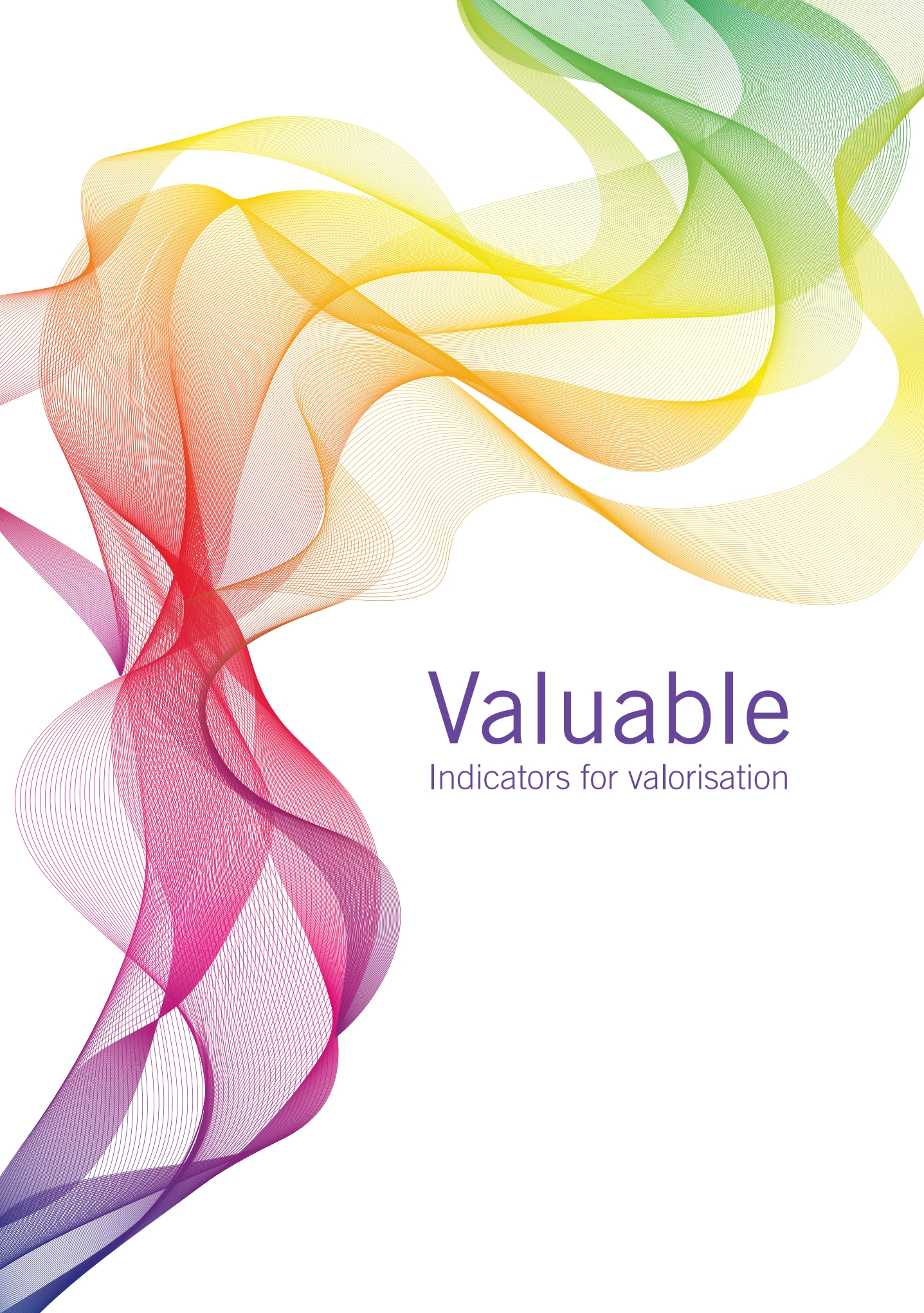

# Valuable

## Indicators for valorisation

# Valuable

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# Contents

# Preface

Dear reader,

This report is the result of a study by the Rathenau Institute, Technology Foundation STW, and Technopolis, into the potential for the use of indicators for knowledge valorisation. These institutes took the initiative some time ago to develop valorisation indicators and the National Valorisation Commission is pleased to provide support for this research.

We increasingly recognise that valorisation is an excellent tool for promoting economic growth. This is especially important at a time of economic decline. We are thinking, working and collaborating on all fronts to raise the utilisation of our scientific knowledge to the same high level as the knowledge itself. A great deal of money has been invested directly and indirectly in these activities and processes. The Dutch Cabinet has announced the aim of spending 2.5% of public research funding on valorisation.

In pursuing this goal and all the efforts associated with it, it is important that we can measure what we are doing in a way that can be tailored to each situation. But is that accountability possible or even desirable, I hear you ask? We believe so. Provided that we agree in advance what should be measured, and that is measured in a way that suits the situation and is scientifically substantiated. This report provides a number of model maps that form an excellent basis for valorisation.

It's a basis that we need to take forward, but most importantly, we can take forward.

I wish you, and all of us, every success in doing so.

Aad Veenman
Chairman of the National Valorisation Commission

# An end to counting papers

Counting the number of scientific publications began some fifty years ago in the United States. The idea was that if one could assess a scientist's productivity, the quality and scientific impact of research could be objectively determined; peer review would soon be a thing of the past. This initial optimism soon gave way to more nuanced views. It became obvious that the number of publications (on its own) was not a good indicator. So counting the number of citations as well soon emerged as a way to make quantitative statements about the quality of scientific peers. Since the mid-70s, we have known that citation analysis works well, but in a limited number of fields and always as one of the indicators in a broader picture.

Administrators and policy-makers sometimes forget this limitation, but it is a crucial precondition for the proper application and interpretation of bibliometric data. This applies even more strongly when we try to make quantitative statements about the societal and economic value of research.

## Every number tells a story

Does measuring actually make sense? Does everything then become weakened and less meaningful?  Absolutely not! Numbers are tools; they start up discussions between the parties concerned. And differences are there to be explained. A reality that is reduced to indicators is poor. A reality supplemented with indicators is rich and leads to clear communication.

This report, presented half a century after the beginning of bibliometrics, is intended to provide a framework for discussing knowledge valorisation - the creation of societal and economic value from scientific knowledge. It's a starting point for new developments and I hope it will inspire you to take it forward within your own scientific discipline, group or institute to produce a constructive and useful collection of indicators that will enrich our reality.

I would like to thank the staff of the Rathenau Institute and Technopolis for their enthusiastic collaboration and the expertise they contributed throughout this project. I am also very grateful to the National Valorisation Commission chaired by Aad Veenman. The confidence shown by the commission members in 'taking the plunge' is very much appreciated.

Eppo Bruins

Technology Foundation STW
Initiator

# Summary

The definition of valorisation used by the National Valorisation Commission is the starting point for developing indicators for valorisation. On this basis we identify four dimensions of valorisation in the 4D valorisation model. We present specific, relevant indicators on valorisation maps for different situations.

## Definition of valorisation

*Valorisation is the process of creating value from knowledge by making knowledge suitable and/or available for economic and/or societal use and translating that knowledge into competitive products, services, processes and entrepreneurial activity.*

## The four dimensions of valorisation

**1 Actors**

Various actors are responsible for valorisation: the knowledge provider (university, institute); the knowledge user (business, industry, government, NGO); and the intermediary (science financier).

**2 Aggregation level**

The responsibility for valorisation is held at different levels: from the institutional level of the university, company or financier, through to the mid-level of departments or programmes, to the practical level of the researcher or individual innovation project.

**3 Discipline**

Valorisation takes place in all disciplines and fields of research, both in mono-disciplinary and multidisciplinary research. There are appropriate forms of valorisation for each discipline: from patents and spin-offs, through advice on new legislation, to compiling an exhibition catalogue.

**4 Stages**

Valorisation is a process where awareness and interaction at all stages and levels of research are important: from the formulation of a mission and policies, through the development of research, agenda setting, and execution of research and dissemination of results, to implementation.

## Indicators

- Valorisation cannot be measured and compared simply by counting. Counting provides insufficient insight into the valorisation process and fails to show the value that is created.
- A combination of quantitative and qualitative data is needed to make an informed assessment.
- Every situation is unique and dependent on the context. Comparing performance between different situations is, therefore, neither useful nor relevant.

## Valorisation maps

Each valorisation situation represents a different cut out of the 4D valorisation model. A limited number of relevant indicators can be formulated for each specific situation. These indicators are presented on a valorisation map.

This report contains the following valorisation maps:

- **Map 1 – a university of technology;**
- **Map 2 – a humanities faculty;**
- **Map 3 – a 'knowledge network' in a university of applied sciences**
- **Map 4 – a research council's thematic programme;**
- **Map 5 – a company.**

# 1 Introduction

Valorisation is an interactive process with a result: knowledge utilisation. This outcome is central to the assessment of valorisation and policies for its promotion. But the interactive process that underlies valorisation is often ignored, as are the different forms of valorisation. Because of this, there may be an overview of, but not a true insight into, the actual valorisation performance.

The most commonly used results indicator is the number of patents. The assumption here is that a higher number of patents equals more valorisation. A patent can indeed be an indicator. After all, a patent is essential to valorise certain knowledge: no patent, no valorisation. More patents mean more knowledge that can be valorised. But a patent does not automatically lead to knowledge utilisation; it only means that knowledge is offered in a useful format. For knowledge utilisation, it is necessary that knowledge can also be used outside the laboratory; that there is market potential and interest from investors. Moreover, different activities, certain conditions and a variety of parties are needed to develop an idea in the pre-patent application stage. The patent is neither the end nor the beginning of a valorisation process. In addition, this indicator only applies to a limited number of situations. In the social sciences or humanities, patenting of knowledge is seldom possible. This widely used indicator is irrelevant in these disciplines and knowledge is valorised in other ways: for example, interpreting the news in a news programme, developing a teaching method, managing a museum collection or advising on policy.

In developing a useful valorisation model we have focused on the societal and economic utilisation of scientific knowledge. In this respect we have used the definition of valorisation as formulated in Van voornemens naar voorsprong: Kennis moet circuleren (2009):

*Valorisation is the process of creating value from knowledge by making knowledge suitable and/or available for economic and/or societal use and translating that knowledge into competitive products, services, processes and entrepreneurial activity.*

Who, when, where and how, scientific knowledge is valorised, is related to the organisational level, the scientific discipline, the parties concerned and the stage of research. It is therefore not advisable to develop only one set of indicators that can be applied to any situation. We have therefore developed a variable structure that provides insight into the valorisation process in many different situations. This 4D valorisation model is introduced in Chapter 3. With this 4D valorisation model, specific situations can be clearly mapped; the selection of appropriate indicators provides insight into the valorisation process. In Chapter 4 we illustrate the practical

applicability of the 4D valorisation model with a range of valorisation maps. But first, in Chapter 2, we discuss some general considerations for the use of indicators and evaluations.

# 2 Indicators and evaluations

Below are some considerations for the use of indicators and the use of evaluations in general. Although these points do not specifically relate to indicators for valorisation or the assessment of valorisation only, they have played a leading role in the development of the 4D valorisation model and the valorisation maps.

## Practical use of indicators

A common concern in studies on indicators is the issue of practicality. Many comments can be made about indicators. The most important concerns are described below; we have also indicated how to respond to them.

### Measurable: measuring is not possible; measuring is not the same as knowing

Not all indicators are easy to measure, have a simple meaning and enable comparisons to be made. Many indicators for valorisation can't be measured because they relate to qualitative data. But even if quantitative indicators are formulated, interpreting the score is often ambiguous. Is there a proportional relationship between scores? Does a score that is twice as high imply that it is twice as good? And does that also apply if the scores on the indicator are low, in the order of magnitude of 0 or 1? Can a benchmark be established for an indicator? And are the scores easy to compare? The answer to these questions is usually ‘no’. This means that the interpretation of scores is of great importance, whether they relate to quantitative or qualitative data.

### Available and reliable: relevant data are not collected or recorded

Some indicators don't appear very usable in practice because the data required have either not been collected or have not been recorded at all. Sometimes access to data is limited, because

of secrecy, for example. Both a low score and poorly-substantiated qualitative data can simply be due to inadequate collection of data or an insufficient overview. This means that reliability is an issue; that there is a major difference between the measured score and the actual number. Also, an indicator that appears to say a great deal can prove to be useless because the relevant data are unavailable, have not been collected or are not accessible. This again highlights the great importance of interpretation However, availability is not fixed. If an indicator is considered to be important, then the required data can be better recorded, collected and made more available.

## Manipulable: data can be easily manipulated

One recurring concern when developing indicators is the potential manipulation of scores. Some scores are apparently easy to manipulate because the indicator has not been defined precisely, because certain data have been counted twice, or because data can be relabelled (and counted twice). Once again, interpretation of the score is important: how was the score reached, what has been included, and does the score really reflect what was intended?

## Validity: what does the indicator really mean?

Finally we come to the question of whether an indicator really measures what we want to know; whether the indicator reflects exactly what we want to know. In many cases an indicator is considered to be synonymous with the variable to be measured. In the case of valorisation, which can be categorised as an interactive process, a single results indicator will not be valid. Such an indicator does not do justice to the process-like character of valorisation. This means that for a valid assessment of valorisation, we need indicators that do justice to this interactive process. It takes more than a single quantitative indicator.

## The ‘patents’ indicator: practical usability

The following questions and comments on the ‘number of patents’ indicator highlight the complexity of the practical usability of indicators.

- **Measurable:** are two patents better than one? And if so, are 26 patents twice as good as 13 patents? And what about disciplines where knowledge can't be patented and the score is therefore ‘0’?
- **Available and reliable:** is there an easily accessible list of patent applications available? Does this cover all the stages of patent application, including the stage where the application is prepared and the stage after the patent is granted and licensed?
- **Manipulable:** in some areas it is easy to increase the number of patent applications. Does this really mean that more knowledge has been valorised?
- **Validity:** a patent is not the same as valorisation. A patent only means that knowledge is presented in a useful format. Also, the indicator does not do justice to the process of valorisation; it is simply a snapshot.

# The use of evaluations

Generally speaking, performance can be evaluated in two ways: formative and summative. When developing the 4D valorisation model and valorisation maps we focused on the former: the use of knowledge to learn and improve (formative evaluation).

## Summative: a judgement

In the case of summative evaluation, a third party assesses the extent to which there has been any valorisation: how it has been achieved, and whether it's good enough. Requirements and consequences can be attached to such an evaluation; some scores are rewarded or punished. In practice it appears that this system leads to scores that are often moving quickly in the desired direction, sometimes to the detriment of scores for other indicators. Consequently, the difference between the units under assessment becomes smaller and therefore the ability to distinguish between them also weakens. Whether the desired changes actually occur is not always clear.

## Formative: for learning and improving

In the case of formative evaluation, a third party or the organisation itself assesses the extent to which there has been any valorisation and in particular, why this is so. This includes advice on improving performance: what's good, what should be better, and how that can be achieved. If such a system is used correctly, substantive improvements really can be made. On the other hand, it is more difficult to compare performance because specific contextual factors need to be taken into account.

# 4D valorisation model

# 3

The term valorisation refers to a process that has long been a focus of attention. Public bodies have shown an interest in the use of scientific knowledge since the mid-1970s. This trend is not limited to the Netherlands; the societal utilisation of science has been an important issue in neighbouring European countries and in the United States over recent decades.

However, the word 'valorisation' is only used in a few countries. As far as we know it originated in Belgium and was first used in the Netherlands in the 2004 Netherlands Science Budget, which expressed the view that the Dutch knowledge economy will improve if more is done in the way of valorisation. The word is seldom used outside the Netherlands and Belgium, so there have been few studies on valorisation. This report is based partly on studies into the assessment of research quality, as well as studies on similar subjects to valorisation, such as the societal relevance of research, knowledge exchange, innovation, technology or knowledge transfer, and third mission. The definition of valorisation used by the National Valorisation Commission includes these concepts and forms the starting point for developing indicators.

*Valorisation is the process of creating value from knowledge by making knowledge suitable and/or available for economic and/or societal use and translating that knowledge into competitive products, services, processes and entrepreneurial activity.*
*Knowledge valorisation is a complex and iterative process in which interaction between knowledge institutions, business and NGOs - at all stages of knowledge development - is important.*

In European and American literature there is consensus on some important points, the main one being that interaction and cooperation are crucial for valorisation or to achieve societal impact. It is much more than simply transferring knowledge at the end of a research project. This is also reflected in the definition of valorisation, which emphasises that valorisation is a process of interaction during all stages of research. This implies that meaningful indicators for valorisation relate to interaction and that indicators are required for the various stages of research.

It is also widely accepted that a combination of quantitative and qualitative data is needed to achieve a good assessment. Valorisation cannot be measured through simple counting. The

complexity and diversity of the valorisation process mean that an assessment based on a few quantitative indicators makes little sense. This also means that a simple comparison of valorisation performance is impossible.

# Towards valorisation indicators

Indicators for valorisation have been suggested in many studies. And although the principles and approaches differ there are also great similarities:

- Most indicators have not been tested and are not known to have been used since the study concerned was published.
- Most indicators concern economic use; few indicators relate to societal use.
- Most indicators apply to research in medical, technical or natural sciences; indicators for other disciplines such as humanities or societal sciences are scarce.
- Most indicators relate to output; there are few indicators relating to impact, interaction or other stages of the research process.

This means that there is no ready-made set of indicators available that is in line with the definition of valorisation. We have therefore developed a new model based on existing understanding and which takes into account the deficiencies. In this model we specifically take into account the diversity of forms and practices of valorisation and the process-like nature of valorisation. This gives us the following two dimensions:

- There are indicators for all forms of use and for all disciplines and fields of research. This supplements existing indicators that are often limited to economic use in a limited number of disciplines.
- There are indicators for interaction and indicators for the various stages of research, to do justice to the valorisation process. This supplements existing indicators that are often limited to output indicators.

The model also differs from other models by explicitly stating where responsibility for valorisation lies. This gives us two new dimensions:

- There are indicators for all the parties responsible: knowledge providers, knowledge users and intermediary organisations. Existing indicators mainly apply to knowledge providers while in studies and in practice it is clear that all parties involved play a significant role in the valorisation process.
- There are indicators for all levels of aggregation: from the organisation to the individual. Valorisation is usually assessed on the level of the individual researcher, project or group. However, we know that policy and culture within an organisation have a great influence on performance and opportunities. Indicators have therefore been developed for all levels of aggregation.

# The four dimensions of valorisation

We identify four different valorisation dimensions in this model. These dimensions do justice to the distribution of responsibilities for valorisation, the diversity of forms and practices of valorisation, and the process-like character of valorisation. In summary, they are the following dimensions:

1. **Actor**
   Several actors are responsible for valorisation:
   - the knowledge provider: university, or academic institute;
   - the knowledge user: business, industry, government, societal group;
   - the intermediary: research council, government.

2. **Level of aggregation**
   The responsibility for valorisation is held at different levels:
   - the institutional level of university, company or research council;
   - the mid-level of departments or programmes;
   - the practical level of researcher or innovation project.

3. **Discipline**
   Valorisation takes place in all disciplines and fields of research, both in mono-disciplinary and multidisciplinary research. There are appropriate forms of valorisation for each discipline: from patents and spin-offs, through advice on new legislation, to compiling an exhibition catalogue.

4. **Stage**
   Valorisation is a process in which awareness and interaction are important in all stages of research:
   - formulation of mission and policy;
   - agenda setting;
   - conducting of research;
   - dissemination of results;
   - application and use of research;
   - other interaction throughout the entire process.

# Valorisation maps

This results in a four-dimensional (4D) model that can be applied in various situations. Each situation represents a specific aspect of this 4D model. A limited number of relevant and specific indicators can be formulated for each situation or each aspect of the model and placed on a valorisation map. This means that we can draw up a valorisation map for all situations in which valorisation is assessed.

Chapter 4 presents valorisation maps for:

- **Map 1 – a university of technology;**
- **Map 2 – a humanities faculty;**
- **Map 3 – a 'knowledge network' in a university of applied sciences**
- **Map 4 – a research council's thematic programme;**
- **Map 5 – a company.**

The same three dimensions are defined on each valorisation map: actor, level of aggregation and discipline. The indicators are presented in the fourth dimension, the research stage. To illustrate this, the valorisation map for a university of technology is as follows:

The three defined dimensions:
- Field of research = engineering and design sciences
- Actor = knowledge provider, i.e. a university
- Level of aggregation = high-level

The indicators are presented in the fourth dimension:

| Stage | Key word | Indicator and explanation |
|---|---|---|
| Mission and policy<br>Agenda setting<br>Conduct of research<br>Dissemination<br>Utilisation<br>Interaction | ... | ... |

## Developing valorisation maps

The valorisation maps shown in Chapter 4 are examples. They are not standard formats. They are not meant as an exercise to fill in. That would ignore the overall intention: to gain a real insight into the valorisation process and to enhance performance.

We need new valorisation maps for other situations. These can be developed by those concerned. It is important to take the four dimensions of valorisation into account: actor, level of aggregation, discipline and stage. It is also important to consider the characteristics of the specific situation. Good starting points when developing a valorisation map are mission and policy. What do we want to achieve in terms of valorisation? What is our responsibility? What can we influence? What are the goals we set to achieve our mission? And what strategies do we need to achieve both the goals and the mission? What activities do we undertake, how do we organise the research, who do we work with, what and who do we want to reach? How do we make our results known? Answers to such questions result in relevant indicators for valorisation.

## Reaction of experts

The 4D model was presented to experts during interviews (see also Appendix I). These experts work for knowledge institutions, trade and industry, the government or intermediary organisations. Thanks to their work experience they have a clear perception of valorisation. It must be stressed that they have no responsibility for the model presented here. The interviewees underlined the importance of the valorisation dimensions: party, level of aggregation, discipline and stage. Some of them emphasised the importance of personal contacts or interaction. This point was included in the model.

There was one point on which the interviewees differed, and that is the need to develop indicators for knowledge users: business and government. Some argued that valorisation (i.e. creating value from scientific knowledge) is not the aim of knowledge users, and that knowledge users should therefore not be assessed. Nevertheless we present a model with indicators for knowledge users. After all, valorisation of publicly-financed research is an interactive process in which knowledge users also play a role. Whether these indicators are used is up to the knowledge users themselves and is a matter for politics and policy.

# 4 Valorisation maps

The 4D valorisation model can be applied to a wide variety of situations. It provides an insight into the valorisation process in each situation. This means it is possible to evaluate, stimulate and further develop valorisation.

Below are five valorisation maps that illustrate the model's applicability and usability. These valorisation maps are examples that can be used to develop maps for other situations. In this way, all stakeholders can obtain a real understanding of the valorisation process in all situations.

The five valorisation maps presented below are:

- **Map 1 – a university of technology;**
- **Map 2 – a humanities faculty;**
- **Map 3 – a 'knowledge network' in a university of applied sciences**
- **Map 4 – a research council's thematic programme;**
- **Map 5 – a company.**

# Map 1 – a university of technology

Field of research = engineering
Party = knowledge provider
Level of aggregation = high-level

| Stage | Keyword | Indicator and explanation |
|---|---|---|
| Mission | Mission | Description of the institute's societal and economic mission. |
| | Integral policy | How is the societal and or economic mission an integral part of policy (research, education, funding and quality assurance)? How is valorisation embedded in HR policy? How is valorisation part of the planning & control cycle? |
| | Valorisation policy | Concrete measures and specific plans for valorisation: initiatives to stimulate the valorisation culture in the university; organising a Technology Transfer Office; presence of other forms of support (legal aspects, funding opportunities, project management); presence of a Science Park, incubator, specific buildings. |
| | Budget | The size of the valorisation budget; percentage of the total budget; budgeting principles; the university's share from its own resources. |
| | Governance | Degree of involvement of societal and economic stakeholders in the university's board of governors. |
| Agenda setting | Strategic collaboration | Concrete examples of strategic collaborative arrangements with societal and economic stakeholders at the institutional level. |
| | Participation in major initiatives | Concrete examples of participation in major cross-faculty collaborative initiatives and programmes (top sectors, top institutes of technology, roadmaps). |
| Execution | Funding | The total amount of external funding from thematic research programmes with societal or economic goals as well as from contract research; percentage of the total budget; percentage of employees financed from these sources. |
| | Shared infrastructure | The number of research facilities shared with societal and economic stakeholders; number of external organisations involved. |

| | | |
|---|---|---|
| Dissemination and utilisation | Artefacts | Number of (open source) tools, designs, models, systems, methods and evidence of utilisation: number of visitors, number of contracts, revenue. |
| | Co-publications | Number of publications written in association with societal and economic stakeholders. |
| | Patents and licences | Number of (joint) patents in portfolio; number of licences granted; royalties. |
| | High-tech start-ups | Number of high-tech start-ups; number of new companies and number of staff involved; turnover; growth. |
| People | Dual appointments | (Relative) number of researchers with dual appointments. |
| | Exchanges | (Relative) number of staff exchanges with societal and economic stakeholders. |
| | Entrepreneurship | (Relative) number of students participating in entrepreneurship programmes. |
| | Career | (Relative) number of graduates and researchers following a career in trade & industry / NGOs. |

# Map 2 – a faculty of humanities

Field of research = humanities
Party = knowledge provider
Level of aggregation = mid-level

| Stage | Key word | Indicator and explanation |
|---|---|---|
| Mission | Mission | Description of the faculty's societal and economic mission. |
| | Integral policy | How is the societal and economic mission an integral part of the policy pursued by the faculty (research, education, funding and quality assurance)? How is valorisation embedded in HR policy? How is it included in the planning & control cycle? |
| | Valorisation policy | Which valorisation policy does the faculty pursue and what arrangements fall under that policy? |
| | Budget | The size of the budget for valorisation and percentage of the total (research) budget. |
| Agenda setting | Strategic collaboration | Concrete examples of strategic collaborative arrangements with societal partners: museums, libraries, archives, cultural establishments, governments, training institutes, companies. |
| | Participation in research initiatives | Concrete examples of participation in research initiatives with a societal (and/or economic) goal. |
| Execution | Instruments | Number and examples of specific initiatives and/or instruments: dual learning and research projects; commercial activities such as faculty-affiliated consultancies. |
| | Collaboration | Number and examples of collaboration with NGOs and companies in education and research, collaborative collection development and administration. |
| | Theses | (Relative) number of theses or other graduation projects produced in association with users or based on questions put forward by users; examples of such assignments. |
| | Funding | The total value of funding from thematic research programmes (indirect funding), from contract research and from consultancy; percentage of the total (research) budget; examples. |

| | | |
|---|---|---|
| Dissemination | (Co-)publications | Number of publications written in association with or specifically for societal stakeholders; publications for a wider public; examples. |
| | Public appearances | Number of appearances in the media, contributions to the public debate, public lectures; examples. |
| | Artefacts | Number of exhibitions, websites, methods; examples. |
| | Education and training | Number of courses for organisations/companies, and for a wider public; examples. |
| Utilisation | Interpretation | Media's use of specific expertise to interpret (current) events; examples. |
| | Visitors | Number of visitors to exhibitions, special collections; revenue. |
| | Readers | Number of books sold, number of readers of newspaper articles and other non-scientific publications. |
| | Education and training | Number of participants and participant satisfaction; revenue. |
| | Products and services | Utilisation of knowledge in new products and services and through other artefacts: examples and revenue. |
| People | Dual appointments | (Relative) number of researchers with dual appointments; (relative) number of researchers with their own consultancy. |
| | Consultancy | Researcher participation in advisory and administrative bodies of NGOs, government and companies: (relative) number of researchers and examples. |
| | Career | (Relative) number of graduates and researchers following a career in trade & industry and NGOs. |

# Map 3 – a 'knowledge network' in a university of applied sciences

Field of research = science and technology / technology and innovation
Party = knowledge provider
Level of aggregation = mid-level

| Stage | Key word | Indicator and explanation |
|---|---|---|
| Mission | Mission | Description of the societal and economic mission of the institution, the research group and the professorship. |
| | Policy | How is the societal and economic mission a part of policy (research, education, funding and quality assurance)? How is valorisation embedded in HR policy? How is it included in the planning & control cycle? |
| Agenda setting | Responsiveness | Concrete examples of agenda setting in dialogue with or in answer to practitioners; strategic alliances (number of partners in the knowledge network, other collaborative arrangements). |
| | Grants and funding | Number of grants, term and amount of grant; description of the relationship with professional practice. |
| | Contract research | Number of contracts, duration and amount of contribution; description of the relationship with practitioners. |
| | Other contributions | Contributing organisation, role of the organisation in the professional field, size and objective of the contribution. |
| Execution | Collaboration | Examples of collaborative projects with third parties. |
| | Reports | (Relative) number of reports and papers produced in association with users or based on questions put forward by users; examples of such assignments. |

| | | |
|---|---|---|
| Dissemination | Artefacts | Designs, models, systems, methods, tools: number and examples. |
| | Publications | Publications written in association with, commissioned by, or aimed at users: number and examples. |
| | Education and training | (In-company) courses, symposiums, workshops for professionals: number and examples. |
| Utilisation | Artefacts | Examples of the introduction and use of artefacts; revenue. |
| | Publications | Examples of the use of publications, such as citations. |
| | Education and training | Number of participants and participant satisfaction. |
| People | Dual appointments | List of dual appointments; name of company; the importance of these companies for professional practice in the region; description of the use of these networks. |
| | Memberships | List of employees and their memberships on advisory committees; the importance of these committees for professional practice in the region; description of the use of these networks. |
| | Network | Other businesses and organisations which are part of the network; the importance of these organisations for professional practice in the region; description of the use of these networks. |

# Map 4 – a research council's thematic programme

Field of research = not defined; applicable for all disciplines
Party = intermediary
Level of aggregation = mid-level

| Stage | Key word | Indicator and explanation |
|---|---|---|
| Mission | Mission | Description of the programme's societal and economic mission. |
| | Objective | How is this mission an integral part of the programme? Description of the concrete goals; type of measures/conditions/structure to achieve those goals. |
| | Society's needs | Degree of stakeholder involvement in developing the programme content and structure. |
| Agenda setting | Strategic collaboration | Strategic collaboration with organisations specifically focused on knowledge utilisation and valorisation. |
| | Valorisation scope | Total budget and description of modalities for: intellectual property rights (IPR); conversion or further use of results; market research; development of business plans; exchange of researchers. |
| | Programme monitoring | Stakeholder involvement in monitoring the programme: steering committee membership; possibility of steering the content of the programme. |
| Execution | Call for proposals | Explanation of how the societal goal is reflected in the call, type of projects, type of funding. |
| | Evaluation | Explanation of how the societal goals are reflected in the composition of the panels and the assessment of applications. |
| | Valorisation activities | Scope for valorisation in the funding: percentage of the total budget; percentage of projects that make use of these budgets. |
| | Stakeholder involvement | (Relative) number of projects with a user committee; (relative) number of projects with mixed project consortiums. |

| | | |
|---|---|---|
| | Programme management | Explanation of how the expertise of executive office personnel promotes the programme objectives; explanation of how the organisation of the administrative processes furthers the objectives. |
| Dissemination and utilisation | Project dissemination | (Relative) number of projects that produce a usable product/process (after completion, after x years); financial value of these products; examples. |
| | Further research | (Relative) number of projects which, after completion, are continued with the help of stakeholder co-funding; examples. |
| | Programme dissemination | Programme management activities to involve stakeholders in the programme: number of (participants in) workshops for stakeholders and network meetings; number of (participants in) events for the general public; number of websites and number of visitors; number of newsletters and number of readers. |

# Map 5 - a company

Field of research = not defined
Party = knowledge user
Level of aggregation = high-level

| Stage | Key word | Indicator and explanation |
|---|---|---|
| Mission | Mission | Description of the ambition to play an active role in valorisation of publicly-funded research; implementation of this. |
| Agenda setting | Articulation of demand | How does the company articulate the demands for knowledge? What is the company's involvement in the design of public or public-private funded programmes and project proposals? How does the company incorporate its strategic agenda into such initiatives? |
| | Strategic collaboration | Number, importance and examples of strategic collaborative arrangements with knowledge institutions. |
| | Co-funding | Financial contributions to research programmes or projects: total amount involved, number of projects and percentage of the company's total investment in innovation; contributions to research programmes or projects in kind: description and importance of the contribution. |
| Execution | Funding | Number of sponsored PhD programmes; other contributions; examples. |
| | Collaboration | Number of participations in user committees; number and examples of joint projects. |
| | Exchanges | Number and examples. |
| | Mirror projects | Number and examples. |
| | Facility sharing | Use of publicly-funded research facilities; providing access to (test) facilities for researchers; other forms of facility sharing or making data available: number and examples. |

| | | |
|---|---|---|
| Dissemination | Joint dissemination | Number of co-publications, co-patents and other publications and artefacts in association with a knowledge institute; examples. |
| | Possibility of use | Explanation of the accessibility of research results; of the rules on intellectual property rights (IPR). |
| Utilisation | Patents and licences | (Relative) number of patents and licences obtained from research conducted by or conducted in association with knowledge providers; value and utilisation. |
| | New products and services | (Relative) number of new products and/or services based on research conducted by or conducted in association with knowledge providers; proceeds or turnover; shortening the time to market; effectiveness of R&D. |
| | Follow-up programmes | Number of follow-up programmes ensuing from participation in research programmes or projects; examples. |
| People | Dual appointments | (Relative) number of employees who are also employed by a knowledge provider. |
| | Sponsoring | Total number of jobs financed by the company with knowledge providers and the total cost involved. |
| | Recruitment | (Relative) number of new employees recruited through participation in programmes and projects. |

# 5 Conclusion and recommendations

Valorisation is an interactive process with an outcome. Typically, only the outcome of the process is considered. This gives an initial overview but no insight into how value is created and how the application of scientific knowledge is realised. In the 4D valorisation model presented here, attention is focused on the interaction and the process itself. The 4D valorisation model is applicable to a variety of stakeholders in many different situations.

The major advantage of this 4D model is that it does justice to the four dimensions of valorisation: the actor concerned, the aggregation level within an organisation, the field of research, and the stage of research. The 4D valorisation model does not prescribe a fixed set of indicators but presents a limited set of indicators for every situation. An indicator which is extremely valuable in one situation can be meaningless in another.

This 4D valorisation model has been verified in interviews. Its practical value was seen immediately by the interviewees: stakeholders from different situations recognised that the model could be applied within their own specific situation.

The usefulness and applicability of the 4D valorisation model is illustrated with the aid of five valorisation maps. The sample maps are the first of a dynamic range of maps. New valorisation maps are needed for other situations. When developing a valorisation map it is important to consider the four dimensions of valorisation and the characteristic features of the specific situation. Mission and policy are a good starting point. What do we want to achieve in terms of valorisation? What is our responsibility? What are our objectives? How do we want to achieve them? Answers to these questions lead to relevant indicators for valorisation that can be incorporated into individual valorisation maps, appropriate to a specific situation.

The 4D valorisation model is a new approach that differs from the traditional practice which is quantitative and focuses on output. The model provides the opportunity to gain insight into the complex valorisation process and to expand the valorisation potential of scientific knowledge. Practical implementation requires a different way of using evaluations than for accounting purposes only. The model of 4D valorisation maps is an invitation to evaluate in order to learn

and improve. For this, openness is needed, as well as the courage to scrutinise (or have someone else scrutinise) one's own organisation and processes.

Organisations using the 4D valorisation model gain an insight into the valorisation process in their particular situation. Based on this formative concept, different organisations are able to share their insights. In this way it becomes possible to make a mutual 'comparison', from which each organisation is able to obtain an understanding of its own valorisation process. It is important to remember that each situation is specific; what, why and how a party takes action therefore depends partly on the stage, the discipline and level of aggregation. The valorisation maps are a tool for comparing valorisation efforts and future results; whether in universities, research programmes, institutes or colleges. This opens the way to benchmarking and ranking, nationally and internationally. Valorisation (societal impact, innovation, knowledge exchange) and its assessment are on many agendas worldwide.

Stimulating valorisation and assessing performance is of great importance; the Netherlands as well as other countries want to stimulate the knowledge economy. But the knowledge economy can only be encouraged if we don't lose sight of the role of universities in teaching students and conducting research. We should therefore not focus too narrowly on valorisation. Scientific research and scientific education are both critical to the knowledge system and form the basis for valorisation.

# Appendix I – Interviewees

| | |
|---|---|
| **Keimpe Algra** | Universiteit Utrecht |
| **Jacky Bax** | Ministerie van OCW |
| **Pim de Bokx** | ESA incubator |
| **Lex Bouter** | Vrije Universiteit Amsterdam |
| **Merit Clocquet** | Ministerie van EL&I |
| **Rob Docter** | Berlage Instituut |
| **Fred Dom** | Flexgen |
| **Frank van der Duyn Schouten** | Netspar / Universiteit van Tilburg |
| **Mariken Elsen** | NWO |
| **Jurgen Geelhoed** | Ministerie van EL&I |
| **Thomas Grosfeld** | VNO-NCW |
| **Marcel de Haas** | HBO-raad |
| **Annelies van Herwijnen** | ECN |
| **Arjan van Hessen** | Telecats / Universiteit Twente |
| **Hans Hofstraat** | Philips |
| **Aafke Hulk** | NIAS |
| **Dany Jacobs** | HAN / Universiteit van Amsterdam |
| **Michiel Janson** | Agentschap NL |
| **Harm Jeeninga** | ECN |
| **Mark de Jong** | Universiteit van Amsterdam / OPTA |
| **Wybren Jouwsma** | Bronkhorst High-Tech |
| **Nico Klaasen** | Secretaris Landelijke Commissie Valorisatie |
| **Fenrir van Koert** | Agentschap NL |
| **Rutger van Merkerk** | UMC Utrecht / Pontes Medical |
| **Rik Mooijweer** | MKB Nederland |
| **Cynthia Naus** | NWO |
| **Patrick Ooms** | Agentschap NL |
| **Jeroen van Oort** | VSNU |
| **Sandra Oudejans** | Technologiestichting STW |
| **Marijke van der Veen** | Syntens |
| **Aad Veenman** | Voorzitter Landelijke Commissie Valorisatie |
| **Thomas van Vliet** | Agentschap NL |
| **Johan Vos** | Universiteit van Amsterdam |
| **Marco Waas** | Technische Universiteit Delft |
| **Dorien Wellen** | Radboud Universiteit |

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# Appendix III – Project partners

This report and the 4D valorisation model were drawn up at the request of the National Valorisation Commission and developed by Technology Foundation STW, the Rathenau Institute, and Technopolis.

## Technology Foundation STW

Technology Foundation STW's (www.stw.nl/en) mission is to achieve the transfer of knowledge between technical sciences and users. It accomplishes this mission by bringing users and researchers together, funding excellent technical science, and guiding all its projects towards optimum opportunities for the transfer of knowledge. In addition, STW pursues its own policy and responds to external developments, proactively where possible.

To provide a better insight into the valorisation process, STW publishes an annual Utilisation Report. This report sets out the results achieved from STW-supported projects. An indication is given of how strong the involvement of industry is, the extent to which the research has led to a usable product and how much revenue has been brought in (in addition to any patents and contracts). Furthermore the Utilisation Report showcases STW projects and what determined their success.

## Rathenau Institute

The Rathenau Institute (www.rathenau.nl/en) promotes the formation of political and public opinion on science and technology. To this end, the Institute studies the organization and development of science systems, publishes about social impact of new technologies, and organises debates on issues and dilemmas in science and technology. The Rathenau Institute is an autonomous organization which was founded by the Ministry of Education, Culture and Science in 1986. It is still funded by the ministry, with responsibility for governance falling to the Royal Netherlands Academy of Arts and Sciences (KNAW).

The institute's two key tasks are:

- Stimulating public debate and the formation of political judgements:
  Technological and scientific developments can sometimes raise more questions than they actually answer. The Rathenau Institute highlights the significance of these developments for individuals and society, setting out both the opportunities and the risks. In the professional jargon this is known as Technology Assessment (TA).

- Describing the Dutch science system:
  The Rathenau Institute investigates the dynamics of science and technology. How is the science system organized, how does it respond to scientific, societal and economic developments, and to what specific scientific advances does this lead? This is called Science System Assessment (SciSA).

## Technopolis

The Technopolis Group (www.technopolis-group.com) is a European research group and consultancy operating in the fields of science, technology and innovation policy. The company employs more than 70 people spread across nine offices in Amsterdam, Ankara, Brighton, Brussels, Frankfurt/Main, Paris, Stockholm, Tallinn and Vienna. The Technopolis Group has carried out assignments in more than 30 countries. Its customers are mainly international, national and regional governments and intermediary organisations in the fields of science, technology and innovation. Technopolis BV in Amsterdam was founded in 1996 as an autonomous company within the group, and currently employs a staff of 14.