the highest; and CIL also has a high score.

The scores of ERF and MFF are relatively low, and INF is the lowest, if adjusted for the number of projects.

Obviously, this summary score is only a very rough indicator: the importance of follow-up assignments may differ significantly and this is also the case with the use of outcomes. Additionally, societal impact is more than the above-mentioned figures. In many cases, the actual use of the research will probably become obvious only later. The table most likely gives an underestimate of the actual use.

## 4.6 Finances

Table 4.5 presents the funds that have been spent out of the Director General's 2007–2010 budgets.

*Table 4.5 Expenditure per theme*

Theme	Number of projects	Total	Of which cofinancing	Hours spent (excluding cofinancing)
		[€]	[€]	[h]
RPC	10	7,036,267	342,359	45,365
ERF	8	5,285,424	60,250	32,032
INF	18	10,120,737	308,324	59,921
CIL	17	9,068,683	737,935	51,521
MFF	10	4,741,764	0	32,956
EQH	22	13,318,422	2,084,767	68,068
Total	85	49,571,297	3,533,635	289,962

The table does not include expenditures using funds from external sources, such as commissioners who cofinance research by matching RIVM's own funds. The fourth column presents the funds invested by RIVM in cofinanced projects. The fifth column lists the number of hours worked by RIVM staff, not including hours paid from RIVM funds invested in cofinanced projects (accounting rules stipulate that such hours should be reported elsewhere). The figures also neglect the often numerically important time spent by PhD students on many projects. Consequently the time actually spent is presumably higher. Note: The RIVM has a different method to universities for calculating budgets. For this reason, a comparison is not possible.

The expenditure is attributable to products such as the publications. In this way, one publication costs approximately €140,000. Themes differ considerably in this respect, from approximately €63,000 (CIL) to over €400,000 (ERF), as shown in Table 4.6. It should be noted that large differences between individual projects or themes are to be expected, because there are also large differences in the costs of individual projects. As a result, the value of these observations is limited.

*Table 4.6 Average costs per publication*

Theme	Number of projects	Number of publications (accepted and published)		Average costs (€)	Average costs (€)	
		All	1st, 2nd or last author RIVM staff		Costs (€)	All
RPC	10	32	26	7,036,267	219,883	270,626
ERF	8	13	12	5,285,424	406,571	440,452
INF	18	43	35	10,120,737	235,366	289,164
CIL	17	143	69	9,068,683	63,417	131,430
MFF	10	24	23	4,741,764	197,574	206,164
EQH	22	98	71	13,318,422	135,902	187,583
Total	85	353	236	49,571,297	140,429	210,048

#### 4.7 Early termination of projects

One project has been terminated before the planned end date, because the project leader left RIVM and, by that time, the results were not promising. However, not all the other projects have been equally successful, as stated earlier. In future, terminating projects with insufficient results should be considered, in order to save costs and start promising new projects.

#### 4.8 General assessment of figures and comparison with 2003–2006 Strategic Research Programme

##### *Scientific output*

The total scientific output of the 2007–2010 projects is relatively low, compared with 2003–2006. From 2003 to 2006, 334 peer-reviewed publications came from 47 projects, of which 222 had RIVM staff as 1st, 2nd or last author, which seems relatively (comparing the expenditure) higher than the production of 2007–2010. This may be partially explained by the fact that in 2007–2010 a considerable number of projects started in later years, so their main output is still to come. By the end of 2010 another 100 publications had been submitted for publication and there will definitely be more finished in later years. This still might not fully explain the decrease: the difference from former years seems too large. A possible explanation is that, for several topics, especially in ERF and MFF, new research lines had to be started, which takes several years. A high production level for new topics is only to be expected after this sort of delay.

Obviously, the calculated costs of a 2007–2010 publication (€140,000) are higher than those of 2003–2006 (€110,000). As there is no costs standard at RIVM, it is hard to say whether this is acceptable or not.

On the other hand, 2007–2010 the scientific impact standard was met by almost all themes every year: only twice did the score not meet the standard. This is a much better result compared with 2003–2006: in this latter period the standard was not met eight times. 2007–2010 quality seemed to have prevailed above quantity.

The number of 2007–2010 theses was also much lower than in 2003–2006: only 12 instead of 16. Of course more theses are likely to come, because a complete PhD study and defence (including the bestowal of a PhD) will usually not be completed in the four years of this evaluation.

##### *Other products and commissions*

In contrary to the decline in the number of peer-reviewed publications, there is a considerable increase in other products. A very high number of presentations at international meetings have taken place, and also the number of tools, websites and databases (total 211) is much higher than 2003–2006 (total 60). The number of follow-up assignments from the 2007–2010 projects (116) was higher than from the 2003–2006 (60).

These results deserve discussion by RIVM's Management Board. The production of peer-reviewed publications in journals with high impact factors might conflict with the production of other products. These products are also important, but the peer-reviewed publications are of the utmost importance for operation as a science-based institute. In addition, some project leaders report a dilemma between the production of scientific publications and reaching innovative goals.

However, whether and in which way there are conflicts is yet to be explored, as this is not confirmed by the individual results of projects. Projects with many publications usually also have many other products and are successful in achieving their aims.

*Differences between themes and projects*

The themes differ considerably in production; this is particularly the case with the peer-reviewed publications, but also with the other products and follow-up assignments. In general, CIL and EQH produced the most products, ERF and MFF the least. Scientific production in a project does not necessarily go together with the achievement of its aims: some projects were not intended to produce scientific articles, but other outcomes, e.g. new tools or improved models. Nevertheless, the themes with many products are also more successful in reaching their theme aims. On a more detailed level, there are noticeable differences between projects: from zero to more than 60 publications per project. The aim of this report is not to describe the differences in project levels, but project evaluations are certainly worth carrying out to identify success and failure factors, in order to improve the results of upcoming projects.



## 5 Lessons learned from project and programme management and modifications in 2011

### 5.1 Introduction

This chapter summarises lessons learned from the project and programme management in 2007–2010 projects. Desired improvements were raised by project leaders in their final annual reports (project management) and by the Director General's staff and theme coordinators (programme management). The lessons learned will serve as a guide for future SOR projects and programmes. A number of changes in programme management have already been introduced, or will soon be implemented, as mentioned in section 5.4.

### 5.2 Project management

Generally, areas for improvement resemble those raised by project leaders in 2003–2006, although there seem to be fewer complaints. The following subjects were mentioned:

#### *Availability of data and materials*

Acquiring data or materials from other parties or other ongoing RIVM projects is sometimes problematic, because it is uncertain whether they will arrive in time, or at all.

#### *Availability of human resources*

Although mentioned far less than in the 2003–2006 evaluation, the availability of suitable manpower is crucial and appeared to be a problem for some projects. In some cases PhD students left, and also project leaders changed jobs, which caused delay. Quick replacement usually encounters problems. Sometimes senior staff members have not been able to spend enough time, because of other priorities. Generally, working with PhD students seems to be advantageous, because they are fully dedicated to the project, though their recruitment is time-consuming and should start as soon as possible: recruitment time needs to be incorporated in the overall planning. This has usually not been the case, probably because the programme duration is set at four years, and project leaders typically do not plan beyond this period. Restriction of duration has never been intended, however.

#### *Project planning, budget and underestimation of technical challenges*

Quite a few project leaders would appreciate more flexibility in the use of the planned budget. A total and fixed yearly budget was granted by the head of Strategic Research at RIVM (the RIVM Director General) but this was not sufficiently flexible for the management of multiple-year projects. Delays in recruitment, unforeseen difficulties with data analysis, preparing and testing of software applications, and problems with obtaining data from other parties have been reported. More predictable problems have also been noted, e.g. too little attention to feasibility at the start of the project, too little focus, underestimation of the time needed for writing manuscripts, unrealistic project planning, inexperienced project leaders (not familiar with RIVM's procedures) and too little preparation before the start of the project. In addition, in some projects expenditures rose because costs were not calculated initially (e.g. the level of university contract prices and RIVM benchmark fees).

#### *Collaboration with external partners*

Many project leaders recognise that collaboration with external partners is indispensable. Their advice is to seek out new collaborations when new, highly challenging techniques are to be used. This is more fruitful than performing everything 'in-house'. The development of new collaborations is time-consuming, so this should start as soon as possible. On the other hand, project partners might have their own priorities so extensive discussions at the start of the project on priorities and how to address the objectives, are essential with all participants.

In some cases, more time needs to be invested on coordination of the project and communication among partners, and the planning of the partners should be more integrated. In addition, it has been reported that unsuccessful collaborations should be recognised earlier and replaced by new ones.

#### *Communication*

Multidisciplinary projects are rewarding but it has been reported more than once that it takes time to speak each other's language. For instance, if ICT is a success factor in the project, an ICT project leader with enough time dedicated to the project is essential, which has not always been the case.

#### *Focus*

Some project leaders experience a conflict between their desire to publish in peer-reviewed journals and the strategic potency of the project.

### **5.3 Programme management**

#### *Theme coordinators*

Since 2007 six theme coordinators have been appointed. They all coordinated the projects in their theme from the start until now. This coordination turned out to be highly satisfactory and effective and is being continued beyond 2010.

#### *Delay*

The completion of many projects started between 2007 and 2010 has been delayed. Approximately 50% of the projects that were to be completed before the end of 2010 continued for longer than originally planned. Of course, there might be acceptable reasons in some cases, but this situation still needs attention. The delay has been caused at least in part by the above-mentioned problems, in particular the PhD students' late starts. In future project planning, the time needed for hiring staff should be included.

#### *Annual report*

At the start of the programme, the reporting obligation was relaxed from three times a year to only once. The lower frequency, combined with a more extended report, appeared to be satisfactory. However, the quality of the annual reports needs attention, because the information supplied is often incomplete and incorrect. Often too many details are provided on process, while the description of progress is poor from the content point of view. Accordingly, much effort was necessary to correct and complete the reports and it is necessary to change this situation for efficiency reasons.

#### *Cooperation within RIVM*

Working together within RIVM is not an aim of RIVM Strategic Research, but a means to an end. It is likely that the quality of products will be higher if all available knowledge is exploited. The cooperation between divisions of RIVM in

strategic projects can be assessed either by looking at planned input, at actual realisation in time, or by addressing the output. By counting the joint publications, a fair reflection of significant cooperation can be obtained.

Approximately 25% of the peer-reviewed publications have authors from more than one RIVM division, which might be considered substantial but not extremely high. Most cooperation appears between the CVG and PZO, CVG and GBO, GBO and CMM, PZO and LCI, CVG and EMI and LIS and GBO centres.

Such an analysis of joint publications was not carried out after 2003–2006, so material for comparison is not available. Then it was calculated that in one quarter of the projects more than 10% of the project budget was spend in another division, which might also reflect a substantial amount of cooperation. As the organisation's structure changes over the years it is not possible to monitor developments in cooperation adequately by comparing figures in this way. Still, it seems possible to intensify cooperation within RIVM.

#### *International collaboration*

The strategic budget provides opportunities to cooperate with other parties in international projects: the budget is being used partly for cofinancing of international projects. However, the portion of budget being used in this manner was considered relatively low, at approximately 6%. 2003–2006 the budget used for cofinancing international projects was similarly low.

## **5.4 Project management changes from 2011**

In 2011 six themes with more than 50 new projects started. Several new procedures have been implemented, or are to be implemented in the near future. The most important ones are:

#### *Internationally dedicated budget*

The current calls for proposals are not appropriate for supplying cofinancing for international projects, because they have other time dynamics. International cooperation is considered crucial for RIVM, though it is desirable that it be more stimulated by the strategic budget. From 2011 part of the strategic budget (approximately 5%) is set apart to fund cofinancing of international projects. By mid-2011 many requests had already been submitted and granted.

#### *Different budget funding*

Before 2011, budget granting was allocated by division: every division had its own budget. This is no longer the case. During the selection of projects in 2011, the funding was based on the relevance and quality of the proposals, in combination with the desire to serve as far as possible the goals of the strategic themes and of the whole programme. This procedure will be continued after 2011. In this way, the quality of projects plays a more decisive role in the funding than before.

#### *Reduction of 'overhead time' investment*

As part of RIVM's wish to reduce 'overhead time' the RIVM Management Board decided on a number of simplifications in programme management. The mandate of the theme coordinators will increase: they will be authorised to decide on changes in project budgets, if necessary. They are also in charge of a more intense monitoring of the projects' progress. Simultaneously, the reporting obligation in written reports by project leaders will decrease. It is anticipated that centralisation of RIVM's operational management will decrease overhead



investments on this programme. Finally, the selection of projects will be simplified, starting from 2012.

## 6 General conclusions and outlook for 2011–2014

### 6.1 General assessment of 2007–2010 programme

Between 2007 and 2010 84 strategic research projects started. Together, they provided a great variety of useful products and a considerable amount of new information has been obtained. More results will follow because not all projects were completed by the end of 2010. Overall, more products have been delivered compared with the previous cycle. The scientific work and the (new or existing) scientific networks significantly have contributed to RIVM's scientific position. The scientific quality was generally sufficient, as indicated by the fact that the benchmarks for output (standards) were met most of the time. The success of many of the projects is already visible through a large number of follow-up assignments.

Some critical comments are also applicable. Firstly, the number of scientific publications decreased compared with 2003–2006, although this drop will be less severe upon the completion of the projects starting after 2007. Secondly, despite the success of many projects, not all initially formulated objectives of the themes have been achieved. Finally, the success rate clearly differs between the research themes. The causes of these differences have not been fully explored, but may indicate stronger and weaker divisions and research traditions within RIVM. The results of at least one theme must unfortunately be judged as inadequate, because the results of most projects within this theme are too poor.

### 6.2 Preview of accomplishment: finalising ongoing projects

A total of 37 projects continue in 2011, partly due to delays and partly because of an initially planned duration of more than four years, or a later start (16 projects were originally intended to be completed after 2010). The scientific production of these projects will be monitored and reported in the annual report 2011. The start and end dates are listed in Appendix 1: ongoing projects are marked with an asterisk.

### 6.3 Preview of the 2011–2014 themes

Although the 2011–2014 themes were chosen long before the results of this evaluation were available, they seem to be appropriate in relation to a number of the conclusions of this evaluation.

Examples cited are:

- More attention is being paid to risk perception and risk communication, and social sciences more generally, in the new strategic themes, meeting the changing needs of today's society. This is especially the case with the theme 'Filling the gap: from knowledge to action'.
- The need for new and really integrated approaches is still growing, because of the increasing complexity of commissioners' questions. A new theme, called 'New dimensions in the integrated (risk) assessment of public health and environment' has been chosen for 2011–2014.

Apart from this, the new themes anticipate new developments, which were not as detectable in 2007 as they are now: the accelerating progress of technology, ageing, constantly changing threats (e.g. from infectious diseases).

The six new themes are:

- Application of new technologies (ANT)
- Filling the gap: from knowledge to action (FKA)
- Healthy ageing (HEA)
- Healthy and sustainable living environments (HSL)
- Infectious diseases' dynamics (IDD)
- New dimensions in the integrated (risk) assessment of public health and environment (QRA)

Because in 2011 RIVM was merged with the National Vaccine Institute, also their strategic research programmes have been merged. This resulted in a seventh research theme:

- Strategic vaccine research (SVR)

The new themes differ considerably from the old. There is more focus on innovation and less on the maintenance of already available skills. The description of the themes is much more detailed compared with the old, with the intention of giving more direction to new proposals. As a consequence, not all RIVM research subjects fit into these themes.

A summary of the projects started in 2011 (except the international projects, which were granted later on) is available in RIVM report 000201101/2011 Strategic Research RIVM 2011–2014, project summaries.

## Appendix 1 Themes, research programmes and projects

A full list of projects started 2007–2010, is provided below. Some of the projects have only recently started.

\* Project continues after 2010

### Theme RPC

Programme	Project no.	Project leader	Title	Start	End
Experimental (animal) studies in risk assessment	230136	Ing. J.H.J. Reimerink	Proteomics for population screening	2007	2010
	320001	Dr. P.M.J. Bos	Population based biokinetic modelling	2009	*
	320002	Prof. Dr. F.X.R. van Leeuwen	Improvement of risk assessment	2010	*
	340001	Dr. A. de Vries	Adverse effects of circadian disruption	2010	*
	340010	Dr. M. Luijten	Toxicogenomics in risk assessment	2007	2009
	350010	Dr. Ir. M.C. Ocké	Methods of dietary exposure assessment	2007	2010
	340050	Dr. L.T.M. van de Ven	Alternatives for animal testing	2007	2010
	340030	Dr. W. H de Jong	Nanotechnology, potential risks	2007	*
Information to consumers	270136	Dr. H.C. Ossenbaard	gettingBetter.nl	2007	*
	260196	Prof. Dr. G.P. Westert	Effective use of performance indicators	2007	*

### Theme ERF

Programme	Project no.	Project leader	Title	Start	End
Measuring and modelling	330006	Dr. B.J. van Rotterdam	Biothreat DNA micro-arrays	2007	2010
	620001	Dr. P.A.M. Uijt de Haag	QRA: quantitative risk assessment	2007	*
	630007	Dr. F.S.M. Stom	Rapid assessments after disasters	2007	2010
	609001	Dr. S.M. Hoffer	Terrorist attacks	2007	2008
Risk assessment in emergencies	610003	Dr. C.J.W. Twenhöfel	ERFRAD: Emergency response function for radiation	2007	2010
	609002	Dr. Ing. N.J.C. van Belle	From subacute to acute response	2007	2010
	609150	Dr. Ir. L. Grievink	Health 10 years post-disaster in Enschede	2010	2010
Clinical toxicology	660001	Prof. Dr. J. Meulenbelt	Research cooperation in human toxicology	2007	*

**Theme INF**

<b>Programme</b>	<b>Project no.</b>	<b>Project leader</b>	<b>Title</b>	<b>Start</b>	<b>End</b>
Modelling	210026	Dr. H. Grundmann	Modelling the future of MRSA in NL	2007	*
	210036	Dr. J. Wallinga	Tracking emerging epidemics	2007	2010
	210046	Dr. J. Wallinga	Epidemic modelling of molecular data	2007	2009
	210056	Dr. M.E.E. Kretzschmar	Chlamydia positivity and prevalence	2008	2010
	210066	Dr. J. Wallinga	Who infected whom	2009	*
	210076	Dr. M.E.E. Kretzschmar	Timeliness response during outbreaks	2009	*
Immunology	230426	Dr. A.M. Buisman	Memory immunity	2007	*
	230146	Dr. B. Pinelli <sup>2</sup> Ortiz	Immunomodulation by helminth molecules	2007	-
	230166	Dr. B. Pinelli Ortiz	Zoonotic helminth infections and allergy	2008	*
	230406	Dr. C.M. Janssen	Host-response to RSV (Respiratory Syncytial Virus)	2007	*
	230416	Dr. R.S. Van Binnendijk	Immune pathways in vaccination	2007	2010
	340002	Dr. C.M. Janssen	Effect of paracetamol on vaccination	2010	*
Genomics	230136	Dr. D. v. Soolingen	Whole genome analysis of M. tuberculosis	2007	*
	230436	Dr. A.J. King	Micro-arrays to map pertussis adaptation	2007	2010
	230446	Dr. F.R. Mooi	B. pertussis adaptation to vaccination	2007	*
	330116	Dr. H. Sprong	Ticks: Trojan horses with new surprises	2008	*
INF - other	210086	Dr. H.E. de Melker	Set-up monitoring acceptance NIP	2010	*
	230156	Dr. E. Duizer	Transmission intervention strategies	2008	*
	V/330274	Dr. A.M. Roda Husman	VITAL: foodborne viruses	2008	2008

**Theme CIL**

<b>Programme</b>	<b>Project no.</b>	<b>Project leader</b>	<b>Title</b>	<b>Start</b>	<b>End</b>
Modelling chronic diseases	260146	Dr. Ir. W.M.M. Verschuren	Primary prevention research on cardiovascular diseases and diabetes	2007	*
	210116	Prof. Dr. H.C. Boshuizen	Adaptable chronic diseases modelling	2007	2010
	260166	Dr. P.C.A. Droomers	Modelling SES disparities in health	2007	*

<sup>2</sup> As of 2009, projects 230146 and 230166 have been combined.

Programme	Project no.	Project leader	Title	Start	End
Healthy ageing	350040	Dr. Ir. J. Hoekstra	Modelling health effects of nutrition	2007	2009
	260156	Dr. Ir. W.J.E. Bemelmans	Healthy ageing: overweight/underweight	2007	*
	340020	Dr. M.E.T. Dollé	Healthy ageing: gene-diet interactions	2007	*
Quality of care	260116	Prof. Dr. G.P. Westert	Health system performance	2007	2010
	270116	Dr. C.H. van Gool	Are diseases becoming less disabling?	2007	2010
	270166	Dr. J.Polder	Healthy ageing and health care expenditure	2009	*
Economic evaluations	270156	Dr. J.S. de Koning	Hospital performance measurement	2007	2008
	260176	Dr. T.L. Feenstra	Communicating uncertainty in economic evaluations	2008	2010
Other	260186	Dr. G. A. de Wit	Future unrelated medical costs	2007	2008
	350020	Dr. H.B. Bueno de Mesquita	Primary prevention research on obesity, cancer and ageing	2007	2010
	270126	Dr. A.J. Schuit	Knowledge transfer in public health	2007	*
	260126	Dr. A.H. Wijga	Lifestyle from childhood to adolescence	2007	*
	260136	Dr. A.H. Wijga	Chronic health problems in childhood	2008	2010
	270146	Dr. Ir. F. H.G.M. Hoeymans	Validation of data from general practice registries	2007	2008

### Theme MFF

Programme	Project no.	Project leader	Title	Start	End
Not applicable	340001	Dr. F. Vroom	NOCEBO: negative perception of treatment	2010	2010
	340040	Dr. Ir. R.J. Vandebriel	Chronic drug use and autoimmunity	2007	*
	350030	Dr. Ing. H.J. v. Kranen	The food-pharma interface	2007	*
	360001	Dr. Ing. A.M. Akkermans	Novel <i>in vitro</i> for pertussis toxin	2009	*
	360003	Dr. J.W. van der Laan	Carcinogenicity of growth factors	2010	*
	360010	Dr. S.W.J. Janssen	Pharmaco-economic evaluations	2007	*
	360020	Dr. M.H.N. Hoefnagel	Immunogenicity of protein pharmaceuticals	2007	2009
	370010	Dr. D.M. Barends	Riskred	2007	2009
	370020	Dr. D.A. van Riet-Nales	MAGIC: Manipulation and administration of medicines given to children	2007	*
	370030	Dr. D.M. Barends	BIOTHREE	2008	2010

**Theme EQH**

<b>Programme</b>	<b>Project no.</b>	<b>Project leader</b>	<b>Title</b>	<b>Start</b>	<b>End</b>
Risk assessment	601001	Dr. T.G.Vermeire	ITS: integrated testing strategies	2007	2010
	601150	Dr. E. Rorije	Developmental toxicity analysis	2010	2010
	601151	Dr. J.W.A. Scheepmaker	Fungal: Risk assessment fungal metabolites	2010	2010
	607001	Dr. L. Posthuma	EIA: environmental impact assessment	2007	2010
	607002	Prof. Dr. A.M. Breure	RICIERA: research cooperation in ecological risk assessment	2007	*
	630006	Dr. C.M.A.G. van Wiechen	SMARAGHT: small area health analyses, a geographical toolkit	2007	2010
	610002	Dr. H. Slaper	COURSE: climate and ozone change effects	2007	2010
Interface risk assessment and EHIA	610001	Dr. H. Bijwaard	MIRACLE: modelling ionising radiation and cancer for low dose effects	2007	2010
	660150	Dr. C.C. Hunault	PK/PD modelling in human toxicology	2010	2010
Environmental health impact assessment	607150	Dr. L. Posthuma	ICQSAF: integrated contours of a quantitative sustainability assessment framework	2010	2010
	610150	Dr. J.F.B. Bolte	KINESE: validation of key exposure indicators in epidemiological studies of electromagnetic fields	2010	2010
	630001	Prof. Dr. Ir. E. Lebret	IRAS: environmental health collaboration	2007	*
	630002	Dr. N. Janssen	RAPTES: risks of airborne particles	2007	2010
	630003	Dr. A.B. Knol	VAMPHIRE: versatile assessment methodology project for health impacts and risks in the environment	2007	2010
	630004	Dr. A. B. Knol	IQARUS: uncertainty in environmental biological oxygen demand	2007	2009
	630005	Dr. R. van Poll	PACEHR: perception, appraisal and communication of environmental risks	2007	2009
Measurement methods	680001	Dr. Ir. W.A.J. van Pul	NITROGEN: Relating groundwater + air quality for N	2007	*
	680002	Dr. A. Apituley	CESAR: climate and air quality monitoring	2007	*
	680003	Dr. D.P.J. Swart	AQURES: air quality and remote sensing	2007	2010
	680004	Ir. J. Jabben	NOISE: improving noise exposure assessments	2007	2008
	680150	Ir. J. Jabben	Noise and health in the Rijnmond	2010	2010
	680151	Dr. D.E. Lolkema	Brightness of the night sky	2010	2010

## Appendix 2 References 2007–2010

By the end of 2010, 353 scientific papers had been published or accepted by peer-reviewed journals. A full list of references is available on the internet ([www.rivm.nl/SOR](http://www.rivm.nl/SOR)) and will be updated after 2011.





## Appendix 3 Research quality methodology

### *Introduction*

In 2002, in consultation with the Scientific Advisory Board, a set of quality indicators for strategic research was selected. The following principles and plans were formulated:

- The diversity of research in the Strategic Research Programme calls for differentiated criteria and standards.
- Per theme or research field (if fields vary significantly within themes) a bibliometric quality standard is established.
- Research quality per theme will be scored against the quality standard as part of the annual reporting cycle for strategic research; additional performance criteria, such as quantity of research output, will be used.
- Outcomes of the annual review will be reported to the Scientific Advisory Board.

### *Methodology for determining indicators*

The methodology was described previously in a note to the Commission on Implementation, entitled: Implementation of indicators for the scientific quality of RIVM Strategic Research (trial 2002) of May 2002. The approach was based on a methodology developed at the Faculty of Veterinary Medicine of Utrecht University.

The methodology includes the following steps:

- Establish, in consultation with the researchers, a list of relevant reference journals.
- Calculate the standard, i.e. the average Journal Impact Factor (in 2009) of all reference journals (not counting 'high standard journals' with impact factors greater than 15).
- Calculate the average Journal Impact Factor (in 2009) of the research output.
- Compare the average Journal Impact Factor (in 2009) of the research output to the average Journal Impact Factor (in 2009) of all reference journals using a five-point scale.

After consulting with project leaders, theme coordinators provided a list of reference journals at the start of the programme. Using the most recent Journal Impact Factors (2008), standards were set.

Actual output was compared against the standard and subsequently rated on a five-point scale following a table taken from the Utrecht University methodology.

Class 5	well above 110% of the standard <sup>3</sup>
Class 4	higher than 110% of the standard
Class 3	between 90% and 110% of the standard ('acceptable')
Class 2	between 70% and 90% of the standard
Class 1	lower than 70% of the standard

<sup>3</sup> In practice: higher than 130% of the standard.



## Appendix 4 Reference journals 2010

### Key

THR = Threshold, lowest impact factor of a major journal.

HSJ = High standard journal (impact factor >15), excluded from the average impact.

### Theme RPC

Journal name	Journal Impact Factor (in 2010)	
Biological Reproduction	3.300	
Biomaterials	7.365	
British Journal of Nutrition	3.446	
British Medical Journal	13.660	
Cancer Prevention Research	6.000	
Carcinogenesis	4.795	
Environmental Health Perspectives	6.191	
European Journal of Clinical Nutrition	3.072	
European Journal of Public Health	2.313	
Food and Chemical Toxicology	2.114	
Health Services Research	2.407	
International Journal of Medical Informatics	3.126	
International Journal of Nanomedicine	2.612	
International Journal of Quality Health Care	1.881	
Journal of Applied Toxicology	2.073	
Journal of Clinical Epidemiology	2.956	
Journal of Critical Care	2.127	
Journal of Immunological Methods	2.347	
Journal of Infectious Diseases	5.865	
Journal of Medical Internet Research	3.924	
Journal of Proteome Research	5.132	
Journal of Virology	5.150	
Medical Care	3.241	
Nano Letters	9.991	
Nanomedicine	5.982	
Nanotoxicology	5.744	
Pharmacogenomics	3.893	
Proteomics	4.426	
Public Health Nutrition	2.749	
Regulatory Toxicology and Pharmacology	1.798	THR
Risk Analysis	1.953	
Toxicological Sciences	4.814	
Toxicology	3.241	
Toxicology and Applied Pharmacology	3.359	
Average impact:		4.207
Threshold:		1.798

## Theme ERF

Journal name	Journal Impact Factor (in 2010)	
Analytical Chemistry	5.214	
Applied and Environmental Microbiology	3.686	
Archives of Toxicology	3.312	
BMC Health Services Research	1.660	
BMC Medical Research Methodology		
BMC Microbiology	2.890	
British Journal of Psychiatry	5.777	
Clinica Chimica Acta	2.535	
Clinical Microbiology and Infection	4.014	
Clinical Toxicology	1.460	
Computers and Geosciences	1.142	
Diagnostic Microbiology and Infectious Disease	2.451	
Emerging Infectious Diseases	6.794	
Environmental Health Perspectives	6.191	
Environmental Monitoring and Assessment	1.356	
Environmental Science and Technology	4.630	
European Journal of Epidemiology	3.718	
European Journal of Public Health	2.313	
Externe Veiligheid		
FEMS Immunology Medical Microbiology	2.335	
FEMS Microbiology Letters	2.199	
Human and Experimental Toxicology	1.307	
International Journal of Emergency Management		
International Journal of Epidemiology	5.262	
International Journal of Geographical Information Science	1.533	
International Journal of Risk Assessment and Management		
Journal of Toxicology Environmental Health	1.724	
Journal of Applied Microbiology	2.098	
Journal of Chromatography A	4.101	
Journal of Chromatography B	2.777	
Journal of Clinical Microbiology	4.162	
Journal of Disaster Management		
Journal of Exposure Science and Environmental Epidemiology	2.718	
Journal of Molecular Diagnostics	3.413	
Medical Microbiology and Immunology	3.767	
Molecular and Cellular Probes	1.899	
Psychological Medicine	5.012	
Public Health	1.261	
Radiation Protection Dosimetry	0.707	THR
Risk Analysis	1.953	
Toxicology Letters	3.479	
Average impact:		3.079
Threshold:		0.707

## Theme INF

Journal name	Journal Impact Factor (in 2010)	
Clinical and Experimental Allergy	4.084	
Clinical and Experimental Immunology	3.009	
European Journal of Immunology	5.179	
Infection and Immunity	4.205	
Journal of Clinical Microbiology	4.162	
Journal of Immunological Methods	2.347	THR
Journal of Infectious Diseases	5.865	
Journal of Virology	5.150	
Vaccine	3.616	
Average impact:		4.180
Threshold:		2.347

**Theme CIL**

<b>Journal name</b>	<b>Journal Impact Factor (2010)</b>
Allergy	6.380
American Journal of Clinical Nutrition	6.307
American Journal of Epidemiology	5.589
American Journal of Preventive Medicine	4.235
American Journal of Public Health	4.371
American Journal of Respiratory and Critical Care Medicine	10.689
Age and Ageing	3.131
Annals of Oncology	5.647
Archives of Disease in Childhood	2.657
Archives of Internal Medicine	9.813
British Journal of Cancer	4.346
British Journal of General Practice	2.442
British Journal of Nutrition	3.446
British Medical Journal	13.660
Cancer Causes and Control	3.199
Cancer, Epidemiology, Biomarkers and Prevention	4.310
Cancer Research	7.543
Carcinogenesis	4.795
Clinical and Experimental Allergy	4.084
Clinical Infectious Diseases	8.195
Computer Methods and Programmes in Biomedicine	1.144
Cost Effectiveness and Resource Allocation	
Disability and Rehabilitation	1.555
Drugs	4.732
Endocrine-Related Cancer	4.282
Environmental Health	2.481
Epidemiology	5.511
Epidemiology and Infection	2.365
European Journal of Ageing	
European Journal of Clinical Nutrition	3.072
European Journal of Epidemiology	3.718
European Journal of Gastroenterology and Hepatology	1.662
European Journal of General Practice	
European Journal of Pharmaceutics and Biopharmaceutics	3.151
European Journal of Public Health	2.313
European Respiratory Journal	5.527
Eurosurveillance	
Expert Opinion on Pharmacotherapy	2.018
Family Practice	1.515
FEMS Microbiology Reviews	9.783
Health Care Management Science	
Health Economics	2.011
Health Policy	1.348
Health Services Research	2.407
Huisarts & wetenschap	
Infectieziekten Bulletin	

Journal name	Journal Impact Factor (2010)	
Infection Control Hospital Epidemiology	2.770	
Informatics in Primary Care		
International Immunology	3.403	
International Journal of Cancer	4.722	
International Journal of Epidemiology	5.262	
International Journal of Medical Informatics <sup>4</sup>	3.126	
International Journal of Microsimulation		
International Journal of Obesity	4.343	
International Journal for Quality in Health Care	1.881	
International Journal of Tuberculosis and Lung Disease	2.548	
Journal of Allergy and Clinical Immunology	9.165	
Journal of the American Medical Association	28.900	HSJ
Journal of Clinical Endocrinology and Metabolism	6.202	
Journal of Clinical Epidemiology	2.956	
Journal of Clinical Microbiology	4.162	
Journal of Clinical Virology	3.043	
Journal of Epidemiology and Community Health	3.043	
Journal of Family Practice	1.426	
Journal of Gerontology; Biological & Medical sciences	3.083	
Journal of Gerontology; Psychological & Social sciences	2.094	
Journal of Intellectual Disability Research		
Journal of the National Cancer Institute	14.069	
Journal of Nutrition	4.091	
Journal of Nutrition Health and Ageing	1.712	
Journal of Pharmaceutical Sciences	2.906	
Journal of Public Health	1.230	
Journal of the American Geriatrics Society	3.656	
Lancet	30.758	HSJ
Medical Decision Making	2.597	
Medicine and Science in Sports and Exercise	3.707	
Molecular Microbiology	5.361	
Nederlands Tijdschrift voor Geneeskunde		
Nederlands Tijdschrift voor Medische Microbiologie		
Nephrology Dialysis Transplantation	3.306	
Netherlands Journal of Medicine, The	1.500	
New England Journal of Medicine	47.050	HSJ
Obesity	3.366	
Obesity Reviews	5.086	
Obesity Research	3.366	
OMICS A Journal of Integrative Biology		
Pediatric Allergy and Immunology	2.676	
Pediatric Pulmonology	1.816	
Pediatrics	4.687	
Pharmacoeconomics	2.612	

<sup>4</sup> Formerly known as International Journal of Bio-medical Computing



Journal name	Journal Impact Factor (2010)	
Pharmeuropa		
Population Health Metrics		
Preventive Medicine	3.172	
Primary Care	0.809	THR
Public Health	1.261	
Public Health Nutrition	2.749	
Quality of Life Research	2.376	
Risk Analysis	1.953	
Scandinavian Journal of Primary Health Care	2.205	
Sexually Transmitted Infections	2.175	
Simulation: Transactions of the Society for Modelling and Simulation International		
Social Science and Medicine	2.710	
Thorax	7.041	
Tijdschrift voor Gezondheidswetenschappen		
Tijdschrift Gerontologie en Geriatrie		
Vaccine	3.616	
Value in Health	3.032	
Voeding Nu		
Voedingsmiddelentechnologie		
	Average impact:	3.948
	Threshold:	0.809

**Theme MFF**

<b>Journal name</b>	<b>Journal Impact Factor (in 2010)</b>	
Biologicals	1.381	
Biopharmaceutics and Drug Disposition	1.250	
British Journal of Clinical Pharmacology	3.246	
British Journal of Nutrition	3.446	
British Medical Journal	13.660	
Clinical Immunology	3.863	
European Journal of Nutrition	2.866	
European Journal of Pharmaceutical Sciences	2.608	
European Journal of Pharmaceutics and Biopharmaceutics	3.151	
Food and Chemical Toxicology	2.114	
International Journal of Pharmaceutics	2.962	
Journal of Pharmaceutical and Biomedical Analysis	2.453	
Journal of Immunology	5.646	
Journal of Pharmaceutical Sciences	2.906	
Molecular Immunology	3.202	
Pediatrics	4.687	
Pharmaceutical Research	3.933	
Pharmacoepidemiology and Drug Safety	2.527	
Pharmacy World Science	0.919	THR
Pharmeuropa Scientific Notes		
Toxicology	3.241	
Toxicology and Applied Pharmacology	3.359	
Trends in Food Science and Technology	4.051	
	Average impact:	3.521
	Threshold:	0.919

## Theme EQH

Journal name	Journal Impact Factor (in 2010)
Acta Acustica United with Acustica	0.637
Applied Soil Ecology	2.122
Applied Optics	1.410
Archives Environmental Contamination Toxicology	1.743
Atmospheric Chemistry and Physics	4.881
Atmospheric Environment	3.139
Basic and Applied Ecology	2.422
Biology and Fertility of Soils	1.757
Bodem	
British Journal of Radiology	2.105
Chemosphere	3.253
Communication Research	
Ecological Complexity	2.040
Ecotoxicology and Environmental Safety	2.133
Ecotoxicology	3.507
Environment International	4.786
Environmental Biosafety Research	
Environmental Microbiology	4.909
Environmental Monitoring and Assessment	1.356
Environmental Pollution	3.426
Environmental Science and Pollution Research	2.411
Environmental Science and Technology	4.630
Environmental Toxicology and Chemistry	2.565
Environment and Health	
Environmental Health Perspectives	6.191
Environmental Research Letters	3.342
Environmental Research, Section A	3.237
Environmental Science and Policy	2.322
Environmetrics	1.000
Epidemiology	5.511
European Journal of Soil Biology	1.247
European Journal of Epidemiology	3.718
FEMS Microbiology Ecology	3.598
Functional Ecology	4.546
Geophysical Research Letters	3.204
H <sub>2</sub> O	
Health Physics	0.917
Human and Ecological Risk Assessment	1.528
Inhalation Toxicology	3.202
Integrated Environmental Assessment and Management	
International Journal of Health Geographics	
International Journal of Radiation Biology	1.842
Journal of Environmental Monitoring	2.225
Journal of Environmental Quality	2.291
Journal of Exposure Science and Environmental Epidemiology	2.718

Journal name	Journal Impact Factor (in 2010)	
Journal of Soils and Sediments	2.613	
Journal of Toxicology and Environmental Health	1.724	
Journal of Decision Making		
Journal of Geophysical Research D: Atmospheres	3.082	
Journal of Radiological Protection	1.054	
Journal of Risk Research	0.569	
Milieu		
Naturwissenschaften	2.316	
New Phytologist	6.033	
Occupational and Environmental Medicine	3.643	
Optical Engineering	0.553	THR
Particle and Fibre Toxicology		
Pedobiologia	2.414	
Pesticide Management Science	2.190	
Photochemistry and Photobiology	2.253	
Photochemistry and Photobiology Science	2.708	
Plant and Soil	2.517	
Public Understanding of Science	1.981	
QSAR and Combinatorial Science	3.030	
Radiation and Environmental Biophysics	1.635	
Radiation Protection Dosimetry	0.707	
Radiation Research	2.948	
Risk Analysis	1.953	
Risk and Decision		
Science of the Total Environment	2.905	
Science Communication	1.054	
Soil Biology and Biochemistry	2.978	
Statistics in Medicine	1.990	
Theoretical and Applied Climatology	1.776	
Tijdschrift voor Communicatiewetenschappen		
Toxicological Sciences	4.814	
Toxicology in Vitro	2.060	
Toxicology Letters	3.479	
Water Science and Technology	1.094	
Water Air and Soil Pollution	1.676	
	Average impact:	2.612
	Threshold:	0.553



## Appendix 5 Indicators for the impact of environmental and health research on society

Indicators from RGO report		Indicators selected for RIVM Strategic Research	
<i>Indicators for societal impact</i>		<i>Indicators for societal impact</i>	
Process-based	Memberships of health-related advisory committees Collaborations with stakeholders (e.g. patient organisations) Research publications (including [Dutch] journals, text books etc.) Contributions to professional education Informing the public through authorised websites References to research in public media.	Process-based	Participation in international advisory bodies Request for advice from third parties Follow-up assignments
Product-based	References in (treatment) guidelines and protocols  References in significant policy documents Contributions to health-related technologies and services New diagnostics New treatments or medicines	Product-based	Application of research outcomes in guidelines, regulation, policies and so on
<i>Indicators for economic impact</i>		<i>Indicators for economic impact</i>	
Process-based	Memberships of advisory committees in the private domain	Process-based	N/A
Product-based	Commercial products Private spin-off companies Patents	Product-based	N/A

Note: Not all indicators on the RGO list were selected. Some of them could be meaningful when applied to RIVM as a whole, but were deemed too far removed from the goals of RIVM's Strategic Research Programme.



## Appendix 6 New assignments, contracts and commissioners

Theme	Follow-up assignments
RPC	<ul style="list-style-type: none"> <li>• Early detection of breast cancer using serum biomarkers (together with the Executive Board – CvB), commissioned by the Ministry of Health, Welfare and Sport (VWS)</li> <li>• <i>Detection of immunological responses to pathogens</i>: project to expand information on the immune responses to avian influenza strains in Indonesia (Economic Affairs, Agriculture and Innovation – EL&amp;I)</li> <li>• Project of the Food Safety Authority (VWA) with emphasis on interaction of nanomaterials and immune system</li> <li>• Project of VWS on food consumption knowledge base</li> <li>• Participation in NanoNext.NL (Economic Affairs, Agriculture and Innovation)</li> <li>• Kinetic and biodistribution study of nanosilver (VWS-Medicine and Medical Technology – GMT)</li> <li>• Nanonext.NL: project in area of bioavailability and toxicity of nanomaterials (EL&amp;I)</li> <li>• Probabilistic tool to estimate usual intake distributions and individual usual intake using the EFSA comprehensive food consumption database (European Food Safety Authority – EFSA)</li> <li>• The developed methodology on probabilistic modelling was applied in a study commissioned by VWS in 2008</li> <li>• Participation in European (e-)Health Literacy Survey project – HLS-EU (Pennsylvania Home Educators Association – PHEA)</li> <li>• Participation in LUMC research 'ICT supported personalisation and contextualization of healthcare information as part of the self-management of chronically ill patients' (The Netherlands Organisation for Health Research and Development – ZonMw)</li> </ul>
ERF	<ul style="list-style-type: none"> <li>• Funding by the National Coordinator for Counterterrorism (NCTB)</li> <li>• Several projects on Q fever (commissioned by ZonMw, VWS, VWA)</li> <li>• AniBioThreat (Seventh Framework Programme – FP7), European Commission Home Affairs – DG Home)</li> <li>• Project 'PathoDetect' for developing detection methods using lab-on-a-chip technology (EU 'Eurostars' funded project)</li> </ul>
INF	<ul style="list-style-type: none"> <li>• Participation in a project of the European Centre of Disease Prevention and Control (ECDC) on the estimation of generation times (VWS)</li> <li>• Funding by VWS: 'Is mumps virus evolution affecting vaccine effectiveness?</li> <li>• Memory B cells analysis from selected patients and contacts</li> </ul>



Theme	Follow-up assignments
	<p data-bbox="539 405 1107 427">of the influenza epidemic 2009–2010 (ZonMw)</p> <ul style="list-style-type: none"> <li data-bbox="491 450 826 472">• Child-Innovac (EU-FP7)</li> <li data-bbox="491 495 1262 577">• The use of functional antibody assays to study antigen variation and the potential for pertussis resurgence (Health Protection Agency – HPA)</li> <li data-bbox="491 600 1230 651">• Commission on Human Papillomavirus (HPV) vaccination (VWS)</li> <li data-bbox="491 674 1278 786">• Optimising the national prevention strategies against Hepatitis B, using molecular epidemiology and mathematical modelling (ZonMw). Collaboration with General Practice Registries (GGD) Amsterdam</li> <li data-bbox="491 808 1262 860">• Analysis of serological surveys on mumps, measles, rubella and varicella (VWS)</li> <li data-bbox="491 882 1278 987">• Development, evaluation and implementation of new-generation tools to type methicillin-resistant <i>Staphylococcus aureus</i> (MRSA) and track transmission (UK Clinical Research Collaboration – UKCRC)</li> </ul>
CIL	<ul style="list-style-type: none"> <li data-bbox="491 1010 1278 1061">• Study to further examine off-hours (weekend and night) care in the Netherlands (Health Care Inspectorate –IGZ)</li> <li data-bbox="491 1084 900 1106">• Overweight in children (VWS)</li> <li data-bbox="491 1128 1075 1151">• Socio-economic inequalities in health (VWS)</li> <li data-bbox="491 1173 900 1196">• Nutrition and ADHD (VWS)</li> <li data-bbox="491 1218 1262 1279">• Commission on discouragement of the use of tobacco (VWS)</li> <li data-bbox="491 1301 1219 1323">• PIAMA data are being used in several VWS commissions</li> <li data-bbox="491 1346 1278 1397">• EHLEIS (Directorate General for Health and Consumer Affairs – DG-SANCO)</li> <li data-bbox="491 1420 1246 1471">• Prevalence and consequences of childhood asthma and on the use of asthma medication by children (Asthma Fund)</li> <li data-bbox="491 1494 1059 1516">• Safefoodera-Beparibbean (European Union)</li> <li data-bbox="491 1538 1278 1621">• Completion of blood based markers in EPIC-Morgen samples (Biobanking and Biomolecular Resources Research Infrastructure – The Netherlands – BBMRI-NL)</li> <li data-bbox="491 1644 1278 1727">• Birthweight and chronic disease in the European Prospective Investigation into Cancer (The Netherlands – EPIC-NL) (VWS)</li> <li data-bbox="491 1749 1246 1800">• Risk-benefit assessments of nitrate (European Food Safety Authority – EFSA)</li> <li data-bbox="491 1823 1059 1845">• Knowledge base on chronic diseases (VWS)</li> <li data-bbox="491 1868 932 1890">• Sustainability and health (VWA)</li> <li data-bbox="491 1912 1262 1995">• Renovation of local liquid nitrogen biobank (Biobanking and Biomolecular Resources Research Infrastructure – BBMRI-NL)</li> <li data-bbox="491 2018 1203 2063">• Project of the International Breast and Prostate Cancer Cohort Consortium (BPC3)</li> </ul>

Theme	Follow-up assignments
	<ul style="list-style-type: none"> <li>• Project commissioned by the Emerging Risk Factors Collaboration (ERFC)</li> <li>• University of Utrecht, UU-IRAS SYNERGY study</li> <li>• Pooled community based cohort study on health effects of exposure to electromagnetic fields (ZonMw)</li> <li>• Collaboration in ESCAPE (international consortium for study of air pollution and mortality)</li> <li>• CHANCES (EU-FP7)</li> </ul>
MFF	<ul style="list-style-type: none"> <li>• Elderly: food, use of drugs and chronic diseases (VWS)</li> <li>• Autoimmunity related to food (VWA)</li> </ul>
EQH	<ul style="list-style-type: none"> <li>• Study on implementation of WFD needs (Ministry of Infrastructure and the Environment – I&amp;M)</li> <li>• Regulation on BRZO in relation to nature protection (I&amp;M)</li> <li>• Ecofinder (EU-FP7)</li> <li>• IWEOS project (I&amp;M)</li> <li>• Project on integrated environmental health impact assessment of Schiphol Airport Mainport 2.0 (I&amp;M)</li> <li>• Collaboration with TNO and ECN on stability of measurements of oxidative potential over time and its relation to chemical composition (I&amp;M)</li> <li>• Risk communication and soil pollution (I&amp;M – Environmental Quality Management)</li> <li>• Quantifying the environmental burden of disease (I&amp;M)</li> <li>• REBAN project: disaster assessment related to Dutch protected nature areas (I&amp;M and the Ministry of Economic Affairs, Agriculture and Innovation)</li> <li>• Contribution to Multidisciplinary European Low Dose Initiative (MELODI), a network of European radiation research institutes (I&amp;M)</li> <li>• Small area health research to investigate the cancer incidence rates around Corus (steel industry) (I&amp;M)</li> <li>• Methodology development for assessing nitrogen deposition on Natura2000 areas (Economic Affairs, Agriculture and Innovation)</li> <li>• PASODOBLE (EU)</li> <li>• SmogProg operations and development (Ministry of I&amp;M)</li> <li>• International project on noise mapping (NL Agency, Economic Affairs, Agriculture and Innovation)</li> </ul>



