

OECD Reviews of Innovation Policy: Sweden 2015

Overall Assessment and Recommendations
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TABLE OF CONTENTS

OVERALL ASSESSMENT AND RECOMMENDATIONS.....	3
The focus of the review.....	3
The Swedish innovation policy context.....	4
Recent achievements and challenges.....	7
Limited success in terms of strengthening the university research base.....	7
Commendable efforts to improve research and innovation links but some concerns.....	8
Need for more concerted efforts to tackle societal challenges.....	9
Prioritisation and strategy development are constrained by weak governance structures and processes.....	10
Strategic tasks.....	10
Guiding principles.....	11
Recommendations.....	13
Strengthening university research.....	13
Linking research and innovation.....	17
Dealing with societal challenges.....	19
Priorities, strategies and governance.....	21

OVERALL ASSESSMENT AND RECOMMENDATIONS

The focus of the review

In 2012, at the request of the Swedish Ministry of Enterprise, Energy and Communications (now the Ministry of Enterprise and Innovation), the OECD performed a review of Sweden's innovation policy. Following the standard methodology for the conduct of OECD country reviews of innovation policy, the 2012 *Review* provided an independent, comparative assessment of the strengths and weaknesses of the Swedish innovation system, examined its main actors and their interactions, and identified opportunities for improving its overall performance. The resulting recommendations focused on how government policies could contribute to such improvements, drawing on the experience of other OECD countries and existing evidence on innovation processes, systems and policies.

This follow-up– the *OECD Review of Innovation Policy: Sweden 2015* – was commissioned by the Ministry of Enterprise and Innovation and is intended to deepen the earlier analysis by following up on developments in six key policy initiatives that were central to the Research and Innovation Bills of 2008 and 2012. These involved:

- a significant increase in the “general university funds” (GUF) or “block funding” for university research and the related introduction of a scheme partially linking funding for research to a performance assessment scheme
- the establishment of Strategic Research Areas (SFOs) to enable universities to strengthen capabilities in existing areas of research strength and excellence
- actions designed to enhance the role of research institutes (RIs) in Sweden's innovation system
- the definition and funding of Strategic Innovation Areas (SIOs), whose aim was to strengthen industrial capabilities by supporting collaborations involving new, broad-based configurations of industrial, academic and research institute actors
- the initiation of a Challenge-Driven Innovation (UDI) programme focusing on four key areas addressing societal challenges (Information society 3.0; Sustainable Attractive Cities; Future Healthcare; and Competitive Production) in which Sweden has both a strategic interest and a good innovation track record
- improved prioritisation and support for Swedish participation in European research and innovation activities, including participation in the European Union's (EU) Horizon 2020 (H2020) initiative and involvement in public-to-public (P2P) partnerships aligning research and innovation efforts across Europe, especially in areas related to societal challenges.

In the following, these policy developments are discussed under the following headings:

- strengthening university research
- linking research and innovation
- dealing with societal challenges
- priorities, strategies and governance.

While the focus of this follow-up report is on Swedish policies and institutions, it has a global context in at least two ways. First, it is informed not only by the history and current performance of the Swedish system but also by lessons and useful practices emerging from international experience. Second, and more important, *it sets out recent achievements and challenges related to the above-mentioned six policy initiatives that constitute the focus of this report, plus a series of strategic tasks, guiding principles and recommendations vital to Sweden's global competitiveness in research and innovation.* These are of the essence if Sweden is not merely to maintain its “good” position in global terms but to establish and consolidate excellence and leadership, untrammelled by some of the limitations of its research and innovation system today.

Specific attention is paid to the historical development of the Swedish innovation system as there are signs that institutions, governance and therefore path dependencies tend to limit the system's flexibility, and hence its ability to keep up with the competition. The signs are evident in some of the governance issues associated with current governance structures, arrangements and related policies; ignoring these signs raises the risk that they will reappear during the development and implementation of future policies. Whatever the strength of the system today, it is clear that it needs to be nimble and flexible in order to keep up with the demands of tomorrow.

The Swedish innovation policy context

The 2012 *Review* of Sweden's innovation policy summarised Swedish achievements and the challenges facing the country prior to identifying a series of strategic tasks, guiding principles and detailed policy recommendations that Sweden might follow. A summary of the results of the review provides a useful starting point for the further analysis of the six policy areas listed above.

The 2012 *Review* pointed to Sweden's impressive economic and social development since it began to industrialise in the 19th century. Sweden's development has been characterised by:

- early internationalisation of large Swedish companies
- in certain fields, co-operation between national industry and the state in developing new technologies and making strategic use of public procurement, allowing Sweden to act as a lead market for new product generations
- a framework for “tripartite” interaction among government and social partners, and sharing of productivity gains
- high levels of education, skill and investment in knowledge-based capital (KBC), including research and development (R&D).

Other characteristics of the Swedish system that are key to understanding recent policy developments include:

- the Research Bill process, involving wide consultation every four years on policy needs related to research (and in later years also to innovation), and the subsequent publication of a bill setting out government policies, including justification for proposals and an account of the reasoning behind them. The Ministry of Education and Research leads this process, since its Minister takes the lead in government discussions affecting research.
- the existence of a “Swedish model” for universities stems from a recommendation made by the Malm Commission in 1942 not to set up a national technological institute such as those developed

by the Netherlands (TNO) or Finland (VTT), but to build the equivalent capabilities into the universities so that they could perform a “third mission” serving the needs of the broader community. Malm did propose a role for various research institutes to serve the needs of industries not dominated by one or more big firms – but they were not to be the major focus of technological efforts. The intention was to avoid fragmenting the research resources of a comparatively small country and has coloured Swedish research policy ever since.

Innovation has long been at the core of Swedish economic and social development. It has underpinned Swedish enterprises’ strong international competitiveness in manufacturing and services, as well as drawn on and fed into the well-educated labour force. It has also generated the revenues to be distributed throughout society and reinvested in innovation activities. This virtuous circle has helped transform Sweden into one of the world’s most innovative economies and societies. Innovation has been facilitated through sharing productivity gains and an active labour-market policy mitigating the frictions associated with “creative destruction”. By international standards, innovation is comparatively well accepted in Swedish society.

Sweden’s development path, however, has not been linear. Like other European countries, the country has experienced a growth slowdown and persistently weak productivity performance following three decades of post-war economic dynamism. As a small, highly open economy, Sweden was not spared by the financial and economic crisis that led to a deep recession in 2009. But earlier fiscal and banking system reforms, as well as industrial restructuring triggered by the recession of the early 1990s, meant that Sweden was better prepared for – and recovered faster from – the recent crisis than many other countries. A less favourable international macroeconomic environment (notably in Europe) has kept growth below pre-crisis levels, although well above that in other European countries.

Overall, the 2012 *Review* concluded that Sweden had embraced changes in the global economy successfully. It has maintained a strong industrial base with an exceptionally broad range of products, in which it shows a comparative advantage for a country of its size. Swedish manufacturers have successfully integrated sophisticated service components into their products, and market services have grown rapidly. Despite these strengths, the *Review* warned that Sweden’s success should not create complacency. Given the intensity of global competition and the continuous need to be at the forefront, new initiatives were needed in order to tap new sources of growth. There was also scope to improve policy formulation and planning.

The 2012 *Review* noted that over the last 25 years, important segments of Sweden’s industry have been taken over by non-Swedish multinational enterprises (MNEs) with headquarters outside of Sweden. At the same time, large Swedish firms – which have long relied on international markets – have become more profoundly “global” in reach and orientation. Irrespective of their ownership, these enterprises are guided by their global corporate strategies, including those related to R&D. These changes have had an impact on interactions in the Swedish innovation system and raise questions of how to facilitate adaptation and further internationalisation of Swedish science, technology and innovation. In some cases, actors in the research system have lost important industrial counterparts.

Sweden’s R&D intensity (gross expenditure on R&D as a percentage of gross domestic product, GDP) – for long the highest in the world – started to decline in 2000 and was at around 3.3% of GDP in 2013. This development was driven by a decline in business expenditure on research and development that is highly concentrated in large MNEs. Many of these MNEs have so far maintained a strong R&D effort in Sweden.

The 2012 *Review* confirmed Sweden’s position as an important international centre of scientific excellence and technological leadership. Sweden performs well in the field of science, in terms of both the volume and quality of its scientific publications (as assessed by the share of citations). Sweden can also boast a higher number of international patents per capita than most OECD countries – far above the EU average.

The general picture that emerges is that Sweden has maintained a high level of performance, but has done less well in recent years than a number of comparator countries.

The Review identified the following key strengths in the Swedish research and innovation system:

- successful economic development
- specialised at high end of global value chains
- good framework conditions
- a strong human resource base
- high investment in R&D, KBC and information and communication technology (ICT)
- a strong science base
- excellent innovation performance
- good positioning in international networks.

Significant weaknesses were:

- some aspects of financing for innovation
- declining educational performance
- a suboptimal academic intellectual property system
- small academic centres of competence/excellence
- weak links between traditional universities and small and medium-sized enterprises (SMEs)
- weak innovation policy compared to policy in other areas (e.g. education)
- lack of a holistic perspective concerning innovation policy
- many medium-sized funding agencies funding similar things
- unclear governance in regional innovation policies.

The 2012 *Review* identified a series of strategic tasks and guiding principles that Sweden might adopt in order to improve the performance of the overall innovation system.

These strategic tasks included:

- the provision of world-class framework conditions and infrastructures for business
- improving links between Sweden's strong universities and its relatively small public research institutes (PRIs), with a view to enhancing the links of both with industry

- fostering internationalisation at the forefront of science, technology and innovation
- adopting pioneering approaches to innovation and the development and implementation of innovation policy.

The guiding principles suggested:

- taking a broad approach to innovation
- highlighting innovation in services
- further strengthening international openness
- ensuring quality, relevance and critical mass in public research.

More detailed recommendations included:

- maintaining supportive framework conditions for innovation and entrepreneurship
- maintaining a world-class human resource base for science, technology and innovation (STI)
- improving public governance of the innovation system
- fostering innovation in the business sector
- balancing the policy mix and enhancing the role of demand-side policies
- fostering critical mass, excellence and relevance in public-sector research
- strengthening regional innovation policy and its alignment with national policy
- strengthening public-sector innovation and social innovation
- maximising benefits from the internationalisation of R&D and innovation.

The 2012 Review argued that maintaining Sweden's strong long-term economic performance in an increasingly globalised world would depend to a great extent on the country's innovation capacity, i.e. its ability to generate, transfer and assimilate a continuous flow of technological, managerial, organisational and institutional innovation. Meeting this challenge calls for continued high investment in R&D and innovation as well as a well-functioning innovation system that ensures high returns on investment.

Recent achievements and challenges

Limited success in terms of strengthening the university research base

Sweden attempted to enhance the university research base by increasing "general university funds" for research (GUF) and launching the Strategic Research Areas (SFO) initiative, both aimed at improving the overall research performance of the higher education institutions (HEIs) by allowing them to build on existing strengths. Universities were expected to use the additional GUF money to give researchers greater freedom to follow their own agendas rather than be committed to some of the agendas of Third Party Funding (TPF) bodies. Similarly, while a new performance assessment scheme introduced at the same time was

partially based on success in raising competitive TPF, the additional funds gained were also envisaged as a form of compensation that could be used to fund the individual research interests of academics. Finally, the SFO scheme specifically prioritised research endeavours in a very broad range of areas that gave universities an opportunity to bid for funds that would allow them to channel money into areas they deemed “strategic”, typically reinforcing areas of strength.

In the event, none of these initiatives can be considered truly effective. GUF certainly increased, but the viciously circular link between GUF and TPF that has existed in Sweden for many years was not broken. Rather than using the money to allow individual researchers to follow “non-tied” or “open” lines of enquiry, the funds were often used to hire new recruits dependent in part for their salaries on raising additional “tied” funds from TPF sources. The mechanics of the performance assessment scheme and the proportion of GUF for research affected by the scheme (10% in the 2008 Bill rising to 20% after the 2012 Bill) also meant that the relative increases and decreases for individual universities as a result of the scheme’s implementation were mostly marginal. Finally, the external evaluation of the SFO concluded that universities with overt strategies had benefited most from the scheme, but that relatively few universities possessed such strategies.

The common thread is the absence of adequate governance mechanisms to ensure that high-level priorities and goals mesh effectively with the lower-level goals of the academic research community. Academics generally value the freedom to conduct research wherever their interests take them, and this sentiment is especially strong in Sweden. In contrast, government often has a civic responsibility to provide a gentle steer to research, sometimes in terms of satisfying broader societal needs, but also often to instigate performance improvements that ensure value for money is realised from the expenditure of public funds. In academic circles, the universities are key institutional intermediates in this process of reconciling often competing top-down and bottom-up priorities. The relative weakness of many Swedish universities in terms of strategic leadership is thus an important impediment to the effective realisation of government priorities and expectations for the university sector.

Commendable efforts to improve research and innovation links but some concerns

As part of its efforts to improve the links between research and innovation, Sweden has paid increasing attention to the role played by research institutes (RIs). It has also launched the Strategic Innovation Areas (SIO) initiative, which supports joint R&D and innovation-related activities between different sets of actors, including universities, research institutes and industry.

Originally comprised of many small specialised institutes serving the needs of specific sectors and occupying a very marginal position in the national innovation system given the “third mission” role of universities, policy since the 1990s has attempted to consolidate and strengthen the role of the RIs, with the formation of Research Institutes of Sweden (RISE) Holding company, signalled in the 2008 Bill and further measures aimed at consolidating and strengthening the role of the RISE institutes announced in the 2012 Bill. This attempt at consolidation and growth marks the recognition that the functions of RIs are significantly different from those of universities, and that neither the RIs nor the universities can alone meet all the needs of local and international firms within a flourishing innovation ecosystem.

Progress towards the establishment of a strong RI sector that plays a pivotal rather than a marginal role in the Swedish innovation system has been slow but steady. There is still some way to go, however, in the transition from branch-focused research associations with membership-based governance structures to the construction of a truly polytechnic organisational form for RISE that can address wider industrial and social needs. This may require changes to the existing governance structure of RISE that allow it not only to satisfy the needs of its traditional sectoral interests (the bottom-up needs of its existing customer base) but also to satisfy the top-down needs of the state for an organisation that can play an extended role in the functioning of the Swedish innovation system as a whole.

The SIO initiative set out to prioritise areas considered to be of strategic importance to Sweden and to launch support programmes for research and innovation programmes and projects within them. A characteristic feature was the emphasis put on the bottom-up construction of the Strategic Innovation Agendas (SIAs) formulated in these priority areas and the Strategic Innovation Programmes (SIPs) that were launched within them. New constellations of industrial, academic and research institute stakeholders were expected to play key roles in setting and operationalising these priorities.

There was no overt prioritisation of particular areas from a top-down, governmental perspective. Responsibility for the orchestration was handed down to the agency level, first to the Swedish Governmental Agency for Innovation Systems (VINNOVA) and subsequently to VINNOVA and two other funding bodies. VINNOVA deployed funds to support the preparation of the strategic research agendas and encouraged the broad involvement of new configurations of stakeholders spanning multiple disciplines, fields, sectors and organisational types. These stakeholders were then invited to submit proposals for the launch of SIPs in line with the strategic research agendas that had been developed. External evaluators were used to assess the proposals for these SIPs and VINNOVA (and the other two agencies) disbursed funds to them.

The effect of funding a portfolio of academic-industrial consortia selected bottom-up is frequently conservative, with the portfolios reflecting areas of existing strengths and interest on both the academic and the industrial sides. A bottom-up competition provides a “snap shot” of potentially interesting and strong areas – but it is also to a considerable degree backward looking and tends to have short term horizons. It needs therefore to be complemented by policy instruments that are more forward-looking, addressing less well-established areas of potential future interest and have longer-term horizons. The agencies involved appear confident that a determined emphasis on the continued evolution of strategic innovation agendas within new configurations of actors from different sectors and disciplines will be enough, but additional efforts may be needed to ensure that these are sufficiently forward looking.

The adamant non-involvement of the agencies in the specification of top-down priorities is seen by the agencies as a strong point of the initiative and a retreat from earlier in-house practices that gave the agencies a much stronger say in the specification of top-down policies. In some respects, however, this can be seen as a high-risk route to take. Ceding control to bottom-up priorities is certainly one way of ensuring that key stakeholders develop a strong interest in the resultant programmes, but it underestimates the importance of maintaining a system of checks and balances between top-down and bottom-up priorities and diminishes the role of the state in maintaining such a balance. The existence of an evaluation scheme that can assess the evolution of strategies every three years constitutes one check, but it may not be enough to ensure that top-down priorities are reflected in future agendas. Without a stronger role for the agencies to ensure such a balance occurs, there is a greater possibility of either fragmented portfolios or the capture of whole portfolios by the stronger factions.

Need for more concerted efforts to tackle societal challenges

In response to the prioritisation of societal challenges signalled by the Swedish Presidency of the EU in the Lund Declaration, Sweden launched the Challenge-Driven Innovation (UDI) programme, which supported research and innovation activities in areas relevant to societal challenges. It also increased the funds available for greater involvement in European public-to-public (P2Ps) networks of national funding agencies in Europe and the establishment of a co-ordination mechanism across agencies to allow a more strategic approach to be taken by Sweden to the alignment of international efforts, especially those tackling societal challenges.

Although many aspects of these responses to Lund are laudable, the limited scale of these efforts and their relatively low level of visibility in the 2012 Bill were surprising. Sweden had an opportunity after Lund to place efforts designed to tackle societal challenges at the heart of a very distinctive national research and

innovation strategy that would have signalled to the world that Sweden was prepared to lead by example in its response to Lund. It did not do this. The 2012 Bill, like many previous Bills, included a broad range of actions designed to improve performance in many of the interdependent domains that constitute a modern, national innovation system. This is fitting and necessary, but the Bill as a whole provided no overall vision of how the system as a whole might develop and the direction it might take. In particular, it gave no indication of how a strong emphasis on societal challenges might fit into an overarching long-term support strategy capable of satisfying the needs of all relevant stakeholders.

The Swedish system of governance for research and innovation does not appear to favour a “challenge” approach. It is characterised by “weak” vertical co-ordination, as ministries have relatively limited ability to steer the large number of government agencies. Instead, agencies are in a position to define and develop their own roles. Horizontally, agencies co-ordinate activities between them and many concrete programmes are managed and funded by several agencies in collaboration. However, this also has the consequence of committing budgets and thereby limiting the agencies’ strategic room for manoeuvre. Tackling societal challenges will require new forms of R&D funding governance and co-ordination mechanisms that can prioritise at the societal level. It will also require levels of financial commitment that signal the importance of this policy reorientation.

Prioritisation and strategy development are constrained by weak governance structures and processes

Prioritisation and co-ordination have proved difficult in Sweden in many research and innovation settings. Prioritisation is especially difficult in the absence of a common vision. International experience concerning either the use of foresight exercises or other aids for prioritisation does not suggest a clear way forward, but the need for some kind of vision to guide Swedish research and innovation policy development is becoming more and more apparent. Swedish policymakers should strive to devise and implement a national visioning mechanism that can build greater consensus around major priorities, without simultaneously excluding other research and innovation efforts that are necessary in a well-functioning innovation system.

Governance structures and arrangements play a critical role in either enabling or preventing reform and performance improvement in the Swedish system. In the university sector, for example, deeply engrained concepts of academic freedom and the autonomy of universities and individual researchers have conspired with weak internal governance structures within many universities to prevent the university sector from wholly fulfilling its “third mission” concerning the conduct of research relevant to many of the needs of society. Similarly, there are concerns about the governance structures of research councils and their dominance by academics; about the level of private sector stakeholder involvement in the RISE institutes; and about an apparent diminution of the checks and balances needed in the relationship between funding agencies, such as VINNOVA, and the research and innovation communities they serve and support that guarantee that the interests of the state are not taken lightly or ignored by these communities.

Perhaps the greatest need currently, however, is for a systemic overview of the governance structures that Sweden will need to both improve performance across the whole research and innovation system and mount a serious response to societal challenges.

Strategic tasks

In the current context of policies and issues, there are at least seven strategic tasks that need to be included in the Swedish policy agenda. Most of them can be related to the interplay of policies aimed at different domains within the Swedish innovation system, spanning education and human resource development; the science and research base; innovation-related activities; and links with market development on the demand side. Many of these tasks relate to *balance*. Innovation systems seldom respond well to

polarised policies. Rather, they seem to function well where an appropriate balance exists between different policy elements. In this sense, the tendency of the Swedish system towards inclusiveness and moderation will stand it in good stead. It also follows that the order of the strategic tasks in this section and of the guiding principles and detailed recommendations in subsequent sections is not important. In a complex system, what matters is the interplay of the components. Interdependence implies that one component is not necessarily more important than another. However, it is sometimes possible to identify where changes in particular components are *preconditions* for improving the others. In this case, the suggested changes covering aspects of governance appear to be preconditions, not least because history shows that existing governance arrangements impede needed changes.

To build on its strength in research and innovation in order to achieve and maintain excellence and a position among the global leaders, Sweden should consider the following strategic tasks:

- addressing the need to move beyond “good” performance and reach for excellence in Swedish research so that it is attractive, innovative and competitive
- continuing a rebalancing of the roles of the universities on the one hand and the research institutes (RIs) and research and technology organisations (RTOs – or applied industrial institutes) on the other hand, in order provide a strong knowledge infrastructure spanning basic research through to innovation – or, in terms of the technology readiness levels (TRLs) increasingly used to describe European R&D policy, from the low to the high TRL numbers
- reconsidering the balance between state competitive and non-competitive funding for research and in the context of funding provided by the private and public foundations, in such a way as to provide the needed range of incentives for excellence, relevance and cooperation in strategic as well as more routine fields
- considering the extent to which the existing structure and organisation of research funders, including their governance and co-ordination arrangements, provide, in the specific context of Sweden, the best way to pursue national priorities, promote excellence and encourage change in the research and innovation system more broadly
- examining very carefully the roles played by government agencies in mediating between the needs of the state and the needs of different groups of research and innovation actors
- explicitly articulating clearer research and innovation funding priorities at the national level, especially (but not only) in the context of societal challenges
- as a precondition for success in most of the other strategic challenges, reforming the governance of research funding and performing organisations, including universities, and reviewing governance arrangements across the whole innovation system.

Guiding principles

When formulating and implementing the policies needed to undertake these strategic tasks, the following guiding principles should be taken into consideration:

A well-performing research system not only has a high average level of quality, but also a number of “peaks” of excellence. The portfolio needs to respect the need for research priorities to address national needs and not only the pursuit of excellence. Hence, an effective funding system must steer towards both these outcomes. Scientometric indicators show that Swedish research is still good, but is missing the handful

of ”performance peaks” that are desirable in any system. While some have attributed this to university careers or funding, these have not changed in ways that can readily be connected to the rather recent dip in relative performance. There are signs that Swedish academic research is becoming less competitive in comparison to similar countries. One likely factor is that Swedish scientists now face greater worldwide competition. In the life sciences, which are particularly affected, the fall in pharmaceutical R&D has caused a striking loss in industrial impulses. There is room on the one hand for more competition and incentives to allow exceptionally strong universities to disproportionately reap the benefits from Swedish research budgets, and for directing some parts of those budgets to themes of industrial and societal importance on the other.

Funding and task allocations between the university and RI/RTO sectors should reflect their roles and abilities to deliver different types of benefits to the research and innovation system. Different types of universities need to be incentivised and supported to perform different roles. The whole state research system will perform best if the different organisations are closely linked and highly co-operative. The “Swedish university model”, established during the Second World War, allocated a broader role to the Swedish universities than is usual in other countries. In particular, it entrusted them not only with performing basic and applied research, but also working close to applications, or in higher technology relevance level (TRL) numbers. History suggests this task is not really compatible with that of a traditional university, and that a re-division of labour is needed within the RI/RTO sector, which is currently experiencing growing demand for its services under the aegis of RISE. Some regional universities, however, are well linked to their economic and social surroundings, to mutual benefit. Their role and contribution should also be reflected in resource allocation.

The balance between competitive and non-competitive state research funding needs to be based on an understanding of the interplay between incentives and context – not least in terms of university governance and internal allocation rules that should connect global incentives to micro-behaviour. No “magic number” or “golden ratio” exists between competitive and non-competitive funding that can guarantee success. However, the effectiveness of funding incentives is clearly mediated by the governance structures of both research funders and research performers, as demonstrated by the limited success of recent attempts to strengthen the university research base. Sweden therefore needs to consider these aspects in designing the funding mix.

Research funding should balance diversity, stakeholder involvement, high standards and relevance on the one hand, and efficiency and effective governance on the other. In particular, it will be important to ask whether the structure – which has evolved in a context of funding basic research and a number of “sectoral” missions, particularly industrial innovation – is able to address the “societal challenges” launched at Lund in 2009. The structure also needs to contain organisations that can act as change agents, sometimes providing a countervailing force to the short-term interests of the research and industrial communities. Sweden should therefore review the effectiveness of the funding structure in the context of its current governance and future funding needs.

Successfully translating research and innovation priority-setting at a high level into effective implementation at a lower level critically depends on instituting mechanisms at all intermediate levels that can establish and maintain a consensus on priorities or reconcile conflicting interests. Sweden has generally followed “bottom-up” approaches rather than powerful thematic strategies, to assemble a wide range of activities that may or may not address priority needs. This may not have been the best way to tackle innovation and the need to address the societal challenges puts it further into question. However, a simplistic “top-down” approach would be equally ineffective, since it would be under-informed about needs and fail to engage relevant stakeholder communities.

Stakeholders such as industry and the research community should inform and have a significant voice in what research funders and performers do. But individual beneficiary communities should not have

majority stakes in the governance of these organisations, or otherwise be positioned in management structures in a way that prevents needed change. Both Swedish and international experience shows that when beneficiaries or members govern organisations that allocate resources, they tend to become locked in, struggle to develop strategic priorities, and may fail to keep pace with external needs. Where RISE is concerned, the government has recognised this issue and is preparing to take over the shares owned by member companies in order to give RISE the strategic freedom and flexibility it needs to do its job well. Similar governance and agenda-setting challenges affect the research councils, other funding agencies and the universities.

In an international setting that requires nations to take the lead in demonstrating how research and innovation can help resolve major societal problems and set examples in terms of the structure, organisation and governance of scientific and technological capabilities, recognition of national prowess and potential should not be constrained by natural reticence. Undertaking strategic tasks of the nature described in this document requires a guiding vision, a commitment to change and a considerable degree of confidence in the ability of all relevant stakeholders to rise to the challenge. Sweden has done remarkably well in historical terms in terms of its scientific, technological, economic and societal achievements, attaining levels of success in a broad range of domains that are acknowledged across the world. This qualifies Sweden as a model of good practice and a leader of world opinion, constrained only perhaps by the natural humility of its people. There is a need, however, for strong countries to lead the way and set examples that the international community can follow, especially in terms of tackling societal challenges that confront all nations across the globe. Now, perhaps, is the time for Sweden to step forward.

Recommendations

The recommendations below are in line with the strategic tasks and guiding principles outlined above. In general they are organised around the topics covered in the main Chapters of this follow-up report, though some issues are touched upon in several places throughout the report. A concluding set of recommendations cover aspects related to priority setting, strategy development and governance across the Swedish innovation system as a whole.

Strengthening university research

State research funding is normally provided because private enterprise does not deliver a socially optimal amount of research. In particular, it tends to under-invest in fundamental research. This “market failure” argument for state funding has been its traditional rationale for at least the past fifty years. While Swedish universities have for some decades made it clear that they want to receive a higher proportion of their research income in the form of institutional funding or GUF, evidence from international experience or statistics does not show any clear way to connect the proportion of university income from this source with overall performance. For example, the Danish and Swiss university systems produce very high levels of research performance (measured in bibliometric terms) while enjoying high levels GUF for research. British universities put in a similarly high performance, based on a much lower proportion of GUF than Swedish universities. However, there is no clear evidence that, if the Swedish universities have a research problem, this is caused by the GUF level or that increasing this level will fix the problem. Together, the increased GUF provided for in the 2008 Research and Innovation Bill and the SFO programme has significantly increased the institutional funding for universities, but evidence of performance increases is limited. Rather, it appears that Sweden’s “good but not sufficiently excellent” scientific performance points to a failure by university management to be selective combined with sub-optimal mechanisms affecting the allocation of funds (whether from TPF with its medium-sized instruments or from the way the universities allocate GUF Internally). In this sense, Sweden hovers uneasily between research funding policy focused on excellence at all costs and research funding policy that requires a deal of “fairness” concerning the distribution of funds.

International statistics on the proportion of GUF in university research are hard to collect and compare because of national variations in the way the scope of this funding is defined and implemented. National averages are normally compared. This is also misleading because in practice the GUF/TPF ratio varies greatly among different types of university – as does the absolute amount of each, compared with the number of teachers or researchers. Good technical universities tend to have high proportions of TPF (KTH, Chalmers, KI). Traditional universities with a lot of social sciences, humanities and natural sciences rely more on GUF. So the “right” ratio depends also upon the role of the university.

Swedish universities will find it difficult to be effective as long as GUF funding creates a paradox. The universities claim they have too little core funding over which they can exercise strategic control, because academic posts cannot be fully funded out of limited institutional funds and researchers must depend on TPFs for their own support. Further, increases in core funding are used to hire more academics whose jobs depend upon third party funds, exacerbating the problem that the increased core funding was supposed to solve. The only way out of this impasse is for the universities to use core funding to pay the full salaries of a greater proportion of their faculty.

Breaking the vicious cycle of GUF/TFP dependence is linked to a lack of clarity concerning career paths in Swedish universities, with few clear tenure tracks and well-specified criteria and procedures governing access to permanent positions on the one hand – which can act as a barrier to the recruitment of top quality researchers from both Sweden and elsewhere – and an apparent reluctance on the part of university management to make “hire, fire or reassign” decisions to on the other hand – which limits their flexibility when adjusting to the volatility of TPF, and constrains their influence over the balance between research and teaching. Strong centres can be built with large third-party funding inputs, but these then have to be able to adjust staffing levels to some degree in response to variations in their income. However, academic top management seems to have problems introducing and executing the necessary recruitment and career policies.

This calls for the basis of university funding and governance to be investigated with a view to allowing management to introduce real tenure tracks as well as to be more flexible in hiring, dismissing and reassigning staff, based on their organisational strategies and individual performance, and to fund the majority of their faculty through institutional money. Such changes would help universities to combine funding and human resource policies more effectively in their pursuit of excellence. It would also make it easier to implement strategic changes. The necessary transition will need to take place over an extended period and will not be easy. However, the current investigation in Sweden into academic careers and the basis of tenure may provide a useful first step in this direction.

The new performance assessment scheme introduced after the 2008 Research and Innovation Bill was meant both to raise scientific productivity and to reward and incentivise success in raising TPF, allowing the additional funds gained to act as a form of compensatory addition to GUF. The proportion of GUF affected by the scheme (10% in the 2008 Bill rising to 20% after the 2012 Bill) and the mechanics of its implementation, however, meant that the relative increases and decreases for individual universities as a result of the scheme’s implementation were mostly marginal.

The Strategic Research Areas (SFO) scheme was innovative and was intended to have a double effect by increasing university specialisation (or launching new activities) while gradually increasing core funding over time. It appears to have suffered from lack of focus, so that it made only a limited difference to universities’ degrees of specialisation. It was well used by universities able to articulate and implement strategy and less well used by those that did not. Its failure to involve industrial and other societal stakeholders to any significant extent undermines the societal relevance and applicability of the funded work. Its role as a potential change agent is doubtful. Its evaluation focused on judging the performance of the individual centres and universities funded by the scheme and devoted little attention to addressing the

question of whether it succeeded in its policy purposes. The policy lesson from the SFO scheme appears to be that this is not an instrument that can be used successfully in the current context.

Increases in GUF, the associated performance assessment scheme and the SFO were all meant to improve university research performance, and all rested on the premise that universities would make sensible, strategic decisions concerning the utilisation of this additional income. Increased funding for research will always be welcomed by universities, and there is always the danger of adverse impacts on research performance if additional funding for academic researchers to undertake self-determined research is stifled, but genuine improvements in performance cannot truly be expected until barriers related to university governance, strategy formulation and internal policies for funding faculty members have been removed.

Although the focus here is specifically on measures stipulated in the 2008 and 2012 Research and Innovation Bills designed to strengthen university research, many factors and structural facets of the Swedish university and research systems that have affected the ability of universities to respond adequately to these measures were explored, especially the implications of the “Swedish model” for universities, which allocates an unusually large share of state-funded research activity to a widely competent university sector.

The idea of a “knowledge triangle” is a useful reminder that research, innovation and education are intimately interconnected, and that related policies should be similarly interconnected. A historical strength of the “Swedish model” has been its focus on higher education and training, thereby providing the people and skills needed not only to maintain the higher education sector, but also other parts of society. In principle, the insistence on research-based teaching in universities has probably helped ensure that higher education is up-to-date, but higher education’s focus on more basic research knowledge means that industry faces the challenge of transforming graduates’ general skills into the specific skills valued by companies.

The expansion of PhD education since 1994 was partly intended to support increased PhD employment in industry, since Swedish firms were employing fewer PhDs than major foreign competitors. The expansion took place partly through instruments such as new graduate schools, industry PhD programmes and schemes such as the competence centres, which established a more direct link between industry’s skill needs and PhD training. Growing numbers of PhDs have therefore been trained in applied and problem-driven areas and not only in basic research. Third party funding also provided a major impulse to shift from the old continental model of mid-academic career PhDs towards the modern four-year cycle, with a taught component as well as research.

The “Swedish model” developed at a time when the national research and innovation system was much smaller than today. In 1942, the Malm Commission’s desire to avoid fragmenting a small system between universities and technological institutes made sense in context. Even at that time, there existed a clear division of labour between technological and traditional universities. Since then, the system’s increasing size of has fostered a finer division of labour, with traditional (non-engineering) universities, technical universities, “omniversities” and regional universities carving out different roles – though considerable scope persists for more thematic and functional specialisation.

The economic consequence of “massification” – which would make it impossibly expensive for all universities to be research universities if around half of each generation attends university – has not been fully addressed in the Swedish system. As elsewhere, the new, regional universities will probably need to align both their research agendas and their teaching on specific regional and “professional” education needs, in order to allow higher education to remain research-based. Whether these universities can afford to do research in the full range of subjects they teach is not clear, and selective strategies are probably needed. The benefits of specialisation can only be secured, however, if university governance is changed so that rectors have more freedom to develop and manage their universities’ strategies. This requires significant reform on

the part of the universities, as well as a willingness among policymakers and funders to concentrate research resources in larger centres that can reap the benefits of specialisation.

A corollary of greater specialisation and scale is the availability of funding able to support a significant increase in the size of individual research groups or centres. A characteristic of Swedish research funding programmes is the small size of individual awards. For example, the Swedish Competence Centres are much smaller than their Austrian counterparts or the National Science Foundation's Engineering Research Centres on which they are partly modelled. Achieving the necessary advantages of scale and specialisation, whether to pursue academic excellence or fulfil industrial and societal missions – is difficult without larger grants and centres. While not all research funding is about scale, some Swedish funding schemes need to provide significantly larger grants to significantly fewer beneficiaries. There will be losers, but without losers you also cannot have winners. The number of research councils, funding agencies and other sources is very high in international comparison and for a small country. This has historical reasons as well as consequences for the size and the level of ambition of funding interventions. There are reasons to consider the rationalisation of funding organisations, together with re-alignment of missions and governance structures.

The EU Framework Programme has the potential to support strategy-building by research-performing organisations, including universities. It offers a wide range of thematic choices for researchers seeking funding. However, it operates essentially by enhancing national strengths, and is too short-term and competitive in most cases to support long-term capacity-building. Like their counterparts in the United Kingdom (UK), the Swedish universities are very successful in obtaining funding from the Framework Programme. But while the evidence suggests it is a useful source of additional income for universities, it has little effect on research directions. Universities generally welcome all contributions to their research income, but until they develop more focused strategies, the Framework Programme will have little strategic impact on the Swedish research sector.

The government should:

- address the governance and leadership weaknesses of the Swedish university system that undermine the universities' abilities to define and implement strategies, especially those that require the reallocation of internal resources
- ensure that any increases in GUF are accompanied by other measures that enhance the possibility of sustainable research performance improvement
- avoid extending the SFO programme unless and until there is clearer evidence (a) that most of the universities are able to make use of such resources to develop and implement strategies, including change strategies, and (b) university governance is reformed in ways that enable university rectorates to exercise effective strategic leadership
- either amend the way the existing research performance assessment scheme for allocating GUF is implemented so that it can have a real rather than marginal impact on performance and rewards, e.g. by increasing the percentage of GUF that can be affected by it, or consider the use of alternative schemes. In so doing, consider also the need to incentivise and reward research outputs that go beyond excellence and satisfy “third mission” criteria
- encourage university management to introduce a real tenure track as well as to be more flexible in hiring, dismissing and reassigning staff, based on clear organisational strategies and individual performance, and to fund the large majority of their faculty out of institutional funding. This may require a change to the rules on how universities can spend their money.

- encourage the universities to specialise in their research to a greater extent than today, underpinning excellence in selected areas of research and teaching and strengthening their individual differentiated functions in the research and innovation system. Such focus is needed in order to be present in the very top ranks of global research. It does not follow that the same pattern of specialisation adopted in research should always apply in teaching, where societal needs are often broader
- examine the usefulness and the options for strengthening the desired effects of TPF to universities, RIs and industry. In particular, options should be considered for:
 - re-orientating some funding schemes to provide significantly larger grants to significantly fewer beneficiaries
 - rationalising the number of funding organisations, together with re-alignment of missions and governance structures.

Linking research and innovation

Ensuring that research links effectively with technologically-based innovation is a prerequisite for a well-functioning innovation system. Two policy initiatives in the 2008 and 2012 Research and Innovation Bills that were relevant to this task were scrutinised in particular during this follow-up review: efforts to strengthen the position of research institutes in the Swedish innovation system and their role in linking the worlds of research and innovation; and the launch of the SIO initiative, designed to provide support for new, cross-sectoral configurations of research and innovation actors.

While the Malm Commission's principle that the universities should perform some of the tasks undertaken by applied institutes was reflected in the decision not to set up a big national institute of technology, it was never strongly reflected in the shape or activities of the universities themselves. Partly as a result, the applied industrial research institutes – now RISE – continue to expand within the “sectoral”-space previously allocated to universities, arguably because they were designed for sectoral tasks, and especially to interact with industry in ways that the universities were not doing.

The steady growth of RISE, working in areas of market and systemic failure related to industrial innovation, testifies to its relevance. While it may conceivably represent a loss in human capital development compared with the intended “Swedish model”, large numbers of PhD students do their practical work in institutes while registered at universities. At present, RISE provides over seventy adjunct professors to the university system. Thus, while there is scope for greater interaction (which would benefit both sides), university and institute research are often already linked. The present arrangement provides a good basis for simultaneously supporting innovation and developing human capital through research in the institutes and linkages to the wider Swedish research community. While RISE meets industrial needs that are in general differentiated from those tackled in the universities, there is no evidence that it offers services to industry that could be provided by unsubsidised private companies, such as engineering consultancies.

The experience of the UDI programme, in which research institutes play a significant role, underscores the ability of the RISE institutes not only to meet industrial and societal needs, but also to bring solutions to a higher stage of technological readiness than the universities. It follows that the RISE institutes should be instrumental in a greater and more focused research and innovation effort tuned towards the societal challenges.

However, like other parts of the research system in Sweden, RISE institutes are subject to path dependencies driven by their governance, and sometimes even by their ownership. Branch associations still

own a considerable share of individual institutes and have a large say in their governance. While maintaining close links with stakeholders is important, it is also a source of lock-in and inflexibility. In order to tackle both industrial innovation and societal challenges, the institutes need to be more flexible and able to change direction more quickly. This requires simpler and more unified governance and ownership. This could involve the industrial co-owners of the RISE institutes relinquishing their shares to the state, a development that is highly desirable and has, in fact, recently begun to take place.

A change in ownership structure, however, will not be enough. To address the societal challenges, the institutes need signals and incentives about Swedish policy on the societal challenges that supplement the existing inputs they get from the industrial and higher education systems about industrial needs and scientific opportunities. These signals can take the form of programme funding or additional core funds earmarked for developing the new capabilities required by RISE to tackle some of the challenges. The funding and steering system for the Dutch TNO institute provides a useful example of how to achieve this.

One key mission, which was not clearly discussed when the “Swedish model” was established, is how to provide general support to innovation in small and medium-sized enterprises (SMEs), especially low-to-medium technology SMEs that need to strengthen their technological capabilities. The institutes have sometimes been awarded extra funding to provide an “SME service” but it must be recognised that, from the institute perspective, SMEs are often not attractive customers. They may have trouble identifying their needs, they tend to need small things done generating unattractive projects, and they are frequently reluctant to pay the price that an institute needs to charge in order to help them. To some degree, the regional universities have stepped into the breach but this whole area of SME support appears disorganised. The Strategic Innovation Area (SIO) initiative was an important innovation in research and innovation policy, building on a growing practice across Europe of encouraging public-private partnerships to establish and implement research agendas over an extended period of time and then partially funding these. It is simply too early to say whether this approach has been successful in Sweden. The long Nordic experience with technology programmes suggests that the balance between academia and industry in the governance of such initiatives is crucial to success: too much academic influence, and the work becomes overly fundamental and industry loses interest; too much industrial influence, and the agenda becomes incremental and short term, undermining the case for state and academic involvement. The Finnish experience with its SHOK competence centres well illustrates this second danger, which in the Finnish case led the Academy of Finland to refuse to support the centres and eventually to the termination of the SHOK programme.

As in other aspects of governance, the experience from this type of programming is that excess stakeholder influence has the potential to limit the scheme to conventional and often short-term work. Giving funding to consortia rather than to individual projects means a focus on things that are sufficiently established to have developed an interested community. A call for proposals is an extremely useful way to identify such areas. For example, the Swedish Competence Centres Programme – launched in 1994 and still operating as Vinn Excellence Centres – used an open call (with no specified themes) to generate information about which research and innovation areas in Sweden would benefit from a combination of industrial strength and academic capability. The centres that were funded together more or less comprised a “snapshot photograph” of Swedish strengths in 1994-5, without necessarily capturing newer developing areas that might prove more disruptive and challenging in scientific and competitive terms. In SIO, efforts have been made to ensure the continued evolution of forward-looking strategic research agendas, but participants may require additional assistance if this is to occur.

The SIO succeeded in attracting a broad range of research and innovation stakeholders to construct strategic research agendas and bid for Strategic Innovation Programmes (SIPS) within them. In doing so, it raised expectations amongst a broader set of potential stakeholders than normal, expectations that were not realised for many, and even those making successful bids received relatively small amounts of money. The

challenge now is to manage future expectations, which will require raising budgets and giving more thought to risk-reward ratios if interest is to be maintained in the initiative.

The government should:

- further develop the RISE institute system, to strengthen its contribution to national research and innovation:
 - continue to fund the growth of RISE, aiming to maintain its core funding at about 20% of the institutes' total income
 - approve current plans to take full ownership of the RISE institutes in order to effect this
 - provide signals and incentives about Swedish policy on the societal challenges that supplement the existing inputs they get from the industrial and higher education systems about industrial needs and scientific opportunities
- consider both the role of RISE and the regional universities in supporting innovation in traditional SMEs, with a view to considering whether and how to establish a more formal and longer lasting SME service
- increase funding for initiatives such as SIO to facilitate both broader participation by new cross-sectoral configurations of research and innovation actors and projects of greater critical mass
- when extending SIO-like funding, consider the balance between this sort of funding, which is frequently governed by industry and essentially strengthens existing industrial activity in areas of established importance if left unchecked, and additional efforts and activities aimed at identifying new trajectories and, as necessary, disrupting existing ones
- at an appropriate stage, perform a meta-analysis of the strategic research agendas constituted by the participants in SIO as a means of devising higher-level programme strategies.

Dealing with societal challenges

In the development of a new model of “societal challenges” research funding in Europe, Sweden occupied centre-stage when, during its presidency of the EU in 2009, the Lund Declaration called for a new focus on “grand challenges” that would move away from narrow thematic approaches and involve both the public and private sectors in concerted efforts to tackle them. At the level of the EU, this led to a significant new emphasis on societal challenges in the Horizon 2020 programme. In Sweden, it swiftly led to the launch of the Challenge-Driven Innovation (UDI) programme, led by VINNOVA, and enhanced efforts on the part of Sweden to increase its participation in European cooperative research and innovation initiatives, many of them focused on societal challenges.

The UDI programme represented a timely first step. It shifted policy attention onto the demand side and its coupling with the innovation process, going beyond the Nordic technology programme tradition by involving “users” who are “downstream” of the innovating organisations. This is a legitimate extension of what might be thought of as “normal” research and innovation policy. The budget for the programme is relatively small, however, and the projects supported by it are correspondingly modest. These are grouped into four broad categories, not all of which appear overtly focused on societal challenges as conventionally understood, though an important selection criterion for projects proposed by potential participants is that they have a distinct societal challenge orientation. In future, however, programmes such as these will need

to be complemented by action at a higher, systemic level if Sweden is to adequately address societal challenges.

Nonetheless, this “lower” level of instrument evolution poses challenges to governance. Traditionally, R&D funding agencies have set tight conditions for funding projects, leaving little scope for the project performers to define or redefine them. A new set of instruments – such as competence centres and the SIO programme – shift the design and management of a project portfolio from the agency to the beneficiary level, with a distinct diminution in the ability of the agencies to ensure an effective compromise between the needs of the state and those of the research and innovation communities. This is something to be avoided in the UDI programme if a co-ordinated, cross-sector, cross-agency effort to tackle societal challenges via a “systems innovation” approach is to be attempted.

At the European level, Sweden has increased the budgets available for participation in Public-to-Public (P2P) networks that attempt to align national research efforts with topics of mutual interest, many of them pertinent to societal challenges. Whereas previously Sweden had been involved in many of these networks of national funding bodies, participation tended to be ad hoc and Sweden had not led any of them, in contrast to many other EU countries of a similar standing. It now leads one Joint Programming Initiative on Antimicrobial Resistance (JPI AMR) and partakes in 31 out of 37 P2Ps directly related to societal challenges. Thanks also to the establishment of an office to co-ordinate participation across government agencies, Swedish involvement now seems to be more strategic than hitherto.

However, despite Sweden’s role in the formulation of the Lund Declaration and the endorsement of its aims by the Education Minister at the conference that launched it, there is still no overall strategy at the national level or even at the level of organisations, such as VINNOVA, for addressing societal challenges. The 2012 Bill provided no overall vision of how the Swedish research and innovation system might develop and the direction it might take in order to mount an effect in response to societal challenges, or how such an orientation could satisfy the research and innovation needs of multiple stakeholders. Without such a “higher level” perspective and a commitment to the governance changes it would involve across the Swedish innovation system, it is difficult to envisage an effective mobilisation of resources to tackle societal challenges.

Furthermore, even though Sweden – and VINNOVA in particular – has increased its efforts to encourage greater participation in European initiatives on the part of both national agencies in P2Ps and research and innovation actors in universities, research institutes and industry in Horizon 2020 programmes and projects, without a basis in a national position or strategy, it will be harder to lobby to any effect for changes to the Framework Programme in future.

The government should:

- develop a national strategy regarding societal challenges, integrating these elements with wider research and innovation strategy
- integrate research and innovation strategy for the societal challenges with wider policies, such as energy and transport, in order to enable the needed systemic shifts or transitions in the development and use of technologies
- increase agency efforts to play a leadership role in research and innovation to addresses societal challenges at a European and even global level by stepping up its involvement and leading P2P networks that align national efforts to achieve mutually desirable benefits

- expand the scale of the UDI programme and refine its scope such that its potential contribution to particular societal challenges is well-defined
- devise more and broader policy instruments capable of simultaneously addressing more fundamental and more applied aspects of the societal challenges, rather than dividing them into initiatives separately focused on research and innovation
- consider the way in which not only research and innovation funders but also policy programmes and instruments are governed, in order to ensure on the one hand that they are not “captured” by interest groups and, on the other, that they are capable of involving a broad mix of non-R&D and innovation stakeholders, who will play essential roles in operationalising the results of research and innovation projects related to the societal challenges.

Priorities, strategies and governance

Many research and innovation debates in Sweden have concerned the relative prioritisation of funding for basic research versus funding for mission or problem-oriented research, typically oriented towards innovation and, frequently, economic outcomes and impacts. Often this debate appears to consider these funding modes as straight alternatives rather than as complementary approaches that can coexist happily together. Now, with the rise of a funding mode that prioritises research related to societal challenges, the debates are likely to become even more lively, especially since it is not immediately obvious that this third form of funding can just be added as an additional stratum to the existing basic research and problem-oriented research strata. Firstly, it would increase overall levels of expenditure on research at a time when parsimony reigns, and secondly it introduces a new level of complexity into the funding system because it requires significant levels of co-ordination and increased mobilisation of research and innovation resources if societal challenges are to be tackled effectively. At the same time, it will also be important to leave sufficient space for the continued provision of funding for basic research and more conventional problem-oriented research and innovation geared towards economic returns.

Prioritisation and co-ordination have proved difficult in Sweden in many research and innovation settings. Prioritisation is especially difficult in the absence of a common vision. Sweden has attempted foresight exercises in the past, specifically in 2000 and 2004, but these were generally not received with much enthusiasm and their impact was slight. International experience concerning either the use of foresight exercises or other aids for prioritisation does not suggest a clear way forward, but the need for some kind of vision to guide Swedish research and innovation policy development is becoming more and more apparent. Swedish policymakers should devise and implement a national visioning mechanism that can build greater consensus around major priorities, without simultaneously excluding the range of other research and innovation efforts that are necessary in a well-functioning innovation system.

One thing that history does teach us about prioritisation in the research and innovation world, however, is not to bet on single firms or otherwise try to oppose market forces. It has therefore become common practice for priorities to be defined in terms of enabling technologies, challenges, clusters and networks, without trying to pre-judge the outcome of competition. Moreover, as in other parts of research and innovation policy, governance is very important. While stakeholder involvement in research and innovation prioritisation exercises is very important, it must be sufficiently balanced to avoid capture of priorities and agendas by any one stakeholder or group.

Prioritisation, strategy development and implementation take place within the context of specific governance systems, and these governance structures and arrangements play a critical role in either enabling or preventing reform and performance improvement in the Swedish system. These are not new issues in Sweden. In the university sector, for example, deeply engrained concepts of academic freedom and the

autonomy of universities and individual researchers have conspired with weak internal governance structures within many universities to prevent the university sector from wholly fulfilling its “third mission” concerning the conduct of research relevant to many of the needs of society. Forms of governance that impede universities from developing strategies addressing these needs are clearly problematic.

Similarly, there are concerns in a Swedish context about the governance structures of research councils and their dominance by academics, the prime beneficiaries of their activities; about the level of private sector stakeholder involvement in the RISE institutes; and about an apparent diminution of the checks and balances needed in the relationship between funding agencies, such as VINNOVA, and the research and innovation communities they serve and support that guarantee that the interests of the state are not taken lightly or ignored by these communities.

Sweden has recently established an Innovation Council. Bodies such as innovation councils are frequently set up to formulate strategies and co-ordinate at the national level. Other mechanisms exist, however, and there is no strong body of evidence that one mechanism is better than another. Co-ordination mechanisms do seem to work best when there is a real willingness to strategise and co-ordinate. The most important recommendation that can be made in the Swedish context, therefore, is that the remit and the authority given to the new Innovation Council truly reflects a commitment to contemplate changes at the level of the whole research and innovation system. The greatest current need in Sweden is for a systemic overview of the governance structures that Sweden will need to both improve performance across the whole innovation system and mount a serious response to societal challenges

The government should:

- recognise that while policy, planning and governance structures and processes in Sweden might appear adequate in different parts of the Swedish research and innovation system, across the system as a whole they lack coherence and hinder the realisation of “whole system” performance improvements
- strive to devise and implement a national visioning mechanism (such as foresight) that can build greater consensus about major priorities, without simultaneously excluding the range of other research and innovation efforts that are necessary in a well-functioning innovation system
- set priorities in terms of challenges, areas of technology, clusters and value chains rather than to attempt to pre-judge market outcomes as part of research and innovation policy
- devise an effective mechanism for co-ordinating challenge, innovation and research policies across different sectors of the state and society
- initiate a study by a team or committee that is not dominated by past or present members of the Swedish academic community to explore what university reforms are needed in order to enable them to act in more flexible and strategic ways than is the case today. Reform needs are likely to include:
 - continuing the recently-established requirement for the majority in university boards to be people external to the university
 - strengthening the hand of government in appointing rectors who are not hamstrung by the collegiate to such a degree that they cannot initiate significant changes or effective strategies

- strengthening the rights and power of the individual rectorates to make strategy and to (re)allocate resources
- follow international practice in retaining academic competence in the governing bodies of the research councils but, at the same time, ensuring that academia does not form the majority. The point of this reform is to ensure that the research councils are the servants of society rather than just responding to the scientific community
- require that both the research councils and VINNOVA should seek ways to balance the use of internal expertise as an impulse to change with the impulses (both change-orientated and conservative) that come from the beneficiaries, thereby producing a more robust and change-orientated way to implement their programming and funding roles
- at the overall level, review Sweden's current research and innovation policy governance and co-ordination mechanisms with a view to creating a new co-ordination structure able not only to span research and innovation, but also to co-ordinate responses to societal challenges.