STRATEGIES FOR RESEARCH PRIORITISATION

– A comparison of six small to medium-sized economies

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Preface

This report is the result of a preliminary study conducted under the project "Prioritisation of Research and Innovation", which was conducted during 2009 by IVA, the Royal Swedish Academy of Engineering Sciences, with financial assistance from VINNOVA, the Swedish Governmental Agency for Innovation Systems.

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We want to thank all participants, including all interviewees not mentioned here, for their insights and advice. It is through your dedication to understanding the world's research prioritisation mechanisms that this report was made possible. Through it we hope to inspire more studies of its kind.

Stockholm, October 2009

Lars-Göran Rosengren, Chairman "Prioritisation for Research and Innovation"

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1. Introduction

Research develops knowledge, which after some years, decades or even centuries results in applications. Thus, in a situation of scarce human and physical resources, prioritisation of research becomes a means of preparing for the future we want by attaining critical mass in one area before another.

It is the sincere hope of the authors that this report will inspire decision-makers both in Sweden and abroad to continue to improve the research prioritisation mechanisms by comparing different countries' more or less successful strategies. This report is the written account of a first attempt in a series of investigations by the Royal Swedish Academy of Engineering Sciences to investigate other countries and to establish ties with those countries.

To thoroughly compare six countries spanning Europe and the Far East is not a trivial task and was never within the scope of this project. Nevertheless, because of the substantial interest amongst Swedish research policy specialists to learn about foreign ideas and mechanisms that may be transferable to Sweden, this report will start by characterising the chosen countries from the perspectives of prioritisation structures and instruments and then aim to describe some prominent characteristics that may lay the foundation for deeper discussion and help design future investigations. This is based on a series of interviews with policy specialists in various organisations, whose responses were aligned with the use of existing literature on research policy.

For more information on the continuation of these efforts, please visit the website of the Royal Swedish Academy of Engineering Sciences at www.iva.se.

How to read this report

Each country section follows the same structure: At first a map of the countries' prioritisation structures is shown, with governmental bodies in dark blue, semi-autonomous bodies in light blue and independent bodies in blue. The nature of these demarcations varies significantly between countries and must therefore be seen as a guide rather than a blueprint.

The structural map is followed by an introductory page with some basic facts about the country as well as some key questions that were predominant during the interviews. The authors chose to use purchasing power parity for GDP (source OECD and CIA) to compare countries on a more equal footing. This is important in light of the different infrastructure and personnel costs across countries. However, it cannot and was not intended to be used as an indicator of overall success of the research prioritisation due to the complex nature of GDP generation and calculation.

Descriptions of the policy arena include budgetary figures for various organisations in certain countries. These have not been standardised across countries and serve only to show the relative influence that organisations may have. However, the budget alone is not a sufficient measure of an organisation's power and it must be compared with other indicators.

The mention of prioritisation instruments is solely based on responses from the interviewees and no attempt was made to list these according to relative importance etc. The prominent characteristics are discussed according to the interviewer's interpretation of transferability; i.e. can these prominent characteristics inspire other countries to adopt more successful research prioritisation strategies?

2. Preliminary findings

Based on the views of interviewees and the interviewer, the six investigated countries are faced with essentially the same challenges, with few exceptions. However, there are marked differences in the urgency perceived in meeting these challenges and this influences the strategic decisions made and in turn the structures of prioritisation. Table 1 is an overview of the similarities and differences in research policy of the investigated countries. These characteristics and more are further described in each country section.

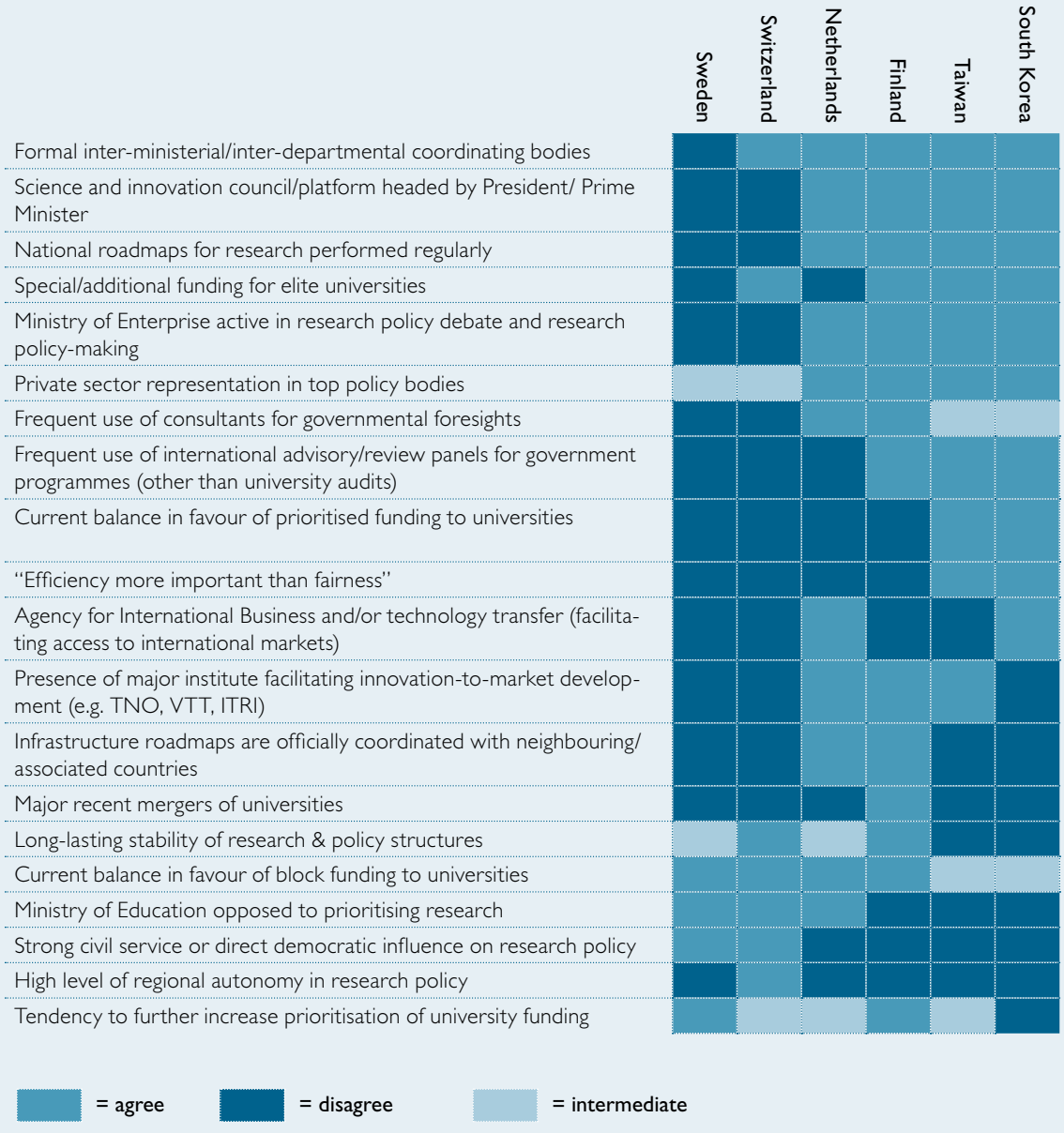
All countries pride themselves in having a strong consensus culture within a fair democratic system. However, as can be seen from Table 1, Sweden's and Switzerland's notion of democratic fairness results in less hierarchy and less top-down strategy than in the other countries. Taiwan and South Korea especially value efficiency over fairness, as stated by interviewees. This makes prioritisation seem more rational and less democratic in those countries. For better or for worse, this "efficiency over fairness" in the name of global competitiveness is beginning to show itself in the development of both Finnish and Dutch research policy. Examples include the use of innovation platforms or advisory committees consisting of very few persons of high standing (and at least half from industry) rather than large committees where all stakeholders are represented. There is also a strong trend of merging ministries, departments and other policy bodies. This trend is not always reflected in actual organisational mergers, but more so in the selection of key individuals from different organisations who take decisions in newly created bodies. This trend is taking place reluctantly in Switzerland too, where the Rectors Conference (CRUS) is being merged with the Rectors Conferences of the Universities of Applied Sciences and Teachers Colleges.

Roadmapping of one sort or another is performed by all countries. However, Sweden and Switzerland are alone in not creating one national roadmap intended as a blueprint for many ministries, agencies and organisations. In the other countries these national roadmaps may not be followed by all intended recipients, but several interviewees pointed to the – perhaps primary – importance of roadmapping: to bring together the smartest persons in the country (and from outside the country) to focus not on a specific research goal, but on the overall welfare of the country, resulting in new understanding and new collaborations, which can have life-long benefits, both for researchers and the country. This associated benefit seems especially true in South Korea and Taiwan, where many expatriates return several times a year to partake in roadmapping activities, thus infusing the debate with objectivity, fresh ideas and connections to their new home countries. The associated benefit seems less likely in the case of the Netherlands or Finland, where there is more reliance on consultants to carry out the initial roadmapping.

All countries involve private sector representatives at some level of the decision-making and/or advisory tree. Matching funds also play a role in all countries. It was interesting to note that in both Asian countries the prevalent opinion was that industry advice (and matching funds) is useful for short-term projects of up to around three years, but that industrial representatives lack the visionary, wider perspective and actually hinder the creativity of more long-term advanced research projects. In Taiwan the role of industrial representatives is rather being scaled-down to allow new actors to flourish in new industrial arenas. In South Korea, venture capitalists are frequently used as more neutral advisors with a wider scope yet still with a firm footing in the private sector.

There are major differences in where advanced mission-oriented research, sponsored by the Government, is performed. In Sweden and Switzerland the universities are seen as the laboratories of the country and the Government sponsored research institutes are few with little funding in comparison. The Netherlands, Finland and Taiwan all

Table 1. Preliminary comparisons based on interview data. Blue denotes agreement with the statement while dark blue denotes disagreement (and/or the opposite is true); light blue reflects an intermediate/unknown state/no change – for many of the statements the colours are not absolute, but relational in nature (e.g. in comparison to Switzerland, Sweden has been and is less stable in its research structures).

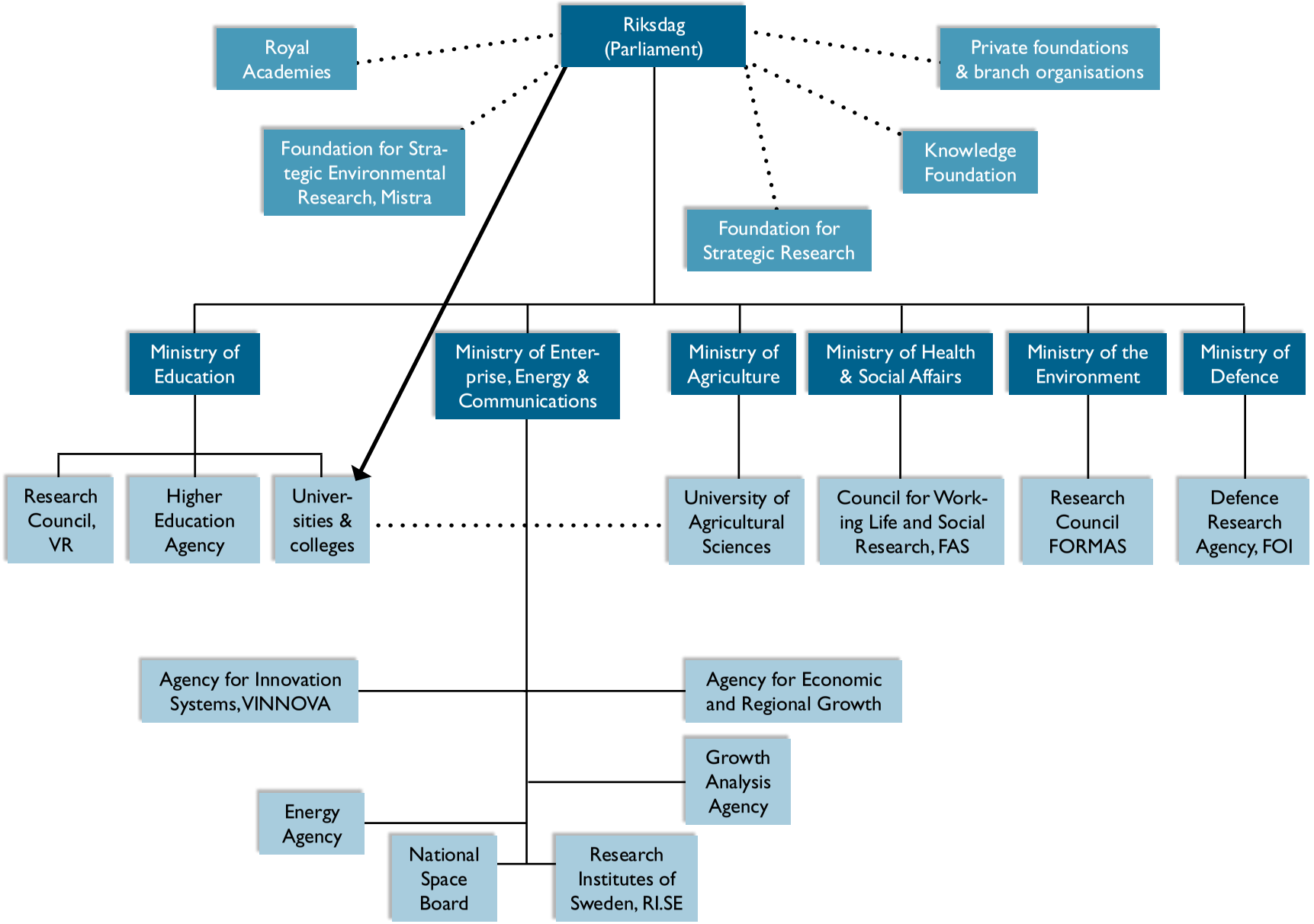


have a major institute facilitating innovation-to-market development where essentially everything up to a prototype product (or service) can be generated (TNO, VTT, ITRI). South Korea has this function spread out over many Government research institutes with more specific areas of focus – perhaps a way to prioritise with differing budgets between the institutes. Only the Netherlands and South Korea have a dedicated Government agency for international business promotion with a mandate to scan the global economy for opportunities. In addition, the Netherlands as well as Finland actively synchronise their infrastructures with the European infrastructure roadmap (ESFRI). Thus, it is fair to say that the Dutch Government is making the most structured efforts to coordinate with the region and bring innovations to niche markets.

Currently all European countries are in favour of a majority block funding for universities, while South Korea and Taiwan are practicing more prioritised funding. However, the tendency to further increase prioritisation of university funding is more or less strong in all countries except South Korea. This is possible even in Sweden, Switzerland and the Netherlands, where the Ministries of Education essentially are opposed to further prioritisation, because the Ministries of Enterprise are manoeuvring to place more weight in the policy debate.

Overall the interview results indicate a continuum of research strategies in the six chosen countries. This continuum may be described as ranging from laissez-faire research with little Government policy intervention, as is the case in Sweden and Switzerland, via a combination of laissez-faire university policy combined with a concerted and prioritised institute sector, as is the case with the Netherlands, Finland and Taiwan, to a strong centrally coordinated research effort, as is the case for South Korea. This interpretation is not a reflection on the relative success of the investigated countries' research strategies, but rather a challenge to all small to medium-sized economies to coordinate not only within but to look beyond their borders for 21st century solutions. No doubt it is those economies that are able to switch relatively quickly from central control to laissez-faire and back again, depending on market and social demands, which will best adapt to the increasing flux of the global knowledge economy.

Prioritisation of research and innovation in SWEDEN – organisations deemed important by the interviewer. Dark blue: Politically governed organisations; Light blue: Semi-independent governmental organisations; Blue: Independent organisations. Note the arrow depicting the direct thematic steering by Parliament of some of the university funds.



3. Sweden

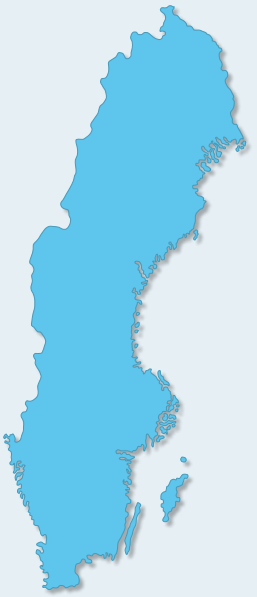
SWEDEN

USD 340 bn GDP (PPP) / 9.0 m people
= USD 37,500 per capita (PPP, OECD 2008)

3.7% of GDP (USD 13 bn) spent on R&D
(75% / USD 9.5 bn by private sector, of which USD 7 bn by Ericsson and Astra Zeneca)

Key questions Swedish interviewees would like answers to:

- How to and why create national & global R&D roadmaps?
- How to produce and/or recruit skilled labour?
- How to prioritise for a more innovative services sector?
- How can Sweden push for an effective political agenda at the EU level?



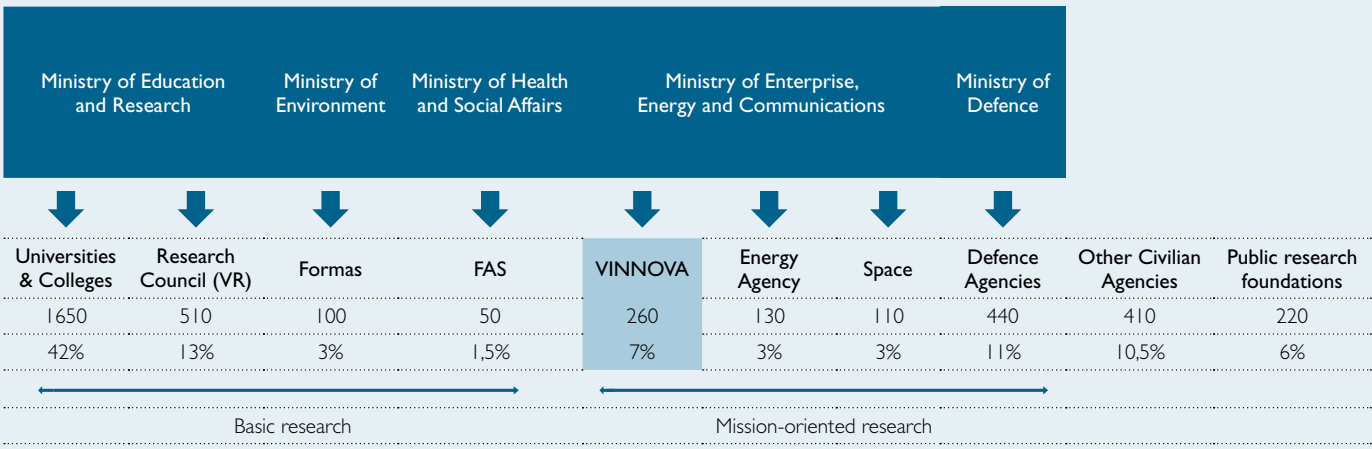
Description of the research policy arena

The Swedish Parliament decides research policy every four years by signing a research policy bill prepared by the Government in power and in particular by three major research policy-forming bodies: the Ministry of Education, the Ministry of Enterprise, Energy and Communications and in a specific sense the Ministry of Defence (see Figure 1). The Ministries of Education and Enterprise encompass a research policy council (established in 1962) and an innovation policy council (established in 2004), respectively, which coordinate policy development yet have only an advisory function to the Government. Due to its recent establishment, the innovation policy council is yet to make a firm mark on policy formation. The Growth Analysis Agency under the umbrella of the Ministry of Enterprise also supports the Government with statistical and particularly economic analyses related to R&D among other things. Policies are implemented by various agencies that act semi-independently within the framework of Government white papers.

The Research Council (VR) and agency for innovation systems VINNOVA, under the umbrellas of the Ministries of Education and Enterprise respectively, are the major funding agencies for R&D. These two agencies are also the major drivers in policy discussions related to R&D, but the lack of formal coordination of these and other agencies' policy proposals is a well-known weakness of the Swedish system.

The Research Council (VR) has approx. twice the budget of VINNOVA. In addition, it must be noted that 42% of all Government funding is channelled directly to the 16 universities (see Figure 1). This 42% also covers salaries for graduate students. The universities are not only responsible for basic

Figure 1: Major Public R&D-funding organisations in Sweden budgets 2008, in USD m.



Source: VINNOVA, Division for Strategy Development with modification

research, but they are also technically responsible for most of the mission-oriented R&D channelled through e.g. VINNOVA. All agencies considered, about 2/3 of Government R&D funds are thus spent without any thematic prioritisation in mind.

Public research in Sweden is funded in two streams, the first is the basic funding of universities, altogether 42% of total public funding of R&D, and is presently for the most part based on capita volume. A change to a new system for resource allocation announced in the latest political decision on research, innovation and funding will be based on quality (citations, peer reviews etc.) and other performance criteria. The second stream is called external funding (external from a university perspective; not a direct resource from the State). This second stream comes from research councils, agencies for support of directed research and so on (for example public or semi-private foundations for strategic research, environmental research etc.). The second stream is arguably prioritised as certain directions are implied in the specific mission of the agency, e.g. the Swedish National Space Board (SNSB) funds space-related research, while the Energy Agency funds research on energy, etc. However, other than in the broadly implied area of research the Swedish universities' public funding supports research of a more basic nature, so called blue-sky research, rather than need or problem-oriented research directly relevant to industry.

The Ministry of Enterprise, Energy & Communications administers a holding company called Research Institutes of Sweden (RI.SE), which has a cumulative turnover of USD ~300 m, of which about 1/5 comes from VINNOVA. These semi-independent (Government) research institutes perform research directly relevant to Swedish industry.

Prioritisation instruments:

VINN EXCELLENCE CENTRES (VINNOVA)

The current 19 VINN Centres consist of several entities combined as a virtual cluster with the purpose of promoting active and persistent collaboration of excellent academic research environments and industrial R&D laboratories.

BERZELII CENTRES (RESEARCH COUNCIL & VINNOVA)

The status and concomitant support for up to 10 years is granted to no more than four universities to focus on excellent basic research which is at the forefront of its field and transferable to industry. Grants are a maximum of EUR 500,000 per year not including possible co-funding from other stakeholders.

LINNAEUS GRANTS (RESEARCH COUNCIL & FORMAS)

Up to fourteen 10-year grants (USD 0.75–1.5 m per year) are awarded to universities for basic research in all scientific fields. The main novelty with this grant is that the universities have to prioritise their own research environments and choose the most likely research environment to include in their application.

SUCCESSFULLY PRIORITISED PROGRAMMES

These examples may illustrate processes for priorities in research funding.

- Vehicle research programme managed by VINNOVA from 1994 onward. The success can be attributed to the transparency and involvement of industry itself in the decision processes. The programme has been expanded despite the economic recession of 2008 in general and the automobile recession in particular.

- National material science consortia managed by former research councils for science and technology (NFR, TFR) and others. This programme gave room for cross disciplinary development that the standard support systems from research councils could not handle.

- The mobile phone system research programme based on the GSM standard. This programme, which was based on an early international standard initiative, created an industrial opportunity and boost from advanced research.

Sweden: Selected characteristics in short

- Government agencies act with a lot of autonomy from ministries
  – This creates stability and rigidity in research policy

- The Government has created a partially prioritised funding scheme for universities
  – This allows the cabinet to directly choose preferred areas for university research without ministry or agency involvement.

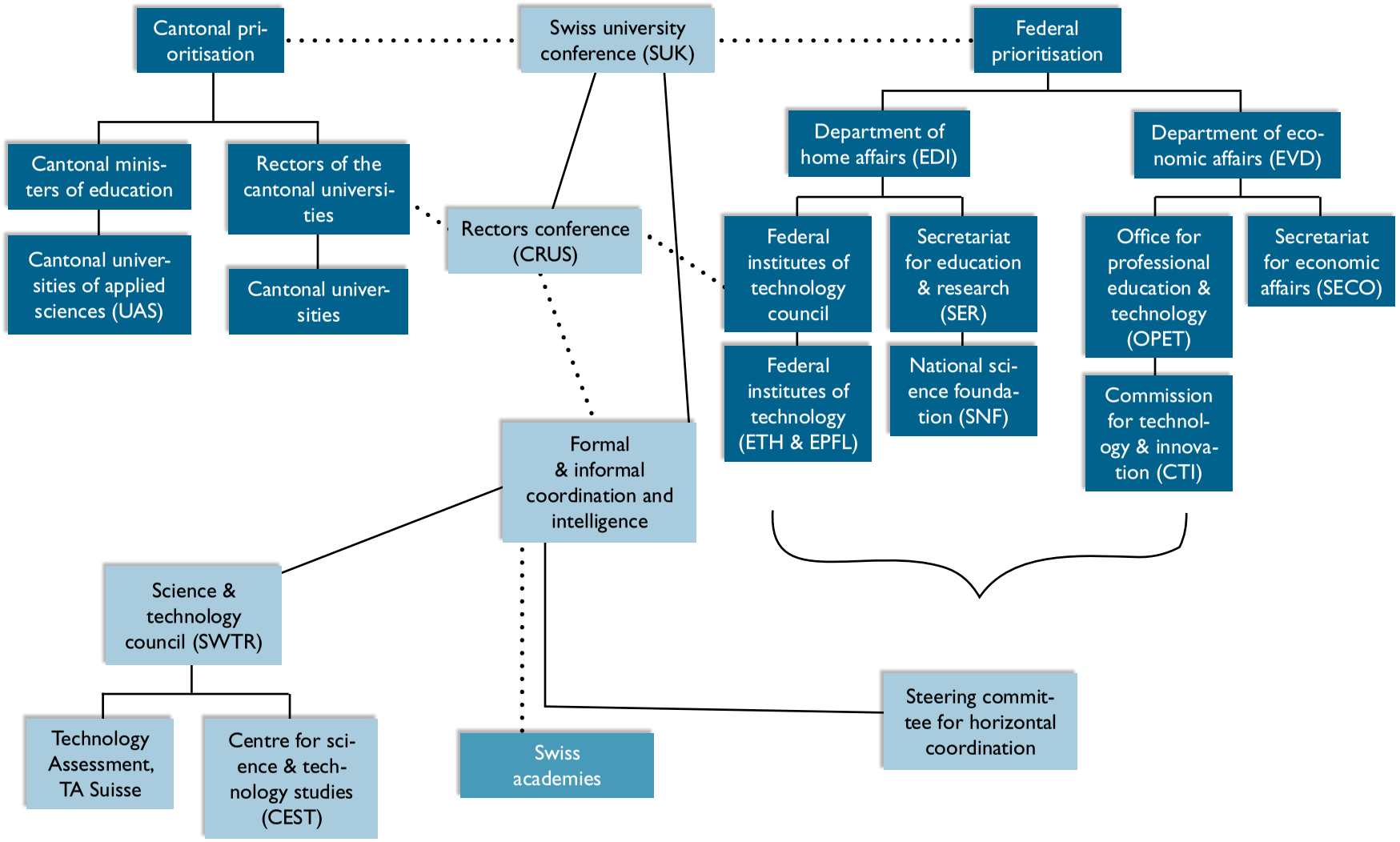
- Defence research is slowly being disbanded
  – This will leave a vacuum in a traditionally strong research field

Prominent characteristics

Before the 1990s there were substantial structures for directed research in Sweden called sectoral research. This stream of funding of R&D was intended to supply competence and technology to a specific sector, for example building and construction, defence etc. The sectoral research was disbanded at the turn of the millennium and restructured into a more general framework of funding of research at universities and research institutes with less direction to specific sectors in society. Thus, from the dismantlement of the sectoral research streams until 2008, there was no specific mechanism for prioritising research, above and beyond the research of performing organisations themselves.

In January 2009, the Swedish Parliament decided on the new national programme for supporting research, which directs new resources to 24 "strategic areas". This is a new, long-term feature in Swedish research policy launched in 2009. The funding commences with USD 75 m the first year and expands to USD 270 m in 2012, which then amounts to 5% of the total public funding of R&D. The political goal of public funding is set for 1% of GDP in 2012. Institutions of higher learning and research are invited to apply to the new programme. The research councils will administer the programme but the cabinet itself will decide who will get the support. It is up to the performing institutions themselves to set up the research teams and themes, of which also (industrial) research institutes can be a partner. Institutions will be selected on a competitive basis by the research councils and agencies to gain support for (technical industrial and energy) research. The applicants have to qualify scientifically and, in the process of selecting winners, standard academic criteria such as citations are to be met. However, it is stated in the bill to the Parliament that the 24 themes must have relevance to society, industrial needs and demands. The progress of the programme for strategic research will be evaluated after five years of operation.

Prioritisation of research and innovation in SWITZERLAND – organisations deemed important by the interviewer. Dark blue: Politically governed organisations; Light blue: Semi-independent governmental organisations; Blue: Independent organisations.

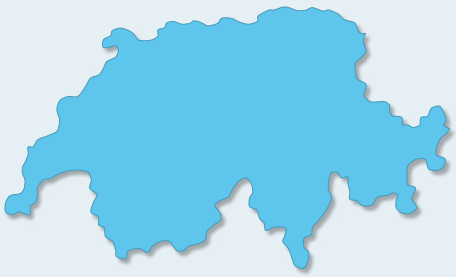


4. Switzerland

SWITZERLAND

USD 310 bn GDP (PPP) / 7.5 m people
= USD 41,000 per capita (PPP, OECD 2007)

2.9% of GDP (USD 8.9 bn) spent on R&D (74% / USD 6.6 bn by private sector)



Key questions Swiss interviewees would like answers to:
- How to manage effective think tanks?
- How to manage effective knowledge transfer instruments?

Description of the research policy arena

Switzerland's research policy structure owes its unique nature to a federal structure consisting of 26 autonomous cantons, which have authority over their own education and research policy as well as the ability to block federal initiatives. Thus, the ultimate authority for research prioritisation is split and coordination is paramount. Switzerland has created several research coordination bodies, the most important being the "Steering Committee for horizontal coordination", the Swiss University Conference (SUK), the Rectors Conference (CRUS) and the Swiss Science and Technology Council (SWTR). However, all four lack any national authority and instead they advise cantonal and federal ministers (some of whom sit on the committees) in the drafting of the so-called ERT-message every four years. The ERT-message is Switzerland's most important multi-year plan endorsed by the Government(s) and relates to both research and education.

The Steering Committee for horizontal coordination coordinates research-related agencies of the Department (≈ ministry) of Home Affairs (EDI) and the Department of Economic Affairs (EVD). It is important to note that the Federal Institutes of Technology Council, governing the two Federal Institutes of Technology, is represented in this committee, while representatives of the other universities (10 cantonal universities, 7 regional universities of applied sciences (UASs) take part in the rectors conferences and SUK only. The latest ERT-message was for the most part prepared by the State Secretariat for Education and Research (under EDV), which seems to have a stronger role in shaping research policy than its counterpart under the EDV: the Office of Professional Education and Technology (OPET).

Public research funding is distributed by the National Science Foundation (SNF; USD 630 m) and the Commission for Technology and Innovation (CTI; USD 120 m). Both agencies provide funds to the 10 cantonal universities, 7 regional universities of applied sciences (UASs) and to the two federal institutes of technology. The federal institutes of technology receive block funding from the Federal Institutes of Technology Council (federal funds), while the other universities receive most of their block funding from one or several cantons. The SNF funds more basic science, while CTI spends its budget on research in collaboration with industry.

Switzerland: Selected characteristics in short

- **Absence of top-down national strategy**
  – decentralised federation, strong cantonal interests
- **Absence of direct Government-industry consultation**
  – industry-university collaboration through matching $
- **Federal universities governed by council of 9 members**
  – in a class of their own in terms of funding and influence
- **University presidents (rectors) have a lot of influence**
  – coordinate national interests through CRUS, which influences both cantonal and Federal Governments
- **The latest ERT-message did not include thematic prioritisation.**

Prioritisation instruments:

The Swiss research policy culture is dominated by a "hands-off" approach and a commitment to funding basic research with no direct investment in private R&D. However, below the surface there are more than the obvious instruments for prioritisation:

GOVERNMENT RESEARCH INSTITUTES

According to federal law, there is funding for several Government research institutes. The two main institutes receive federal funding both through SER and CTI: the Centre for Electronics and Microtechnology (CSEM) and the Institute for Mechatronic Systems (IMP; robotics). In addition, there are four ETH-affiliated research institutes who receive some federal money: the Paul Scherrer Institute (PSI), focusing on particle physics, energy, radiation biology amongst others, the Institute of Aquatic Science and Technology (EAWAG), the Institute for Forest, Snow and Landscape Research (WSL) and the Swiss Federal Laboratories for Materials Testing and Research (EMPA). These long-term commitments reflect a permanent (and thus less flexible) prioritisation mechanism.

NATIONAL CENTRES OF COMPETENCE IN RESEARCH (NCCRS)

In 2001, National Centres of Competence in Research (NCCR) were introduced by the Government and since then are administered by the SNF. There are 20 NCCRs, each under the directorship of a university or another recognised research institution (= leading house), which allows research groups based at the home institution to network with other teams working throughout Switzerland. Notable effects include a purpose-driven coordination between different universities, more jobs for doctoral and post-doctoral scientists as well as more attractive career opportunities. The NCCRs are mainly financed through federal funds budgeted by Parliament. To ensure longer-term improvement of university structures, co-financing by the universities themselves is mandatory and third-party funding is very much encouraged.

NATIONAL RESEARCH PROGRAMMES (NRPS)

These National Research Programmes are of medium duration (4–5 years with possible extensions) and focused on urgent problems. However, they are selected from a pool of applicants by the SUK without prior strategy – i.e. the proposals' strategic worth for Switzerland is assessed without a formal thematic plan in mind.

CTI DISCOVERY GRANTS

The CTI has been regulated for more than 50 years by a constitutional article defining its purpose very narrowly in terms of its direct economic effects in generating jobs and increasing the competitiveness of Swiss enterprises. This orientation very much discouraged financing research aiming for ground-breaking innovations, which are associated with high risk of failure and sometimes numerous years until a significant and maybe indirect economic impact can be discerned. Following an international peer-review in 2001 the CTI started a so-called "Discovery" programme targeting such radical innovations. Since that time, there has been an increased emphasis on international peer-review to assess grant applications and on quality management to promote best practices by the back-office teams. In 2006 a new constitutional article was accepted by the "double majority" of population and cantons. It assigned for the first time to the Federal Government a role in fostering innovations and now serves as a justification to redefine the activities of the CTI within the framework of the research law.

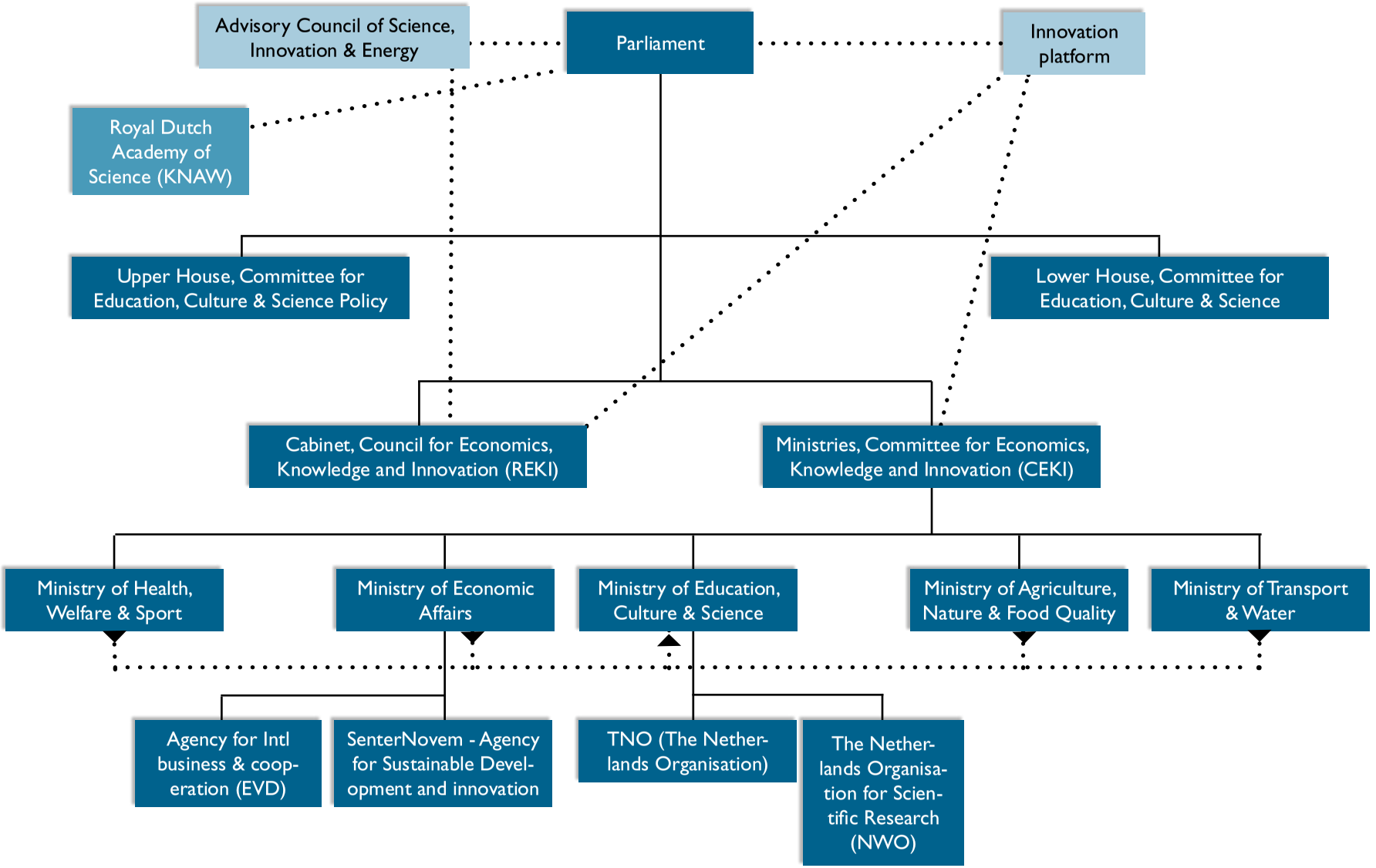
Prominent characteristics

Officially, the State Secretariat for Education and Research (SER) under the EDI seems to be the main policy proposal generator in Switzerland. However, it is noteworthy that it is not represented in the CRUS and only indirectly in the SUK. These have significant power to influence research strategy, and thus the Federal Institutes of Technology Council, which is represented in the CRUS and SUK, has more direct access to influence. This may reflect a long-lasting commitment (prioritisation) to channel more funds to two universities to allow them to compete on an international scale.

Traditionally, Switzerland lacks thematic focus in the distribution of research funding, but recently the Federal Government, together with ETH Zürich and the Universities of Zürich and Basel, created a new institute for "systemic biology". It is interesting to note that the SER and SNF were not consulted in the creation of this new institute, which indicates that it was established outside the formal channels (i.e. outside the Steering committee for horizontal coordination for example).

With so many different coordination bodies, no regional or national thematic strategies and so many universities, Switzerland stands fragmented in its research efforts. There is debate on this matter, but any action has thus far failed due to special interests; e.g. an effort by the Minister of Health from canton Zürich to amalgamate university hospitals to attain more critical mass (to justify the purchase of sophisticated equipment etc.) was thwarted by the special interests of cantons who risked losing their services in the process. For the immediate future, coordination is key for any action in Switzerland.

Prioritisation of research and innovation in the NETHERLANDS – organisations deemed important by the interviewer. Dark blue: Politically governed organisations; Light blue: Semi-independent governmental organisations; Blue: Independent organisations.



5. The Netherlands

THE NETHERLANDS

USD 660 bn GDP (PPP) / 16 m people
= USD 41,000 per capita (PPP, OECD 2008)

1.7% of GDP (USD 11 bn) spent on R&D (58% / USD 6.4 bn by private sector, of which USD 1.3 bn from Phillips)

Key questions Dutch interviewees would like answers to:

- How to train, retain and attract talent?
- How to coordinate internationalisation amongst countries?
- How to bridge the "disconnect" between industrial and academic lead times?

Description of the research policy arena

Parliament makes ultimate decisions in innovation policy, which is prepared by the Council for Economy, Knowledge and Innovation (REKI) within the cabinet and coordinated by the inter-departmental Committee for Economy, Innovation and Knowledge (CEKI) representing the ministries (high-level civil servants). However, these councils are heavily influenced by the Innovation Platform, a high-level coordination and strategy committee consisting of ministers, CEOs of large companies and chaired by the prime minister (a total of 10 persons). The Innovation Platform is advisory in nature and it is interesting to note that the Prime Minister himself has a dual role in countering his own arguments in Parliament.

The two main ministries involved with research policy are the ministry of Education, Culture and Science (OCW) and the ministry of Economic Affairs (EZ). However, EZ is much more hands-on than OCW, which passes on much responsibility to the research council NWO. As OCW does channel the majority of research funds, their hands-off approach has been criticised and changes are being implemented: A new "inter-ministerial knowledge & innovation programme department" has been created to coordinate efforts of research policy setting. This programme department works with "knowledge chambers" in each ministry.

At the agency level, there are two major implementers: the research council NWO and the innovation agency SenterNovem. The NWO is more independent from its ministry than SenterNovem. Although NWO mainly funds universities, it also administers nine research institutes. Another important organisation in research policy implementation is the Technology Foundation STW, which operates as an independent part of NWO.

The main research performers are the 14 universities including leading technology institutes, 4 large Technological Institutes, 18 research institutes + 9 NWO research institutes as well as the TNO (the Netherlands Organisation for Applied Research).

The Netherlands: Selected characteristics in short

- **The Netherlands has an Innovation platform and inter-ministerial coordination programme department**
  – Prime minister is President of Innovation Platform
- **TNO as a semi-independent R&D organisation with wide-ranging activities**
  – **Similar** to VTT in Finland and ITRI in Taiwan, but TNO starts and owns companies itself
- **Roadmapping is often performed by external consultants (such as McKinsey) and then compared to an internal study done by the organization in question (e.g. TNO)**
  – The amalgamation of the two reports is checked with external stakeholders and the government.
- **The Netherlands seems a lot more EU focused than Sweden and even Finland.**
  – Their infrastructure investments follow the European "ESFRI" roadmap closely.
- **Matching funds heavily weighted toward tax payers money**
  – Mostly 25% private, 75% public money

Prioritisation instruments:

INNOVATION VOUCHER

EUR 7,500 voucher for knowledge institutes (a cheque that SMEs can use at e.g. universities or even private research labs in the Netherlands. This has largely been a successful programme in terms of engaging SMEs, which otherwise may not have engaged in university cooperation. It is interesting to note that the innovation voucher can also be used to do research abroad.

INNOVATION ORIENTED PROGRAMMES (IOPS)

In 2009 there were eight IOPs in nano-electronics, nutrition, water technology, maritime innovation, automotive, health, materials and polymer innovation, and three areas on the drawing board: services & ICT, logistics and retirement management. Proposals are developed by companies and institutes bottom-up and evaluated by SenterNovem in collaboration with the private sector funding partners. It is important to note that the purpose is to find niches for the Netherlands to become best at internationally, rather than to bring certain overseas competence to the Netherlands – the key word is "international hot-spots" for the Netherlands.

TOP TECHNOLOGY INSTITUTES (TTIS)

This is essentially a status symbol for institutes to be recognised and facilitate further funding from many sources. Thus far only universities have received this distinction, but no rule seems to exist to not allow other research institutes to apply. The process starts with a handful of Professors talking to industry about their idea and submitting a proposal to the Ministry of Economic Affairs. The process of approval is long – can take up to five years.

Prominent characteristics

Most prominently, the relatively small Innovation Platform, consisting of only 10 key persons, has had a very active role and not just a rubberstamping role as might be expected. The prime minister himself has been very active, but not without controversy – often he has found himself in a dual role, countering his own arguments from the Innovation Platform, when wearing his strict "Prime Minister" hat in Parliament. Generally, the policies of the Innovation Platform have been well received and most agree that their Talent Attraction policies are good. In general, this form of Innovation Platform reflects a strong culture of so-called "committees of the wise", where a few persons make very important decisions in a relatively short amount of time. Of course the platform does have strong support from agencies, especially SenterNovem.

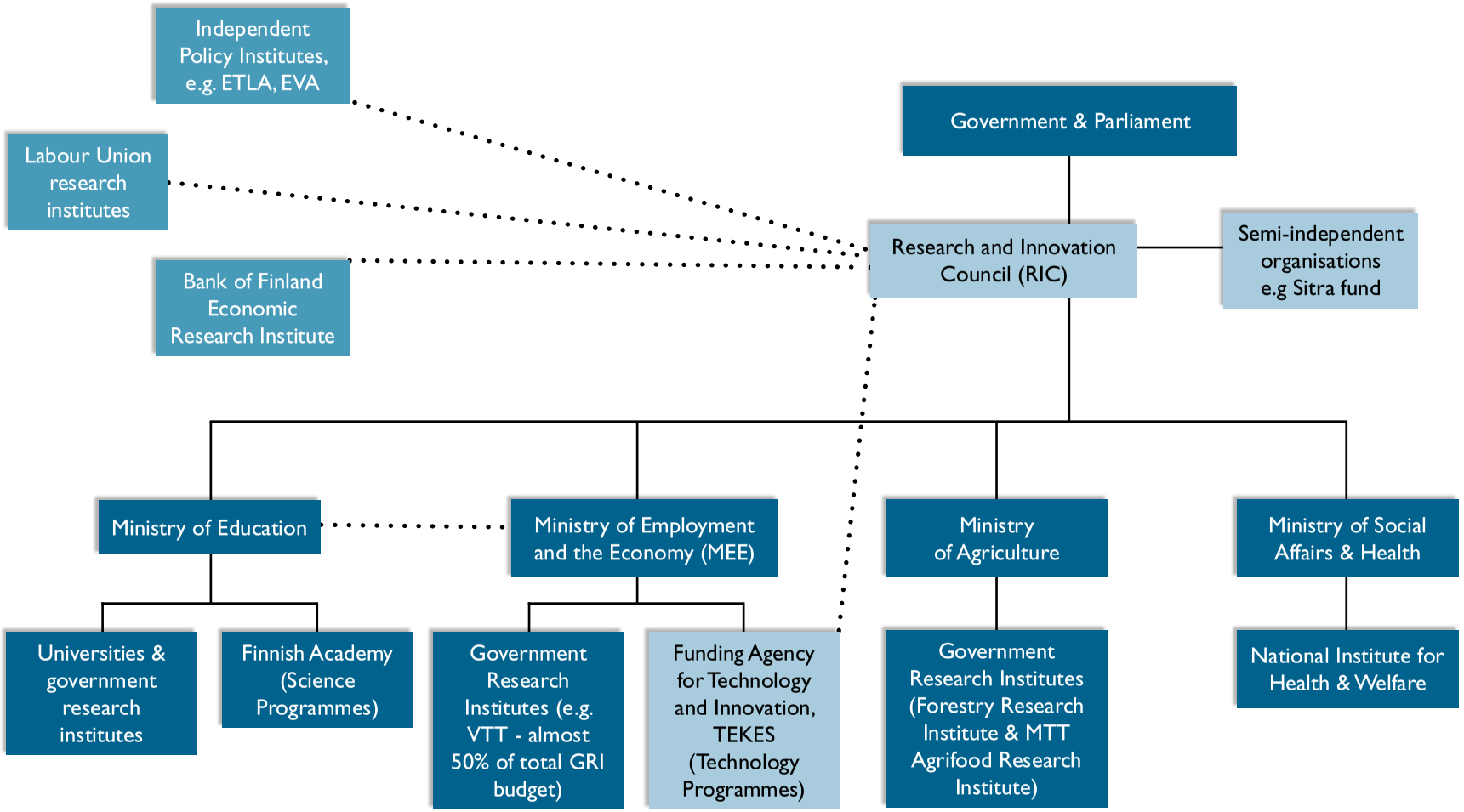
The Government cabinet has requested and subsequently formed an inter-ministerial coordination "programme department" for a limited time 2007–2011. A first draft of a strategy to 2030 has resulted from this coordination. However, there have been misgivings about the Ministry of Economic Affairs dominating the proceedings. This is hardly surprising though, as the Ministry of Education – the other natural player – only employs a small number of policy strategists in comparison.

An interesting aspect of Dutch roadmapping is that often a consultant report is commissioned together with internal reports from ministries or agencies. These two reports must then be recon-

ciled by policy decision-makers as well as external stakeholders from e.g. the private sector. Roadmapping is done at many different levels and it seems that the lower levels, initiated by professors within so-called "NWO regiegroeps" are very well detailed and up-dated regularly in consultation with the private sector. There is a well thought-out structure for assigning chairpersons (by the Ministry of Economic Affairs) and picking consultants to work full-time with professors and industry representatives for 2–3 years.

The biggest issue in the Netherlands at the moment is talent search and everybody seems keenly aware of it. This is especially the case since the Royal Dutch Shell and DSM Laboratories closed – they were a source of experienced young researchers. In comparison to e.g. Switzerland, there is little skilled immigration to offset this, because the pay in the Netherlands is no better than in e.g. Germany.

Prioritisation of research and innovation in FINLAND – organisations deemed important by the interviewer. Dark blue: Politically governed organisations; Light blue: Semi-independent governmental organisations; Blue: Independent organisations.



6. Finland

FINLAND

USD 190 bn GDP (PPP) / 5.3 m people
= USD 35,000 per capita (PPP, OECD 2008)

3.4% of GDP (USD 6.4 bn) spent on R&D (72% / USD 4.6 bn by private sector; USD 2.3 bn by NOKIA)

Key questions Finnish interviewees would like answers to:

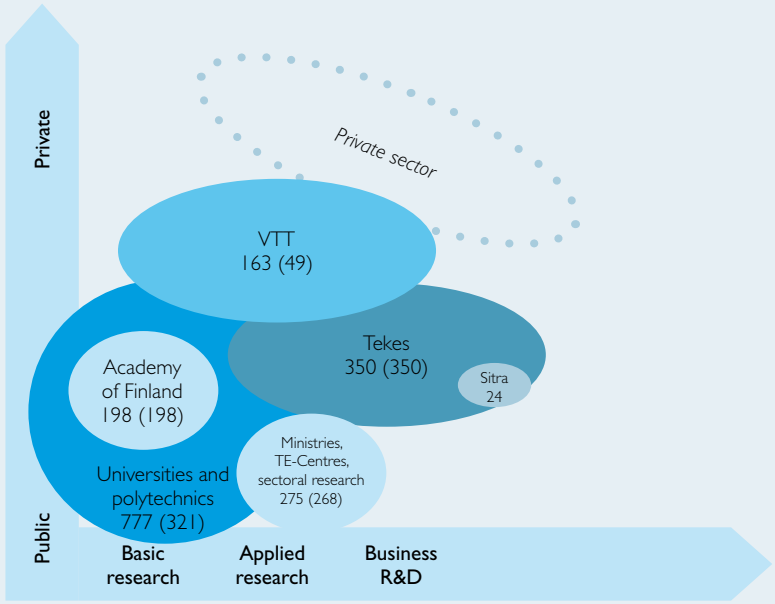
- How to strengthen public-private partnerships?
- How to support regional R&D development despite needs for rationalisation?
- How to improve internationalisation of R&D activities?
- How to integrate development of social and technological innovations?
- How to adapt and sell innovations to developing markets?

Description of the research policy arena

The Finnish research prioritisation structure is centralised around the Research and Innovation Council (RIC), which develops strategies and coordinates all Finnish science and technology policy. RIC, consisting of eight ministers with permanent seats and 10 seats elected for 4-year terms, is responsible for directly advising the Parliament and Government, who make decisions in the form of white papers. The most important ministries coordinated by RIC are the Ministry of Education (Minedu) and the Ministry of Employment and the Economy (MEE). This (forced) coordination has significantly increased collaboration between Minedu and MEE, at least in terms of science & technology policy. The latest white paper entitled "National Innovation Strategy" (October 2008), was prepared by the Innovation Department of the MEE and a broad group of experts, interest groups and even citizens. This was one effort by the MEE to reassert itself in the field of strategic intelligence, an area it had essentially passed on, when TEKES split from the ministry in the 1980s. At agency level, responsibilities are less clearly allocated. The Academy of Finland and Tekes, the funding agency for technology and innovation, are technically funding agencies for Minedu and MEE, respectively. However, Tekes coordinates directly with RIC on most matters and is essentially controlled by MEE in matters of budget only. The Academy of Finland funds research of a more basic nature, while Tekes funds industry-related research. A total of 60% of Government R&D funds are channelled through these two agencies.

As in Sweden and Switzerland, the universities are the main public research performers with a EUR 1.1 bn spent, of which 46% comes from block Government funding, 38% from competitive programmes of the Academy of Finland and Tekes, 7% from the private sector and 9% from abroad. Other public research organisations (e.g. Government research institutes) account for another EUR 0.5 bn of R&D spending, bringing total public R&D to 1% out of the 3.4% of GDP spent on R&D. The current Government aims to raise overall spending to 4% of GDP by 2011.

Innovation environment in Finland: Resources and funding



The figures represent the total extent of each organisation in million USD in 2008. In parenthesis the share that is funded from the State budget. *Source: Tekes 2009, simplified.*

Prioritisation instruments:

EXCELLENCE CENTRES (OSKES)

The current excellence centres were established to strengthen weaker regions and these centres are dominated by universities. They are firstly political instruments for job creation, but do create research and innovation opportunities in specific fields. TEKES conducts a planning process for the centres every few years and the programmes last for 3–5 years. TEKES is the main funding body with 10% of funding, one third of the funding comes from the cities and regions and together companies make up for the majority of the funding. The excellence centres also receive a fair share of EU structural money.

SHOKS

SHOKS are limited incorporated companies that form long-term clusters and are initiatives administered by TEKES. They are not intended to become companies or permanent physical locations and their administration offices consist of only two persons each at present. They take the legal form of a non-profit company with shares owned by companies, universities and in some cases VTT. Six SHOKS have taken shape in 2009, according to the original list of areas chosen by RIC. SHOKS begin with an intellectual property right agreement and then specific priorities are chosen by the partners. The two administration staff facilitate a tendering process (open to anybody) for the research set by partners according to RIC guidelines. Essentially, SHOKS represent a change in focus of TEKES away from technology programmes and towards more company-dominated research programmes and are an effort to try to commit business to longer-term research investments (5–10 years).

GENERAL (FINANCIAL) INCENTIVES

Public Private Partnerships are ubiquitous in Finland; e.g. TEKES runs all its projects on 90/10 to 50/50 Government-industry matching funds. Recently, the Government is indirectly prioritising industry-related research by promising to match industry funding to the new universities by 2.5 to 1.

Prominent characteristics

Finland is particular in its flexibility to adapt to new challenges. During and after a quick recovery from the recession of the early 1990s, Finland implemented improvements drawn from several studies of leading foreign countries. When Finland reached levels of research indicators comparable to its peers, it continued to implement substantial policy changes, spearheaded by the predecessor to RIC, the Science and Technology Policy Council. These policy changes not only targeted research and innovation prioritisation, but also labour issues that would allow Finland to be globally competitive and even attract international enterprise. Currently, there is a broad debate about the definition of innovation itself. There seems to be a move away from the narrow definition of innovation from a science & technology perspective to innovation as "an exploited, competence-based competitive asset, which, in addition to the application of technology, can be founded on e.g. new service and business models, working and operating methods, or the management of product

Finland: Selected characteristics in short

- Science and Technology is a national strategy
  – Prime Minister chairs the highest body; the Research and Innovation Council
- Consensus culture is shifting
  – In the past there were many large committees that operated over long periods. Now a lot of one-man task forces are used to inform roadmapping activities (the wise person principle).
- New prioritisation/funding instruments are being invented
  – SHOKs (limited incorporated companies that form long-term clusters)
  – Government is privatizing or making universities independent, but promising to match industry funding to universities by 2.5 to 1.
- The term INNOVATION is being changed
  – Coined "Broad based innovation" that includes non-technical innovation

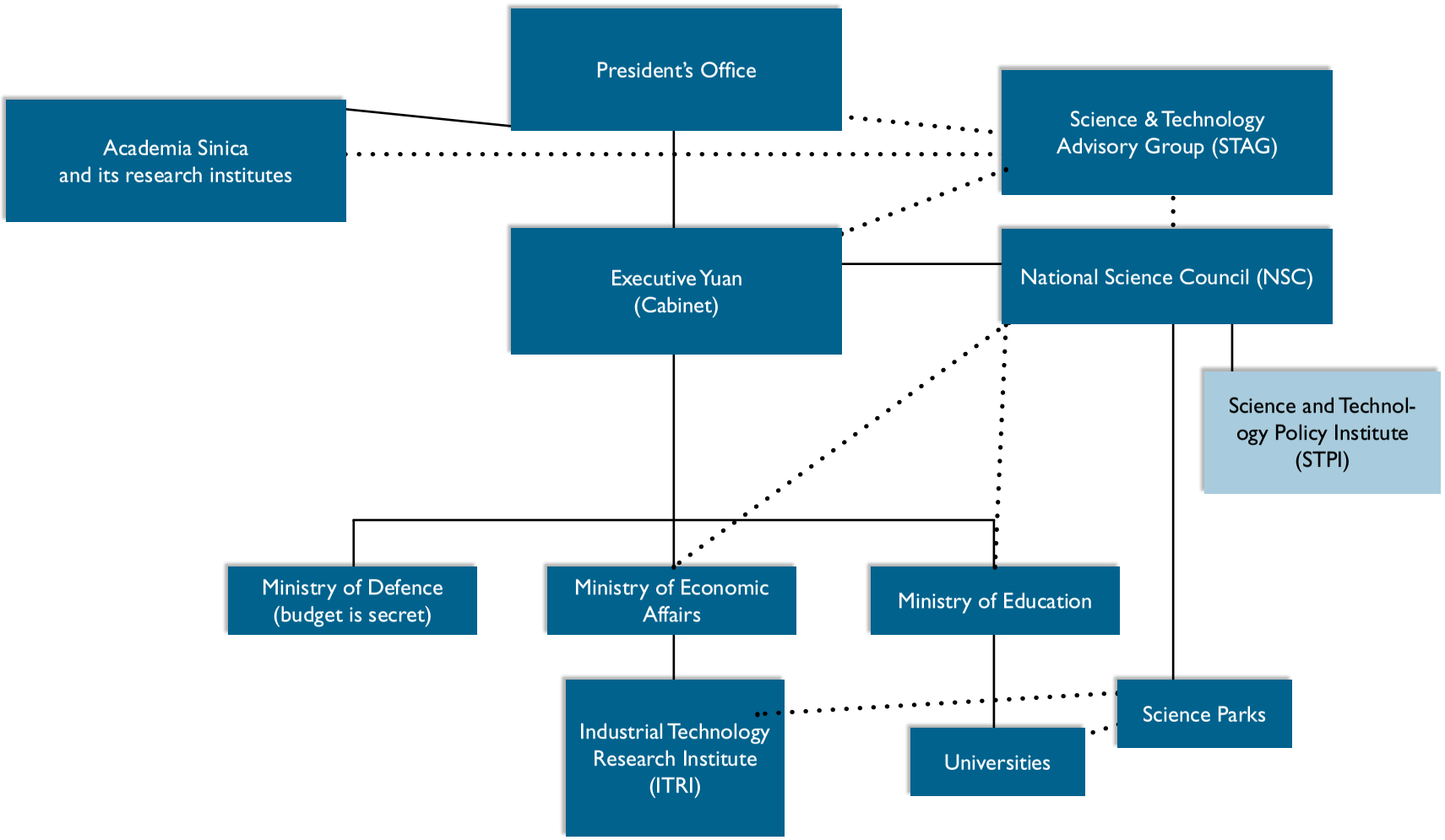
concepts and brands" (quote from the Finnish National Innovation Strategy). Many fear that a new "broad-based" innovation policy would dilute the investment in established sciences. The main efforts of consolidation lie in the creation of new shared operational models for all, because Finnish decision makers seem to agree that without new models, continued investment in the research infrastructure alone will not increase the production or utilisation of innovations.

Finland enacted a major reform in February 2009: the new Universities Act. It outlines major mergers of universities to attain critical mass for international competitiveness and at the same time gives the universities a lot more autonomy. Two universities, Aalto University and Tampere University of Technology, have become foundations, nevertheless receiving block funding from the Government. Aalto University has a budget of EUR 700 m; EUR 500 m from the State and EUR 200 m from the private sector.

The special treatment of two universities can be seen as a way to differentiate between universities, much like the two ETHs are favoured in Switzerland. Many strategies accompany this major University reform, such as roadmaps for new infrastructure investments, guidelines for internationalisation such as mobility of students and attracting foreign talent etc. Interestingly, there has been little opposition to the establishment of the two independent universities, but there was significant opposition to the other universities, due to a larger number of employed civil servants, who would lose some of their benefits.

It must be stated that the state of great flux in Finland feeds on and is fed by much informal decision-making. Recently, the Ministry of Employment and Economy was formed from 2 1/3 ministries and almost immediately a new innovation policy was formed and in part implemented even before approval by Parliament. It is apparent that the traditional consensus culture, exemplified by large working committees and long processing times, is being replaced by committees of the wise (a few prominent individuals) who hire consultants for analysis. This has sped up the process of adaptation in Finland, but also left some actors out of the loop.

Prioritisation of research and innovation in TAIWAN – organisations deemed important by the interviewer. Dark blue: Politically governed organisations; Light blue: Semi-independent governmental organisations; Blue: Independent organisations.



7. Taiwan

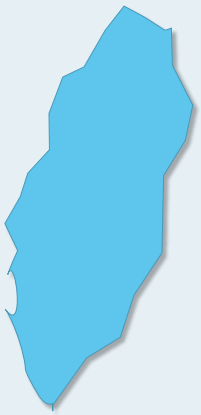
TAIWAN

USD 710 bn GDP (PPP) / 23 m people
= USD 31,000 per capita (PPP, CIA 2008)

2.6% of GDP (USD 18 bn) spent on R&D (67% / USD 12 bn by private sector) (NSC, 2008)

Key questions Taiwanese interviewees would like answers to:

- How to provide effective leadership in an ever more democratic setting?
- How to manage effective start-up programmes



Description of the research policy arena

Research policy decisions are made at the highest levels of government by the President's Office and the Executive Yuan (the cabinet), which are advised by the Science & Technology Advisory Group (STAG). STAG is headed by a minister without a portfolio and approves the budget of the National Science Council. The National Science Council (NSC) is the highest agency for research policy and performs control and evaluation. Its budget is approved by STAG. The NSC formulates mid-long-term plans and coordinates the R&D budgets of all other ministries, but not the Academia Sinica, which is directly approved by STAG. The NSC publishes a Science & Technology roadmap every four years, which, after processing in all ministries, becomes a national white paper for Science & Technology. The NSC is also directly responsible for the Science Parks, whereas it is only indirectly able to influence the universities via the Ministry of Education and the Industrial Technology Research Institute (ITRI) via the Ministry of Economic Affairs. The NSC supports a semi-independent policy institute (STPI – Science & Technology Policy Institute), which acts as a more direct bridge to ITRI as well as many other organisations. The Ministry of Defence has an unknown budget for R&D, which is not coordinated by the NSC. The Academia Sinica is much more than an Academy in European countries. It is a complete research environment much like a set of Government research institutes, but with 98% focus on basic research. It is not synonymous with a university system, as its primary focus is research, not education.

Prioritisation instruments:

INDUSTRIAL TECHNOLOGY RESEARCH INSTITUTE (ITRI)

ITRI is mentioned here as a prioritisation instrument, because of its central role in advanced technology programmes in Taiwan. ITRI performs significant roadmapping and because of its private sector customer relations, adapts any national roadmaps to the specific needs of companies. It thus performs an important prioritisation instrument, because it is able to channel private funds into advanced technology programmes (mostly indirectly through infra-

structure projects) according to Government foresights, which companies may otherwise not follow.

SCIENCE PARKS & TAX INCENTIVES

Science Parks are taken very seriously in Taiwan and because of this, significant incentives exist for SMEs to invest in R&D. For example, for the first five years after an R&D-intensive company starts to make revenue, this revenue remains tax-free. R&D investments themselves are tax deductible forever and this extends to venture capitalists and owners' investments as well. Science Parks are not synonymous with incubators, which help start-ups. In contrast, the Science Parks promote established industries to collaborate with universities or the Academia Sinica.

NATIONAL SCIENCE & TECHNOLOGY PROGRAMMES (NSTPS)

To be funded as an NSTP a proposal must display "great and vast impact through integration of resources at universities, research institutes and industry as well as international partners" and "industry must be ready to carry on the research". The latter criterion has given the NSTPs a high proposal failure rate (i.e. there are lots of good ideas that do not become NSTPs because the industry is not ready to take over). However, the proposals that do make it have thus far been successful in increasing the publication rate and in some cases producing novel products or services. The head of the NSTP is always a highly regarded personality and it is noteworthy that this person is not chosen from the original task force. In some NSTPs money (up to 1/5) is reserved for very innovative research that does not fall into clear categories or goals (but may aid the overall field somehow). Not all NSTPs are successful and some are merged with others or discontinued. Generally, an NSTP starts from bottom-up and becomes more top-down as it progresses (especially if it is not successful in creating industrial benefits).

NATIONAL CORE FACILITIES (NCFS)

NCFs integrate, centralise and make resources and infrastructure available to many actors. Half the core facilities exist in the Academia Sinica and each core facility has a PI and manager. NCFs have 5 missions: Technological R&D, Service, Collaboration, Training and Dissemination/Outreach. Students are involved in all areas except providing services; i.e. NCFs provide training for students in more applied settings but without exploiting them as cheap labour.

AIM FOR TOP UNIVERSITIES

This programme of prioritising the development of some universities over others was unveiled by the Minister of Education in 2008. The aim is to get one university in the top 100 rankings of the world (now the National Taiwan University (NTU) is between 120th–164th by different rankings and by far the most likely candidate – better in ranking than Hong Kong or any mainland Chinese university. An additional USD 1.5 bn NTD is spent for 5 yrs on a maximum of 12 universities, of which NTU receives approx one third or USD 92 m per year. Before it was launched, the intention was to give all the money to NTU, but this idea has been diluted over the years, especially since the total number of Taiwanese universities has increased ten-fold in the last 15 years.

Prominent characteristics

Taiwan differs significantly in its Science & Technology government structure to the other countries in this study; namely in the comparatively negligible R&D budget that the Ministry of Education has compared to the Ministry of Economic Affairs (30 fold difference). Instead the National Science Council, which is essentially civil servant dominated, although under the direction of a minister without a portfolio, sets national strategy. However, the Industrial Technology Research Institute (ITRI) under the Ministry of Economic Affairs plays a large and somewhat competitive strategic role. With a quarter of the Ministry of Economic Affairs' budget, ITRI has significant resources to influence national strategy – especially by coordinating private sector research. This is done by creating national roadmaps that are specifically adapted for the industry's use according to agreed contracts – i.e. ITRI acts as a strategic consultancy firm for industry. In addition, ITRI performs basic, advanced research programmes – a quarter of its budget and thus an eighth of the Ministry of Economic Affairs' budget – with little or no matching funds from industry. There is some competition from the Academia Sinica in terms of

Taiwan: Selected characteristics in short

- **The National Science Council (NSC) is the highest agency and coordinating body for research prioritisation**
  – The President chairs the Science & Technology Advisory Group (STAG), which guides the National Science Council and approves budgets

- **The Industrial Technology Research Institute (ITRI) acts as a government innovation-to-market powerhouse**
  – Similar to VTT in Finland and TNO in the Netherlands, but ITRI does national roadmapping on par with the NSC and acts as a national coordinating body for private sector research.

- **Taiwanese piggy-back funding schemes save evaluation efforts**
  – When a team becomes part of e.g. an EU framework programme, the NSC automatically guarantees additional funding to that group assuming their merit to be proven.

- **Taiwan is trying to find its balance between strong leadership and more democratic aspirations**
  – Famous role models are key for effective leadership and are used to spearhead almost all initiatives

prestige, but not in real terms of overlapping competencies. However, the Academia Sinica is trying to establish an ITRI-like organisation for biotechnology, which may compete with ITRI for Government resources. Note that ITRI in many ways requires the presence of an established industry already, to take over its prototype developments and strategic plans.

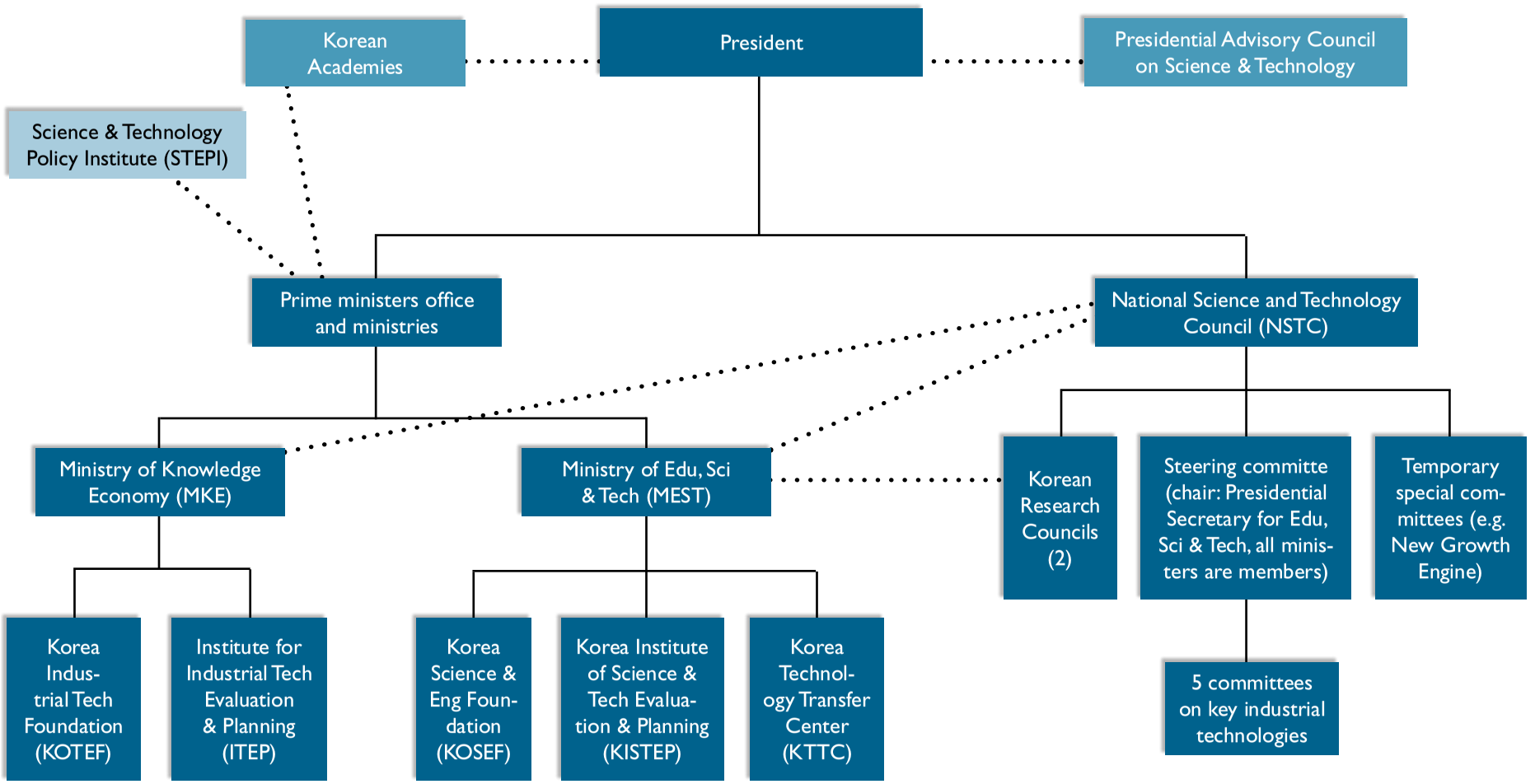
»We must get away from general university rankings and let each university become best at something«

Prof. Yuan Tseh Lee, Nobel Prize Laureate and President Emeritus of the Academia Sinica

Role models are the key to effective leadership in Taiwanese culture and this is reflected in their use of carefully chosen chairpersons for programmes and also in their extensive use of expatriates, who have succeeded in one way or another overseas. These expatriates are flown to Taiwan 2–4 times a year to give their informed, yet unbiased opinions. The short-term use of "committees of the wise", similar to the Netherlands, is widespread. It is interesting to note though, that the Taiwanese industry itself is not that well represented in "committees of the wise", as they are seen to be too conservative by the civil servants. Advice is sought by venture capitalists in the electronics business, but many other areas of industry do not display mature venture capital. Thus venture capitalists are not present on evaluation boards of new programmes of the NSC or the Academia Sinica, as is the case in the South Korean counterparts.

A significant shortcoming of Taiwan is the presence of legal hurdles and lack of incentives for university professors and staff to be involved in private enterprise. Only since 2008 are professors able to earn money from consulting, yet they can still only own a 10% share in private companies and may not have any executive role in any private companies.

Prioritisation of research and innovation in SOUTH KOREA – organisations deemed important by the interviewer. Dark blue: Politically governed organisations; Light blue: Semi-independent governmental organisations; Blue: Independent organisations.

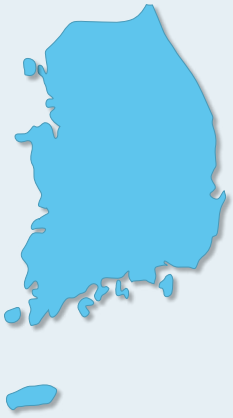


8. South Korea

SOUTH KOREA

USD 1,370 bn GDP (PPP) / 49 m people
= USD 28,000 per capita (PPP, OECD 2008)

3.5% of GDP (USD 48 bn) spent on R&D (78% / USD 37 bn by private sector)



Key questions South Korean interviewees would like answers to:

- How to boost creativity in education and in business?
- How to best balance the social-democratic equality with a free innovative business environment?
- How to build a strong working relationship between the Ministry of Education, Science and Technology (MEST) and the Ministry of the Knowledge Economy (MKE)?

Description of the research policy arena

South Korean research policy is set and coordinated by the National Science and Technology Council (NSTC) chaired by the President of the Republic and consisting of 11 ministers, 7 & 6 industrial and academic representatives, respectively. The President also has an independent advisory council consisting of 30 advisors mainly from the private sector. The two major ministries (out of 9 total) concerned with research and innovation policy are the Ministry of Education, Science & Technology (MEST) and the Ministry of the Knowledge Economy (MKE). Both ministries have their own policy institutes and funding agencies. Due to major mergers of Government bodies under the new administration, some coordinating ability has been lost. The former Office of Science and Technology Innovation (OSTI) coordinated many initiatives, but was disbanded when the Ministry of Science & Technology was merged with the Ministry of Education to form the Ministry of Education, Science & Technology (MEST). Instead the two major ministries have the duty to oversee each other's policy recommendations directly in a formal review process, which, at least in some cases, leads to strategic blocking due to long-standing rivalries. The Korea Industrial Technology Foundation (KOTEF) and the Korea Science & Engineering Foundation (KOSEF) are the funding agencies of the MKE and MEST respectively. In addition, each ministry has a policy institute, namely the Institute for Industrial Technology Evaluation & Planning (ITEP) under MKE and the Korea Institute of Science & Technology Evaluation & Planning (KISTEP) under MEST. The latter is the major coordinating body for the NSTC, thus giving MEST relatively more influence than the MKE. As there are quite strong rivalries between MEST and the MKE, the Science & Technology Policy Institute (STEPI) is an important bridge. STEPI is a non-profit organisation funded at 50–60% by the Korean Government and 40–50% by private contributions. Despite the high Government funding level, it is considered an essentially independent, liberal-minded organisation. STEPI research fellows are often used as experts both nationally and internationally.

The NSTC is run by a steering committee of which all ministers are members. However, there

are five committees on key industrial technologies and there are temporary special committees, which yield significant power and can set the agenda for several years to come. The two Korean Research Councils have around 25 member institutes. Around 50% of the budget comes directly from the Government. Mergers and splits between different member institutes have been very common in the past decades. In addition to these institutes there are over 300 Government research institutes (under the various ministries) with mandates to help the private sector develop. It is important to note that there are over 200 universities (of which around 150 conduct research): 41 national, 2 public and the rest private. The universities get their block funding from MEST and their directed funding from KOTEF and KOSEF as well as the Korean Research Councils.

Prioritisation instruments:

CENTRES OF EXCELLENCE PROGRAMMES

Centres of Excellence programmes started in 1990 and selection is today administered by MEST. By international standards they are generous in terms of duration of funding; namely nine years; and have been popular with universities. Support amounted to about USD 10 m annually in total and selection is very tough (~10% success rate). Selection is made by ad hoc committees. Currently there are around 65 centres in operation, half so-called Science Research Centres and the other half Engineering Research Centres. There are a few other types of research centres also, such as Medical Research Centres and National Core Research Centres.

REGIONAL INNOVATION CENTRES

These work similarly to the centres of excellence programmes, but began as Regional Research Centres and Technology Innovation Centres in 1995 in support of regional advantages or disadvantages. For the most part, these 80 centres take the form of resource/infrastructure sharing centres, where resources are shared with SMEs but the centres are located exclusively at universities.

NURI – NEW UNIVERSITY FOR REGIONAL INNOVATION

Since 2004 this programme addresses the need for complete national development and takes the form of funding linkages between universities and regional strategic industries. The result has been that the industries and universities jointly develop curricula, select tools and practical training for students.

REGIONAL TECHNOPARKS

Since 1997 local Governments and the MKE have run technopark programmes to build up technology infrastructure according to the needs and visions of local businesses and universities.

Prominent characteristics

The post of Minister of Science & Technology was promoted to Deputy Prime Minister in 2003 to improve inter-minister coordination on science, technology and innovation. This is very important as there are deep rivalries between MEST and MKE. Mutual distrust between Government Research Institutes (GRIs) of different ministries and universities also inhibits necessary system linkages. Thus, much discussion about how to remodel the GRIs is underway – everything from ministerial relocation, mergers with universities to privatisation is being discussed.

Mergers are commonplace in the recent past of South Korea. For example, the NSTC itself was merged with the education council only recently, reducing the number of representatives and increasing the responsibilities of the council. Also, MEST is a merger of the Ministry of Education and the Ministry of Science and Technology. Some worry about this recent ministerial merger, because in other countries it has been shown that science and technology falls in the shadow of education policy politically. However, these mergers are examples of the overall trend to centralise responsibilities in South Korea, but also a reflection of a more fluid, adaptable culture than might be expected. To put things into perspective: South Korea is seriously debating changing its capital city from Seoul to Yeongi-Gongju, no doubt mainly for improved national security. Nevertheless, it shows the overall willingness of South Korea to undertake momentous restructuring for the betterment of the country.

Mergers of organisations are not the only form of mergers promoted in South Korean research policy. Unlike any other country in this study, the

South Korea: Selected characteristics in short

- **Science & Technology is a national strategy and the President is given a lot of leeway**
  – The President appoints individuals to the National Science & Technology Council
- **The private sector has significant influence, both direct and indirect**
  – The Presidential Advisory Council on Science & Technology consists of 30 private sector representatives
- **Major restructuring of ministries**
  – Ministries of Education, Science & Technology merged
- **Well-funded Government Research Institutes**
  – Overall mandate to collaborate with industry, but not steered strongly by ministries
- **Both national roadmaps and specific roadmaps revised annually**
  – Up to 2,000 experts meet in different committees
  – The chairpersons for roadmapping groups are often young persons (early 30s) from the private sector; to avoid special interests and old thinking.

South Korean agencies seem to put significant effort into merging teams of researchers whose projects show some promise but have failed to gain financial support; i.e. if one team displays a good research idea within a certain field and another seems to have the experience necessary to carry it through but both have failed in some way to secure funding, these teams are brought together to discuss possible collaboration and resubmission of a new proposal.

»If I were a Swedish decision-maker I would double the spending on KTH and Chalmers and let them focus on what they are really good at!«

Prof. Nam Suh, President of Korea Advanced Institute for Science and Technology

In the same spirit of cooperation, the policy arena shows signs of a momentous collection of will as in the example of the so-called "577 initiative". This initiative from the NSTC promotes the increase of the nation's R&D expenditure from 3.2% in 2006 to 5% in 2012 (#5 in 577) and a focus on 7 areas (#7 in 577) to become one of the 7 major Science & Technology powers in the world (#7 in 577). The latter is measured in terms of parameters such as publications, patents transfer ratio for publicly owned technology, percentage of HRST (Human Resources in Science & Technology) and contribution to economic growth. It is too early to tell if these goals will be achieved, but the directives are taken very seriously by all of those interviewed.

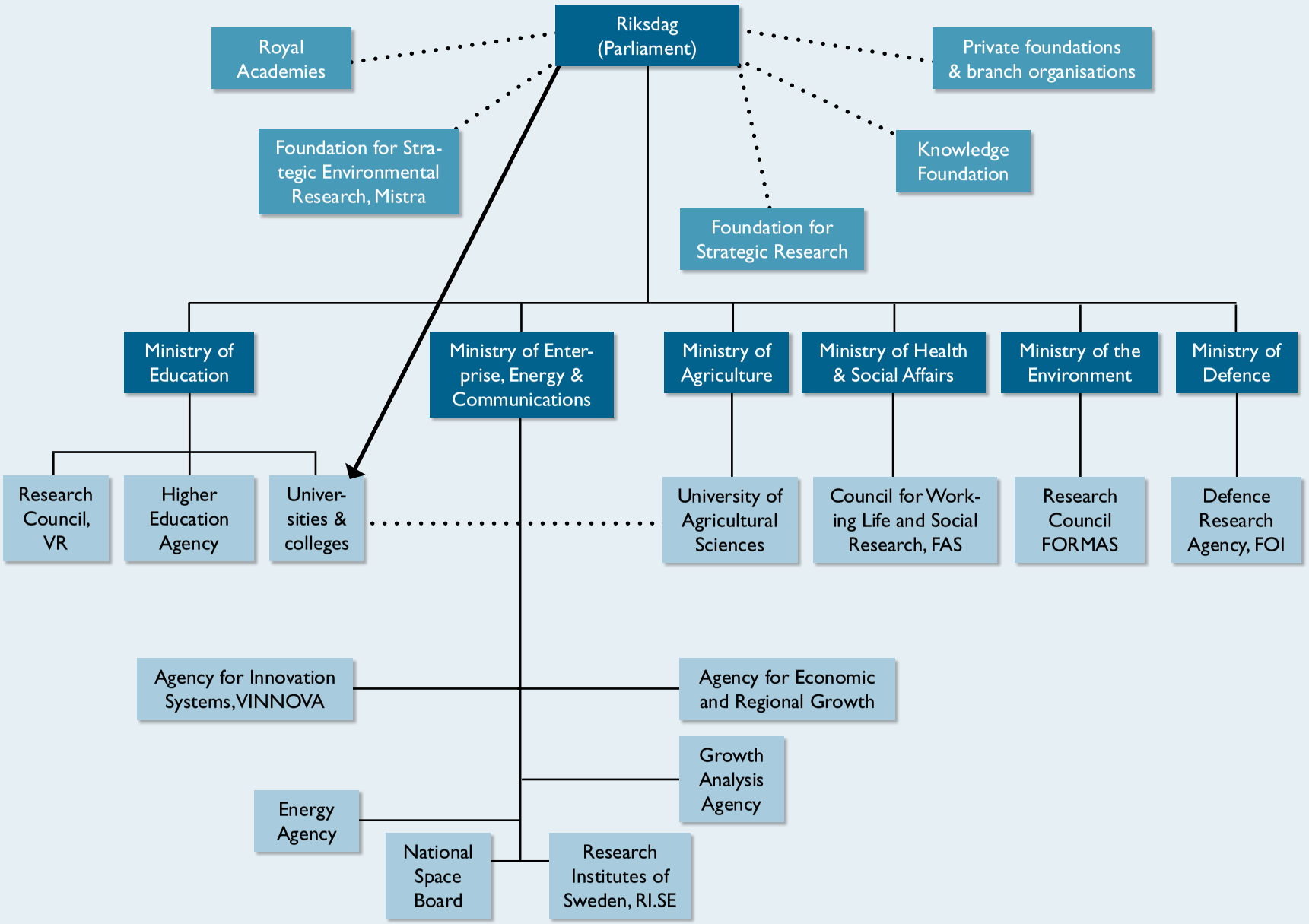
The culture of centralisation is also reflected in the opinion of top-level decision makers; that it is better to focus on efficiency and strength than on an equitable funding system. However, there is a growing understanding that the education system leading up to university level must be more equitable and certainly a lot of resources are spent on helping all capable students to achieve international performance standards. For example, the BK21 – Brain Korea 21 programme, which is a comprehensive programme for graduate students to gain experience and confidence both in South Korea and abroad.

It is evident that some universities have more status and concomitantly more funding than others. The Korea Advanced Institute for Science and Technology (KAIST) is most noteworthy in this regard. Its president, Prof Nam Suh, is a prominent

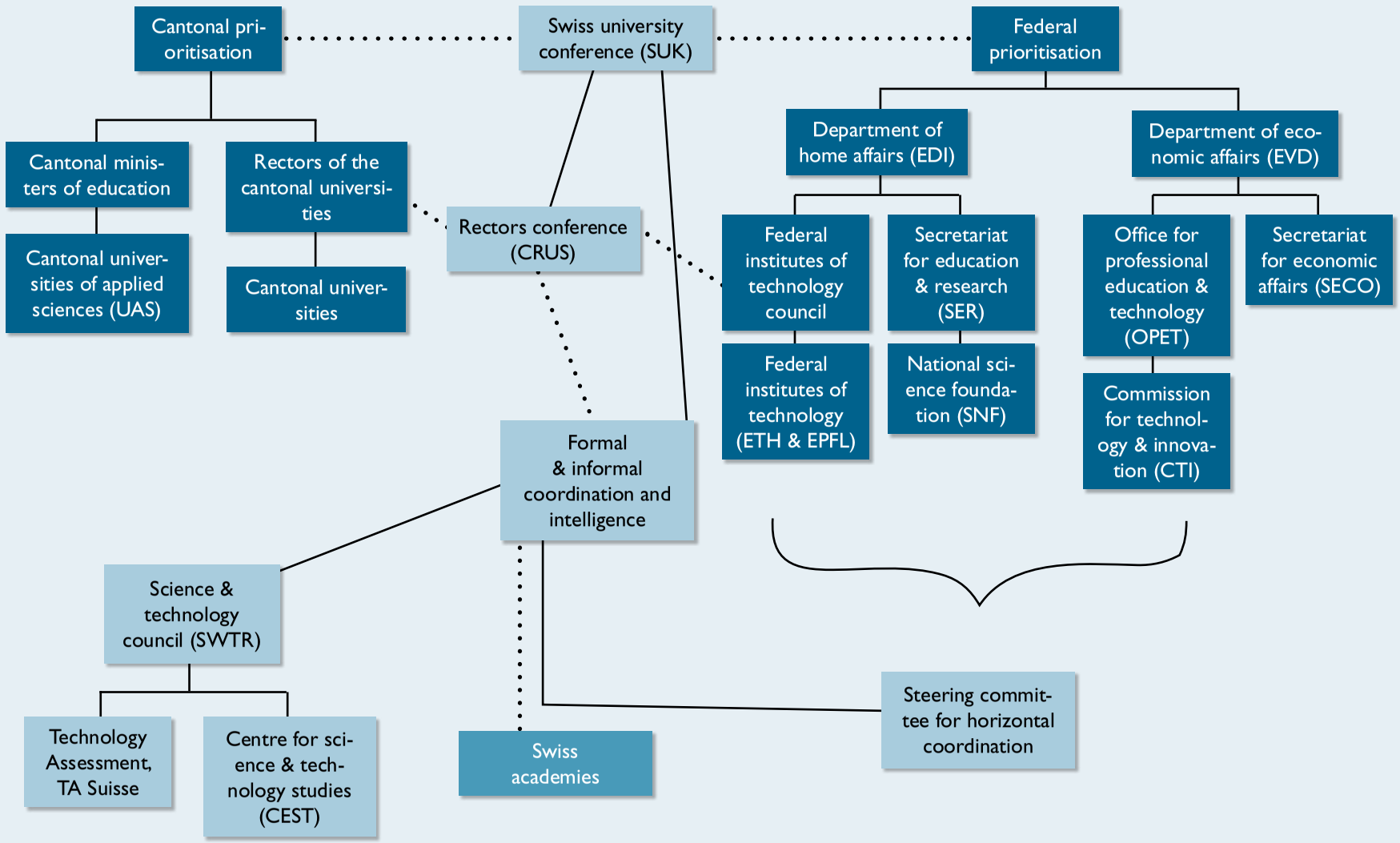
member of the NSTC and was a major driving force for South Korea's "New Growth Engine Committee", which resulted in the "577 initiative" mentioned above. President Suh runs KAIST much like the Massachusetts Institute of Technology (MIT), by building strong, independent departments that get financial and political support within a few strategic areas (albeit wide areas; e.g. energy, cleantech etc.). In his view, this is the recipe for advanced technology innovations, as the private sector too often gets stuck in old cash cow thinking. For this reason, KAIST is working on the next generation of electrically powered vehicles, not with the automotive industry, but with the electricity companies.

9. Detachable maps

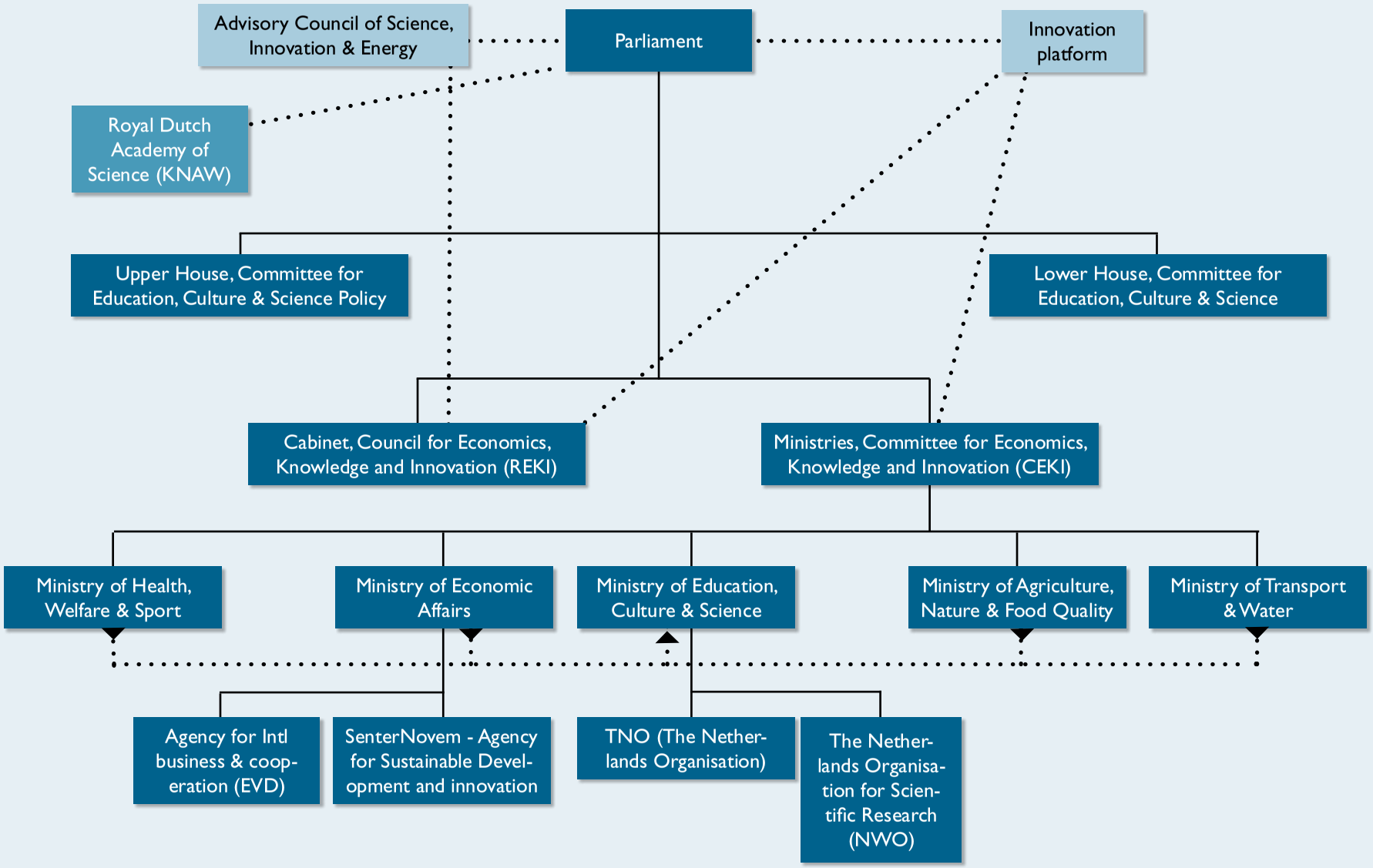
Prioritisation of research and innovation in SWEDEN – organisations deemed important by the interviewer. Dark blue: Politically governed organisations; Light blue: Semi-independent governmental organisations; Blue: Independent organisations. Note the arrow depicting the direct thematic steering by Parliament of some of the university funds.



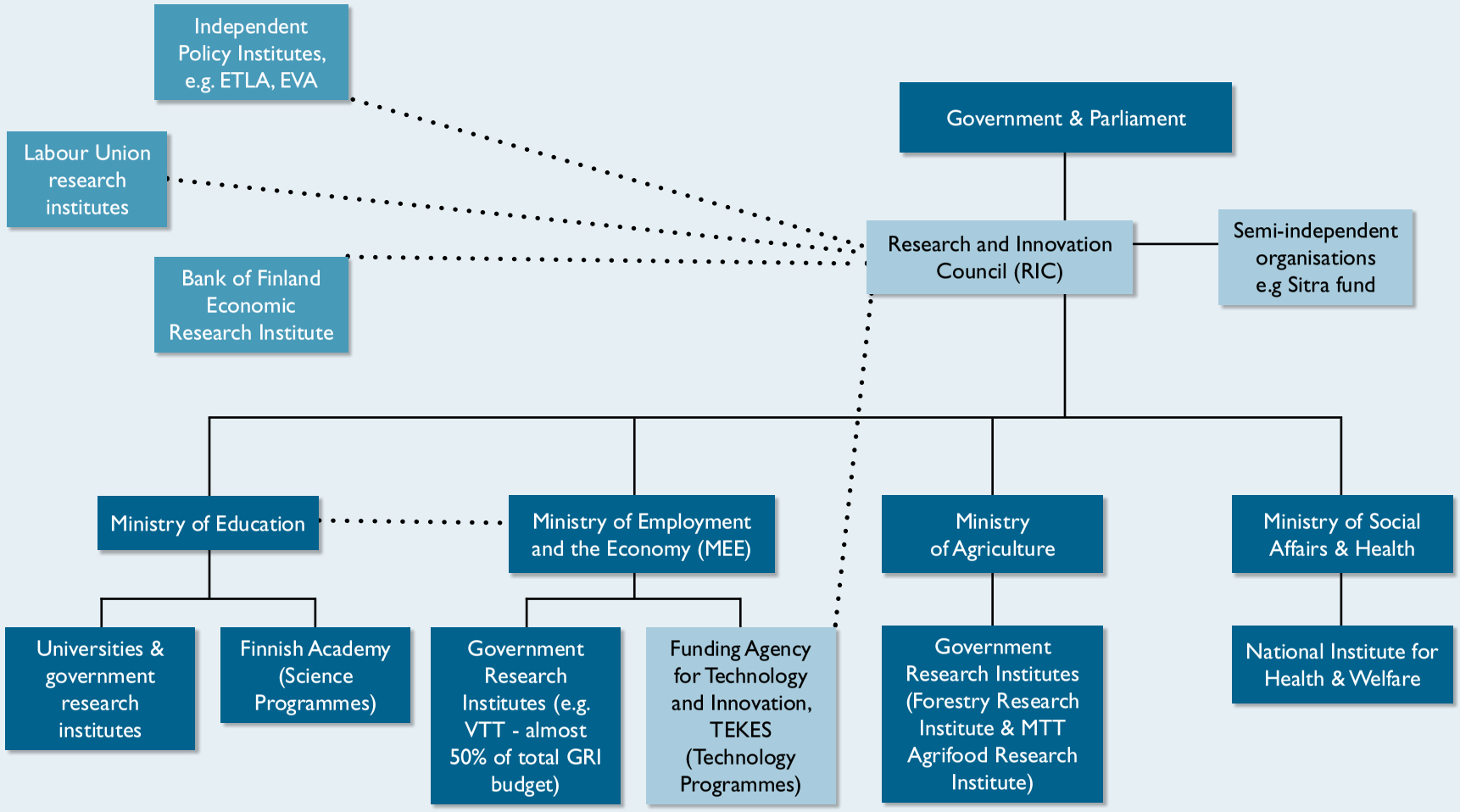
Prioritisation of research and innovation in SWITZERLAND – organisations deemed important by the interviewer. Dark blue: Politically governed organisations; Light blue: Semi-independent governmental organisations; Blue: Independent organisations.



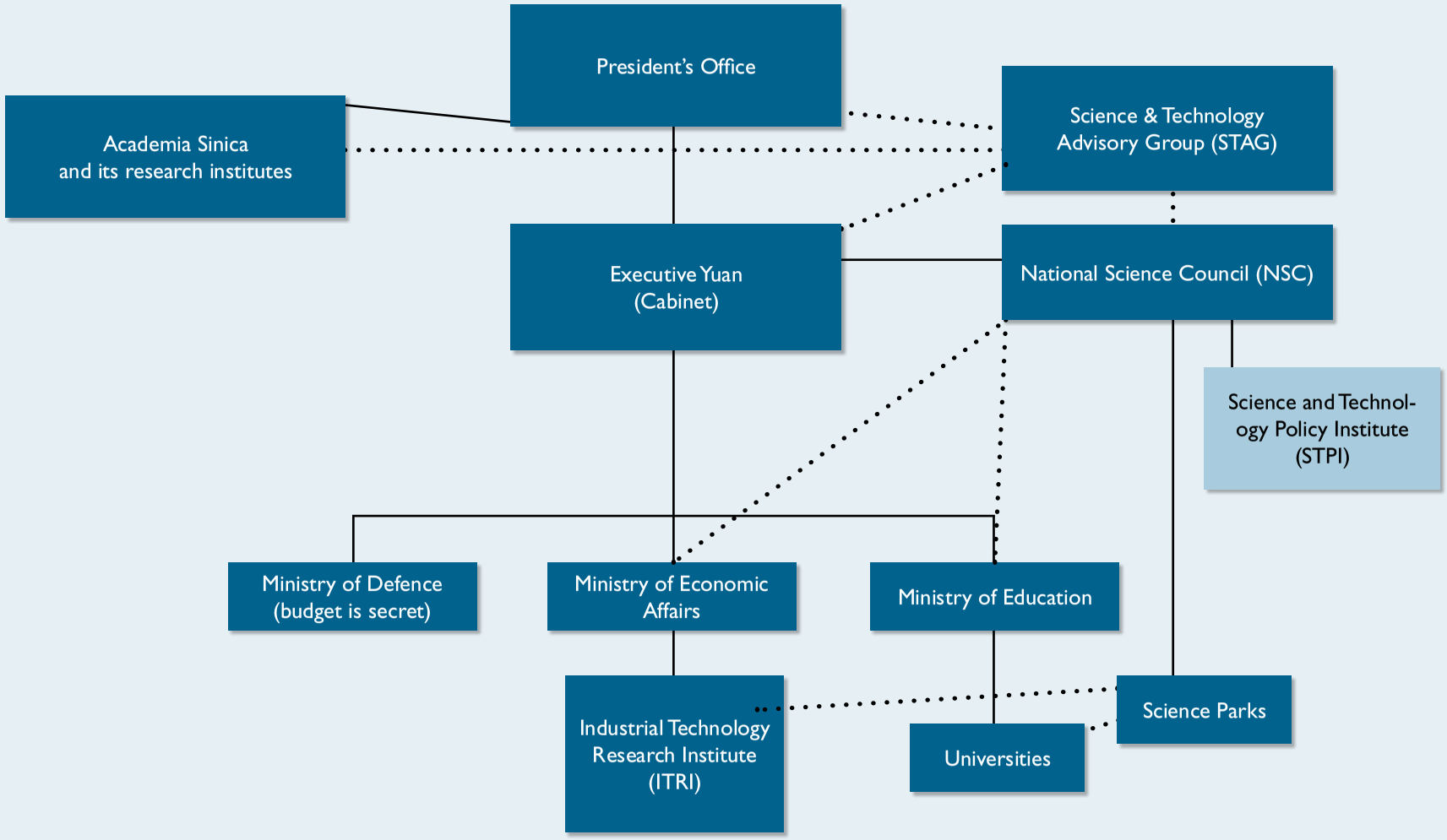
Prioritisation of research and innovation in the NETHERLANDS – organisations deemed important by the interviewer. Dark blue: Politically governed organisations; Light blue: Semi-independent governmental organisations; Blue: Independent organisations.



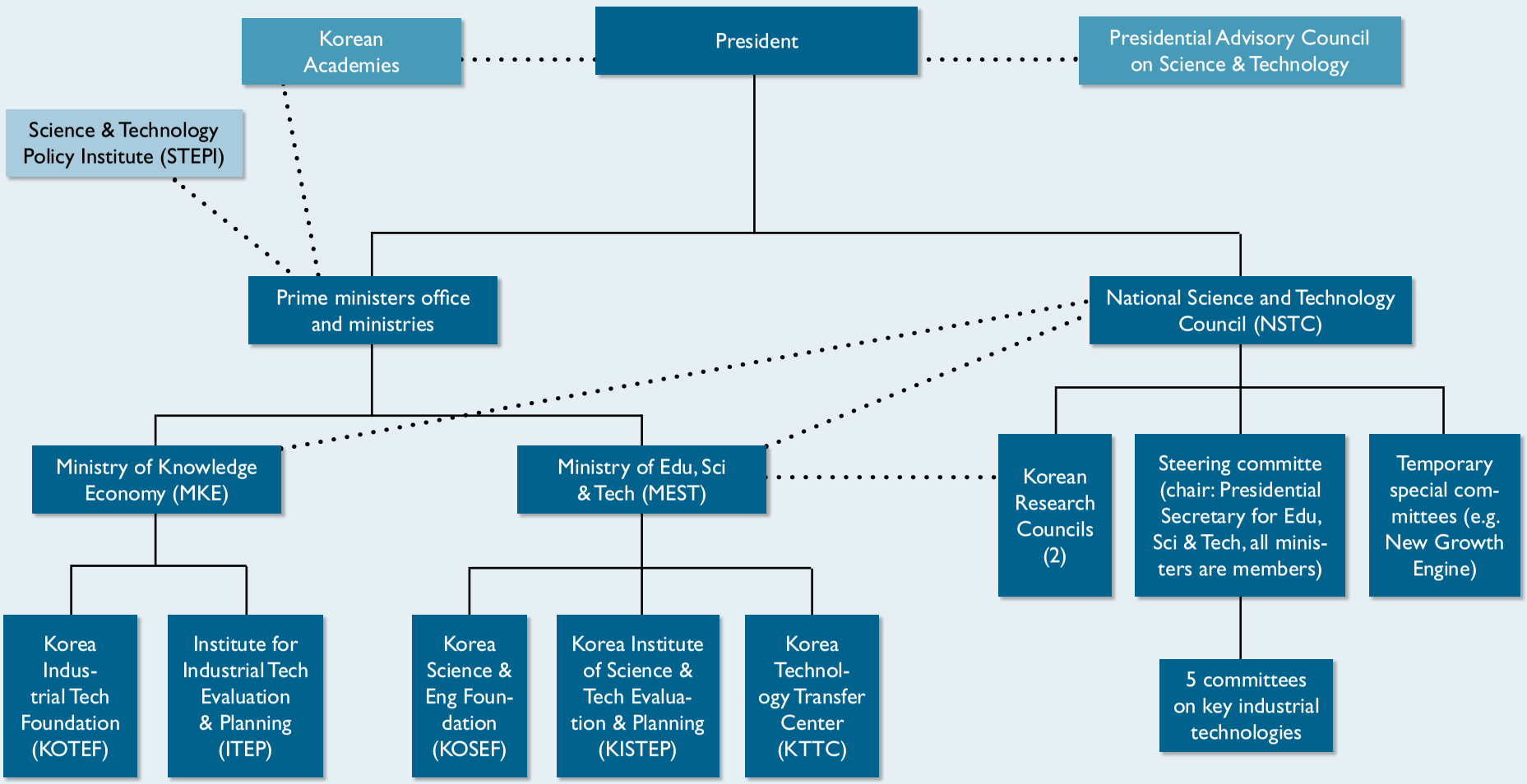
Prioritisation of research and innovation in FINLAND – organisations deemed important by the interviewer. Dark blue: Politically governed organisations; Light blue: Semi-independent governmental organisations; Blue: Independent organisations.



Prioritisation of research and innovation in TAIWAN – organisations deemed important by the interviewer. Dark blue: Politically governed organisations; Light blue: Semi-independent governmental organisations; Blue: Independent organisations.



Prioritisation of research and innovation in SOUTH KOREA – organisations deemed important by the interviewer. Dark blue: Politically governed organisations; Light blue: Semi-independent governmental organisations; Blue: Independent organisations.



STRATEGIES FOR RESEARCH PRIORITISATION

Small to medium-sized countries need adaptive strategies for research prioritisation to stay abreast with global competition. At the same time, democratisation and consensus culture dilute resources.

Sweden lacks either a national science & technology council or an inter-ministerial coordination body and does not conduct any detailed national roadmaps for research and development. This report presents answers from selected foreign policy specialists – from Switzerland, the Netherlands, Finland, Taiwan and South Korea – to the question of what structures and instruments exist in their countries to prioritise research and innovation.

Are large mission-oriented institutes or specially-funded elite universities better suited for innovation-to-market development? What kind of coordination bodies can help strategy development without causing unnecessary delay or dilution of resources? This report will help policymakers to ask the right questions leading to the right answers.