Vetenskapsrådet

DIRECTION TO THE FUTURE SWEDISH RESEARCH SYSTEM

Goals and Recommendations

VETENSKAPSRÅDET 2016

DIRECTION TO THE FUTURE SWEDISH RESEARCH SYSTEM – GOALS AND RECOMMENDATIONS

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Box 1035
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VR1604
ISBN 978-91-7307-312-7

DIRECTION TO THE FUTURE
SWEDISH RESEARCH SYSTEM

THE FUTURE OF SWEDISH RESEARCH

This report is the final outcome of analyses and surveys conducted by the Swedish Research Council in 2014. To describe the status of Swedish research, overviews of research fields and infrastructures were prepared, along with structural analyses and overviews.

Research overviews were prepared for the following seven fields:

- Humanities and social sciences
- Artistic research
- Natural and engineering sciences
- Development research
- Medicine and health
- Research infrastructure
- Educational sciences

Analyses and overviews have been prepared for the following fields (available only in Swedish):

- Gender equality in the higher education system and the Swedish Research Council's research funding
- Career structure and career paths in the higher education system
- Swedish scientific production and publication patterns in an international perspective
- Research policy reforms in Sweden during the period 1990–2014
- Mobility of Swedish researchers

FOREWORD

In this report, the Swedish Research Council presents its goals and recommendations for the Swedish research system. The principal aim of the report, entitled Future orientation of the Swedish research system, is to provide a basis for a broad discussion concerning the importance of research and how it can best be conducted and funded. A further aim is for these goals and recommendations to form a basis for input to the impending Research Bill, which the Swedish Research Council and other government research funding bodies have been tasked with submitting to the government during autumn 2015.

The report is based on extensive research overviews and structural analyses of various aspects of the Swedish research system. These research overviews have been prepared by the Swedish Research Council's scientific councils and committees, while the structural analyses were prepared by the Swedish Research Council's research policy department. The final formulation of the goals and recommendations was prepared by a smaller group within the Swedish Research Council and anchored in the board.

The proposals set out in the report are divided into three main sections: research funding, research infrastructure and the research system. The first two of these sections are largely aimed at the Swedish Research Council's remit to fund research of the highest scientific quality within all research fields and to prepare long-term plans for providing Swedish researchers with access to research infrastructure. In this regard, the goals and recommendations are aimed at the government, but we also explain the Swedish Research Council's own strategies for research funding. The section on the research system presents a discussion concerning structural aspects of the entire system and here the goals and recommendations are primarily targeted at the government and research institutions.

The Swedish Research Council looks forward to further debate and of course specific measures based on the *Direction to the Future Swedish Research System*. We would also like to express our considerable gratitude to everyone who has contributed to the preparation of this report. It has been a comprehensive and intensive task, which we are convinced will help to steer the Swedish research system in the right direction.

Stockholm, September 2015

Lars Anell
Chairman

Sven Stafström
Director General

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SAMMANFATTNING

Regeringen har satt upp ett övergripande mål för svensk forskningspolitik som innebär att Sverige ska vara en framstående forskningsnation där forskning och utbildning bedrivs med hög kvalitet. För att uppnå detta mål i ett läge där konkurrensen mellan länder ökar behöver alla delar av det svenska forskningssystemet ses över och förbättringar genomföras i flera av dem. Vetenskapsrådet presenterar i denna rapport förslag på mål för det svenska forskningssystemet samt rekommendationer för vad som behöver åtgärdas för att uppnå dessa mål. Dessa mål och rekommendationer är baserade på forskningsöversikter samt strukturella analyser av olika aspekter av det svenska forskningssystemet.

Förslagen i rapporten presenteras uppdelade på tre huvudavsnitt: forskningsfinansiering, forskningsinfrastruktur samt forskningssystemet. De två förstnämnda är främst inriktade på Vetenskapsrådets uppdrag att finansiera forskning av högsta vetenskapliga kvalitet inom samtliga vetenskapsområden samt att långsiktigt planera för tillgången till forskningsinfrastruktur för svenska forskare, medan avsnittet om forskningssystemet är inriktat på strukturella aspekter i hela systemet med både forskningsfinansiärer och forskningsutförare. Med forskningsutförare avses i första hand universitet och högskolor.

Forskningsfinansiering

Fria forskningsmedel: Forskarnas kunskap och idéer för framtida forskningsprojekt måste vara grunden för forskningens utveckling. Denna grund för framgångsrik forskning måste också vara vägledande för huvuddelen av forskningens finansiering. För att finansieringen ska kopplas till de allra bästa forskningsidéerna och forskningsprojekten måste dessa konkurrera med varandra och de bästa projektförslagen väljas ut genom sakkunniggranskning. Detta är en av Vetenskapsrådets huvuduppgifter och hanteras främst inom ramen för det så kallade fria projektbidraget.

Vetenskapsrådet har genom sitt granskningssystem en mycket god bild av ansökningarna till det fria projektbidraget och bilden är tydlig: det finns ett stort antal lovande forskningsidéer som idag inte finansieras på grund av en otillräcklig budget. För att Sverige ska kunna utveckla denna potential av framgångsrik svensk forskning avser Vetenskapsrådet att omfördela medel till det fria projektbidraget. Samtidigt är det angeläget att ytterligare medel tillförs en sådan satsning genom ett ökat anslag från regeringen. Ytterligare en satsning som stödjer forskarinitierad forskning är långsiktiga stöd: ett som möjliggör för de mest lovande forskarna att etablera sig internationellt, samt ett som möjliggör för redan etablerade toppforskare att utveckla de forskningsmiljöer de själva skapat.

Riktade satsningar: För att riktade satsningar ska vara effektiva för forskningens utveckling bör de begränsas till områden som har en strategisk betydelse för Sverige och där samordning mellan finansiärer kan effektivisera forskningen och underlätta för internationellt forskningssamarbete. Vetenskapsrådet föreslår riktade satsningar i form av att ett antal tioåriga forskningsprogram inrättas under den kommande tioårsperioden. Centralt för dessa program är en nationell strategisk forskningsagenda. Inrättandet av programmen måste föregås av att en modell utarbetas för hur dessa forskningsagendor tas fram samt för hur samverkan mellan finansiärer ska gå till.

Forskningsmiljöer: En stark forskningsmiljö är ofta en nödvändighet för att komplexa forskningsfrågor ska kunna lösas. Sådana miljöer är attraktiva för de bästa forskarna och de har stor betydelse för kunskapsförsörjning inom och utanför akademin. En satsning för att öka antalet världsledande forskningsmiljöer i Sverige bör göras av Vetenskapsrådet tillsammans med lärosäten och eventuellt ytterligare finansiärer. Denna satsning behövs både för att garantera en fortsättning för de i Sverige mest framgångsrika existerande forskningsmiljöerna och för att stödja etablering av nya framstående forskningsmiljöer.

Karriärstöd: Karriärstöd för unga forskare är avgörande för att svensk forskning i framtiden ska kunna behålla sin höga vetenskapliga kvalitet och för att forskningen ska förnyas genom att unga forskare utvecklas till

självständiga och framgångsrika forskare. Inom ramen för ett internationellt postdoktorsstöd behöver en satsning göras för att öka nydisputerades möjligheter att få internationell forskningserfarenhet. Satsningar behöver också göras för karriärstöd i etablerings- respektive konsolideringsfasen av forskarkarriären. Dessa satsningar görs företrädesvis på nationell nivå och i nationell konkurrens.

Forskningens infrastrukturer

Forskningen kräver kontinuerlig utveckling av ny infrastruktur och uppdatering av etablerad infrastruktur. Detta tillsammans med den allt snabbare teknikutvecklingen talar för att de nuvarande kostnadsökningarna för infrastruktur kommer att fortsätta. Det är därför viktigt att all forskningsinfrastruktur har en långsiktig och stabil finansiering, att ansvaret för finansieringen är tydligt och att rutiner finns för uppföljning och utvärdering.

En bra balans mellan forskningsverksamhet och forskningens infrastrukturer kräver att beslut om finansieringen av infrastruktur baseras på översikter, behovsinventeringar och långsiktiga strategiska överväganden. För att uppnå detta har Vetenskapsrådet börjat implementera en ny modell för initiering och finansiering av infrastruktur. Denna innebär bland annat att lärosätena ges ett tydligare ansvar för att medfinansiera nationell infrastruktur och därmed ökar kraven på lärosätena att prioritera investeringar i nödvändig infrastruktur. Ett viktigt nästa steg är att i den nya finansieringsmodellen integrera svensk medverkan i internationell infrastruktur. Detta kommer att innebära att regeringens roll behöver förtydligas.

Forskningssystemet

Nationellt karriärsystem: Karriärsystemet behöver förbättras så att det blir attraktivt för unga lovande forskare att fortsätta sin forskarkarriär. Det finns för få unga forskare anställda på meriteringsanställningar och vägen till en sådan anställning är orimligt lång och osäker med korta tidsbegränsade anställningar.

Åtgärder behövs från såväl regeringen som lärosätena för att skapa tydliga karriärvägar och rekryteringsprocesser och för att korta tiden från doktorsexamen till en tillsvidareanställning. Den nya meriteringsanställningen bör förlängas för att underlätta bedömning för tillsvidareanställning och regeringen bör inleda en dialog med universitet och högskolor om hur en tydlig karriärväg bör se ut. Lärosätena behöver utveckla rekryteringsprocesserna så att dessa blir mer strategiska och formaliserade där jämställdhet respektive rörlighet tillmäts större betydelse.

Forskares villkor: Framgångsrik forskning kräver långsiktighet och de ekonomiska villkoren för forskarna behöver bli mer stabila. Nya medel har tillförts systemet i de fyra senaste forskningspropositionerna. I stor utsträckning har dessa medel använts till omfattande nyrekryteringar, vilket inneburit att resurserna per forskare har minskat något. Det är viktigt att bryta den trenden; anställda forskare måste få stabila och goda villkor genom att lärosätena i högre utsträckning finansierar forskningstid, stödpersonal och lokal infrastruktur.

Basanslaget: Ett effektivt nyttjande av lärosätenas basanslag kräver en tydligare profilering och rollfördelning mellan lärosätena. Detta är en strategisk uppgift för lärosätesledningarna som kräver samarbete mellan de olika lärosätena och goda underlag. Dagens prestationsbaserade modell för fördelning av en del av basanslagen behöver ersättas med det av Vetenskapsrådet föreslagna nationella forskningsutvärderingssystemet FOKUS. Detta utvärderingssystem, som är baserat på sakkunniggranskning, är heltäckande vad avser forskningsinriktningar (såväl disciplinära som tvärvetenskapliga). Det är också framåtblickande och inbegriper forskningens genomslag utanför akademin.

Forskningsfinansiärernas roll: Mångfalden av forskningsfinansiärer ger till viss del oönskade överlappningar och glapp i finansieringen av områden och miljöer. För att minska dessa risker behöver regeringen se över dagens forskningsrådsstruktur och forskningsråden behöver öka sitt samarbete för att samordna forskningsresurserna. Det är också viktigt att övriga stora nationella forskningsfinansiärer ingår i denna samordning.

Samverkan: Förmågan att använda forskningens resultat för att åstadkomma sociala, ekonomiska, kulturella och miljömässiga förbättringar är en nyckelfråga för Sverige. För detta krävs samverkan mellan forskarsamhället och övriga samhället. Denna samverkan behöver tydligt integreras redan i forskningsprocessen. Studier av flera länders forskningssystem har visat att det finns en stark korrelation mellan vetenskaplig excellens och omfattningen av genomslaget utanför akademin Även forskningsmiljöernas nära koppling till den högre undervisningen innebär en framtida samverkan via många studenter som kommer att arbeta på svenska företag och inom svensk förvaltning.

För att skapa incitament för samverkan, och på så sätt underlätta för genomslag av forskningsresultat utanför akademin, bör regeringen ta ett helhetsgrepp på Vetenskapsrådets förslag till utvärderingsmodell för fördelning av basanslaget (FOKUS) och erfarenheterna av det uppdrag Vinnova har angående bedömning av prestation och kvalitet i lärosätenas samverkan.

Internationellt samarbete: Internationella forskningssamarbeten bidrar till att höja den vetenskapliga kvaliteten på svensk forskning. Det är viktigt att svenska forskare ges stöd för att delta i sådana samarbeten, ett stöd som bör fördelas i nationell konkurrens. I dagsläget sker en samordning och diskussion kring finansiering av forskning på europeisk nivå. Denna samordning bör utökas och omfatta internationell forskningssamverkan på global, europeisk och nordisk nivå.

Jämställdhet: För att uppnå ett jämställt forskningssystem krävs fortsatt uppmärksamhet och åtgärder. Andelen nydisputerade kvinnor närmar sig 50 procent i genomsnitt för alla akademiska ämnen. Dock är ökningen av andelen kvinnor bland professorer långsam. Flera studier visar att kvinnor fortfarande i lägre utsträckning än män väljs till de högsta positionerna inom akademin. Arbetet med jämställdhet måste integreras i hela forskningssystemet, både hos forskningsfinansiärer och forskningsutförare.

Öppen tillgång till vetenskaplig information: I förslaget till nationella riktlinjer för öppen tillgång till vetenskaplig information föreslår Vetenskapsrådet bland annat att alla vetenskapliga publikationer och konstnärliga verk (som är resultat av forskning) som är finansierade med offentliga medel ska publiceras direkt öppet tillgängligt från och med år 2025. Regeringen bör införa dessa riktlinjer för det svenska forskningssystemet.

SwePub: Analyser av vetenskaplig publicering är centralt för kunskapen om hur svenska forskare bidrar till den totala vetenskapliga produktionen, hur de samarbetar och i vilka kanaler som resultaten publiceras. Databasen SwePub behöver därför utvecklas så att det år 2018 är möjligt att göra bibliometriska analyser av vetenskaplig produktion på alla svenska lärosäten och universitetssjukhus publicerat från och med 2012. Denna utveckling kräver bland annat en tydligare styrning av databasens förvaltning och tillgängliggörande av uppgifter i lärosätenas lokala databaser.

Hantering av oredlighet i forskning: Ovillkorligt iakttagande av god forskningssed är avgörande för att forskningen ska bidra till samhällsnytta och för att allmänheten ska ha förtroende för forskarsamhället. Idag finns inget tillfredsställande system för hantering av oredlighet och Vetenskapsrådet föreslår därför att en utredning tillsätts som tar fram ett sådant nationellt system.

SUMMARY

The government has established an overarching goal for Swedish research policy which states that Sweden shall be a leading research country characterized by high-quality research and education. To achieve this goal in a situation where competition between countries is increasing, every aspect of the Swedish research system must be reviewed and in many cases improved. In this report, the Swedish Research Council proposes goals for the Swedish research system, along with recommendations concerning what needs to be rectified in order to attain these goals. These goals and recommendations are based on research overviews and structural analyses of various aspects of the Swedish research system.

The proposals set out in the report are divided into three main sections: research funding, research infrastructure and the research system. The first two of these sections are largely aimed at the Swedish Research council's remit to fund research of the highest scientific quality within all research fields and prepare long-term plans to secure access to research infrastructure for Swedish researchers, while the section on the research system is aimed at structural aspects throughout the system encompassing both research funding bodies and universities. In this context, 'universities' primarily refers to both universities and university colleges.

Research funding

Funding of researcher-initiated basic research: The knowledge and ideas of researchers concerning future research projects must form the basis for the development of research. This basis for successful research must also form a guiding principle behind the majority of research funding. To ensure that funding is linked to the very best research ideas and projects, these ideas and projects must compete against each other, with the best project proposals being selected through peer review. This is one of the Swedish Research Council's key tasks and is primarily handled within the framework of what is known as the "researcher-initiated basic research project grant".

Through its assessment system, the Swedish Research Council has got good knowledge of applications for the researcher-initiated basic research project grant and the picture is clear: many promising research ideas are currently not being funded due to an inadequate budget. If Sweden is to develop this potential for successful Swedish research, the Swedish Research Council intends to reallocate funding to the researcher-initiated basic research project grant. It is also vital that additional funding is allocated to such an initiative through an increase in the government grant.

A further initiative which supports researcher-initiated research is long-term grants. This support enables the most promising researchers to establish themselves internationally and enables already established top level researchers to develop the research environments which they themselves created.

Targeted initiatives: To ensure that targeted initiatives are effective in developing research, they should be limited to areas which are of strategic importance to Sweden and where coordination between funding bodies can make research more effective and facilitate international research collaboration. The Swedish Research Council proposes that targeted initiatives in the form of a number of ten-year research programmes should be established during the impending ten-year period. Pivotal to these programmes is a national research agenda. The establishment of these programmes must be preceded by the creation of a model for the development of these research agendas and for collaboration between funding bodies.

Research environments: A strong research environment is often essential in order to solve complex research issues. Such environments are attractive to the best researchers and of great importance for the provision of knowledge both within and outside academia. An initiative to increase the number of world-leading research environments in Sweden should be carried out by the Swedish Research Council together with universities and, where appropriate, other funding bodies. This initiative is needed both to guarantee the continued existence of

the most successful research environments in Sweden and to support the establishment of new leading research environments.

Career support: Career support for junior researchers is vital if Sweden is to maintain its high scientific quality in the future and if research is to be renewed through the development of junior researchers into independent and successful researchers. Within the framework of international postdoctoral grants, an initiative is needed to increase the opportunities open to recent PhD graduates to gain international research experience. Initiatives are also needed for career support during the establishment and consolidation phases of researchers' careers. These initiatives should ideally be carried out at national level and in national competition.

Research infrastructures

Research requires the continual development of new infrastructure and the up[10] dating of established infrastructure. This, combined with the increasing pace of technological development, strongly suggests that the current trend for infrastructure costs to rise will continue. It is therefore important that all research infrastructure has long-term and stable funding, that the responsibility for the funding is clear and that routines are in place for follow-up and evaluation.

A good balance between research activity and research infrastructures requires infrastructure funding decisions to be based on overviews, needs inventories and long-term strategic considerations. To achieve this, the Swedish Research Council has begun to implement a new model for the initiation and funding of infrastructure. Among other things, this entails giving universities a more clearly defined responsibility for co-funding national infrastructure, thereby increasing the demands placed on the universities to prioritise investments in essential infrastructure. An important next step is to integrate Swedish involvement in international infrastructure in the new funding model. This will entail clarification of the government's role.

The research system

National career system: The career system needs to be improved in order to make it attractive for promising junior researchers to continue their research career. Not enough junior researchers are employed in qualification positions and the path to such posts is unreasonably long and uncertain and characterised by short-term temporary positions.

Measures are needed from both the government and the universities to create clear career paths and recruitment processes and to shorten the period from PhD graduation to permanent employment. The new qualification position should be extended in order to facilitate assessment for permanent employment, and the government should initiate a dialogue with universities and university colleges concerning what a clear career path should actually be. The universities need to develop recruitment processes so that they are more strategic and formalized and attach greater importance to gender equality and mobility.

Researchers' conditions: Successful research requires a long-term approach, and the economic conditions for researchers need to become more stable. New funding has been injected into the system in the last four Research Bills. To a large extent, this funding has been used for extensive new recruitment, which has led to a reduction in the resources available per researcher. It is important to reverse this trend; research employees must have stable and good conditions through the universities funding research time, support staff and local infrastructure to a greater extent.

Direct government funding: The effective utilisation of the universities' direct government funding for research requires clearer profiling and role delegation between the universities. This is a strategic task for university managements which will require collaboration between the universities and firm foundations. The current performance-based model for allocating a proportion of direct government funding for research needs to be replaced by FOKUS, the national research evaluation system proposed by the Swedish Research Council. This evaluation system, which is based on peer review, is comprehensive as regards research focuses (both

disciplinary and interdisciplinary). It is also forward-looking and encompasses the impact of research outside academia.

The role of research funding bodies: The diversity of research funding bodies results in what are to some extent undesirable overlaps and gaps in the funding of certain fields and environments. In order to reduce these risks, the government must review the current research council structure, and the research councils need to work together more closely in order to coordinate research resources. It is also important that other major national research funding bodies join this coordination.

Collaboration: The ability to apply research findings in order to bring about social, economic, cultural and environmental improvements is a key issue for Sweden. This requires collaboration between the research community and the rest of society. This collaboration must be clearly integrated as early as the research process. Studies of the research systems of many countries have shown that there is a strong correlation between scientific excellence and the scope of the breakthrough outside academia. The close link between research environments and higher education also entails future collaboration through the many students who will work for Swedish companies and within the Swedish public administration sector.

In order to incentivise collaboration and thereby facilitate the impact of research findings outside academia, the government should adopt a holistic approach to the Swedish Research Council's proposal for an evaluation model for distributing direct government funding for research (FOKUS) and the experiences gained through Vinnova's assignment concerning the assessment of performance and quality in university collaboration.

International cooperation: International research cooperations help to improve the scientific quality of Swedish research. It is important that Swedish researchers are given support to participate in such cooperation. This support should be allocated through competition at national level. Coordination and discussions are currently taking place concerning the funding of research at European level. This coordination should be expanded to encompass international research activity at global, European and Nordic levels.

Gender equality: Bringing about a gender equal research system will require further attention and measures. The average proportion of recent female PhD graduates is approaching 50 percent in all academic subjects. However, the rate of increase in the proportion of women amongst professors is slow. Several studies indicate that fewer women than men are still being appointed to the highest positions within academia. The effort relating to gender equality must be integrated throughout the research system, amongst both research funding bodies and research institutions.

Open access to scientific information: In the proposed national guidelines for open access to scientific information, the Swedish Research Council is proposing that all scientific publications and artistic works which are the result of research, funded by public funds, must be published so that they are directly and openly accessible from 2025 onwards. The government should introduce these guidelines for the Swedish research system.

SwePub: Analyses of scientific publications are key to our understanding of how Swedish researchers are contributing to overall scientific production, how they are collaborating and the channels in which findings are published. The SwePub database therefore needs to be developed so that by 2018 it will be possible to carry out bibliometric analyses of production at all Swedish universities and university hospitals published from 2012 onwards. Among other things, this development necessitates the clearer management of the database's administration and the provision of information in the local databases of the universities.

Handling of misconduct in research: Unconditional observance of good research practice is vital if research is to contribute societal benefits and if the general public is to have confidence in the research community. There is currently no satisfactory system for dealing with misconduct and the Swedish Research Council is therefore proposing that a study be set up to develop such a national system.

INTRODUCTION

The government's overarching goal for Swedish research policy is that "Sweden shall be a leading research country where high-quality research and education are carried out and generate new knowledge which contributes to innovation, societal development and the competitiveness of trade and industry" (Budget Bill for 2015, prop. 2014/15:1). To achieve this goal, a research system is needed which promotes innovation and research breakthroughs, attracts gifted students to choose a career as a researcher, is attractive to the most capable researchers, combines the knowledge-building of basic research with societal needs and utilizes resources effectively. A broad research base of high-quality, internationally renowned basic research is also needed.

To realize the research policy goals of high quality and new knowledge, it is important to safeguard opportunities for conducting researcher-initiated, critical basic research and the systems for scientific quality assessment. This can be described on the basis of the three fundamental tasks of science: An analytical, insight-seeking task where research seeks new knowledge, a critical task where research tests established truths and a task where research resolves practical problems and promotes innovation. The first task – basic, theoretically sound and methodologically rigorous scientific analyses – constitutes a precondition for critical scrutiny and practical problem-solving.

Compared with other countries, Sweden invests heavily in research and development (R&D). Only Japan, South Korea, Israel and Finland allocate a higher proportion of their gross national product than Sweden and, as with these other countries, trade and industry are both the largest funding bodies and the largest R&D institutions. Research at universities and university colleges accounts for around 25 percent of the total Swedish R&D system and is largely publicly funded. However, compared with other countries, the scope of publicly funded research is considerable and the output in the form of publications and citations gives a picture of Sweden as a leading research country (Swedish Research Council 2015a). Compared with the very best, particularly as regards groundbreaking discoveries, Sweden is however lagging a little behind. In an international comparison, the Swedish research system is characterized by a relatively large number of universities, as well as a large number of research funding bodies which overlap to some extent. In some respects, this diversity leads to competition which promotes quality and facilitates flexibility and adaptability. Clearer delegation of roles and better coordination are also needed in order to strengthen national research and higher education as a whole. This applies both to research funding bodies and research institutions in the form of universities and university colleges.

Changes are needed in order to bring about a coordinated research system which is viable in the long term and which can effectively underpin and contribute to the development of excellent research, education and innovation of relevance within different areas of society. This report, which is based on a broad consultation with active researchers in Sweden (Swedish Research Council 2015b) and structural analyses (Swedish Research Council 2015a, 2015c-g), presents a number of recommendations aimed at developing the national research system and thereby also strengthening Swedish research and innovation, as well as the scientific base for higher education in the long term. The Swedish Research Council has a key role to play in this task, but the responsibility must be clearly distributed between the various stakeholders. Ultimate responsibility for allocating the necessary resources and clarifying the roles rests with the government.

Research needs and societal benefits

Research creates new knowledge, meets societal needs and helps society to define and tackle challenges. It has long been an ambition to bring about desirable breakthroughs within areas that are important for society through targeted initiatives. However, it is vital for scientific development that such targeted initiatives are limited to areas where the strategic importance of the specified research focus is clearly apparent.

The ability of leading research environments, research groups and individual researchers to identify key issues is the pivotal driving force in researcher-initiated research. In this process of curiosity-driven research thrives both research which has no clear current application and research which is of great relevance in our

efforts to overcome major societal challenges and bring about benefits for trade and industry. The research that is initiated by the research community provides fundamental knowledge which helps to find new ways of defining and dealing with the challenges.

At the same time, it also genuinely gives new knowledge beyond the current horizon with the potential to bring about completely new fields of knowledge and thereby lay the foundations for the further development of trade and industry, care, schools and conditions for mankind. Many important societal, medical and technical innovations which are taken for granted today are based on discoveries made within basic research. Independent and free research represents a cornerstone in the development and democratic vitality of society. High-quality national researcher-initiated basic research is also essential if we are to adopt and benefit from the research and knowledge development that is taking place in the world around us.

Although research findings are essential in resolving topical issues and meeting societal needs, research also looks beyond the topical issues. Researcher-initiated research provides a cornerstone for a society with preparedness to meet and nurture unexpected and unforeseen development. The interface between basic research and applied research is also not always clear in practice. In many cases, basic research leads to applied research by extension, and applied research often reveals a need for additional knowledge which is obtained via basic research. Researcher-initiated research needs to be strengthened and researchers need to cooperate with surrounding society to a greater extent. The aim of this collaboration is to bring about breakthroughs outside academia in the form of societal, economic, environmental or cultural effects. Constructing a research system which can promote researcher-initiated basic research and also capture and identify breakthroughs to the benefit of society and trade and industry represents a major challenge. It is this challenge which all stakeholders in the Swedish research system must now take seriously.

Initiatives to improve the quality of research

Based on comprehensive analyses of current research in Sweden, international comparisons and structural analyses of the research system, the Swedish Research Council is proposing goals and recommendations for a number of research policy areas.

The pivotal role of researcher-initiated research in the research system and the importance of the excellence of individual researchers, research groups and research environments is discussed first. The recruitment of researchers is a vital factor in maintaining and further developing the quality of researcher-initiated research. In connection with recruitments, those appointed must have the best qualifications and the best competence. Universities and university colleges must be able to offer attractive conditions and career opportunities in order to attract the most capable researchers. In this respect, junior researchers represent a key group. Gifted junior people must see pursuing an education to become a researcher as an attractive proposition. A high-quality education will equip them to take on complex and challenging research assignments. In this report, the Swedish Research Council highlights a number of components which will enable junior researchers to develop focuses which can uncover new tracks for future knowledge and which motivates them into remaining within research. Of course, senior researchers also have an important role to play in the research system as regards the development and execution of research and as research leaders. In the report, the Swedish Research Council discusses how these researchers can be given the prerequisites necessary to conduct high-quality research and how the funding of researchers and the research environments they build up should be handled.

A high-quality research system also needs elements of targeted initiatives. Such initiatives should be preceded by thorough deliberations where strategic importance is accorded great emphasis. It could for example concern a marked need for new knowledge in order to overcome important societal challenges or knowledge which establishes the prerequisites necessary for the development of Swedish trade and industry. A long-term approach and national coordination are vital in order to develop this type of research so that it achieves the highest quality and paves the way for international breakthroughs. In order to achieve this, the establishment of a number of national research programmes is proposed here. The aim of these programmes is to increase the strength and impact of strong and topical research fields in society based on a well-defined field.

Thriving international research collaboration entails an influx of new ideas and people. In such collaboration, it is important that Sweden actively participates in the international research community and, in particular, in the contexts where the international research agenda is set.

Gender equality is a quality issue for the whole research system. Over a period of many years, the Swedish Research Council has built up knowledge concerning how the work to improve gender equality within research funding can be carried out. In order to advance this issue, the Swedish Research Council believes that it is now vital to further improve the work of research funding bodies relating to gender equality, particularly in connection with support for research environments. It is also important that the work of universities and university colleges relating to recruitment and career development is improved from a gender equality perspective.

Research within all fields has seen major advances made in recent years with the aid of new research infrastructure. In turn, this has led to increasing demands for the development and funding of this type of infrastructure and a greater need for coordination. Many steps have been taken towards greater national coordination and a clearer delegation of financial and activity-related responsibility for development, operation and use. However, more action is needed to define the respective roles and tasks of universities and research funding bodies. In many cases, research infrastructures also generate unique research environments with the potential to attract the best researchers from around the world – environments where new insight is gained and research breakthroughs are made. It is also important to manage these aspects, particularly as regards striking an appropriate balance between the funding of research and the funding of research infrastructure in order to achieve the highest possible research quality for the funding that is allocated to the research system.

A high-quality, effective research system is characterised by transparency and competition. Academic freedom and the independence of research are vital if research is to produce innovative research. At the same time, it is essential that demanding quality requirements can be met, which is based around research being assessed by leading researchers. Peer review is decisive in the development and funding of research of the highest quality.

The following section describes the aspects which are referred to above. Goals and recommendations are supplemented with argumentation, all with the aim of developing Swedish research in the direction of higher quality with increased international impact and greater application in society, trade and industry and higher education.

FUNDING OF RESEARCH FOR THE BUILDING-UP OF KNOWLEDGE AND SOCIETAL NEEDS

Interaction between researchers and research funding bodies can roughly be divided into two categories: research where ideas and initiatives are based entirely on the interests and knowledge of the research institution, and research where the funding body, often acting on behalf of the government, steers the focus of the research by calling for proposals within a particular field, topic or challenge. These two categories are referred to here as ‘researcher-initiated research’ and ‘targeted initiatives’.

What characterises the funding of researcher-initiated research is that the selection of research ideas, individuals, environments or research focuses which are given support is based on the quality of the research, without the application of strategic boundary conditions. Most basic research, i.e. research with the principal aim of creating new knowledge, is conducted with this type of funding and is referred to here as ‘researcher-initiated basic research''. Researcher-initiated research may well also encompass interdisciplinary research and applied research, e.g. clinical research.

The two largest funding sources for researcher-initiated research are the universities’ direct government funding for research and the Swedish Research Council’s grants. The role of the universities in respect of this research is discussed in more detail in the section entitled “Research institutions and researchers’ conditions”. In this section, it is argued that research funding which originates from the universities should primarily be used for long-term measures, e.g. for salaries for permanent employees and for local equipment and research infrastructure. The Swedish Research Council considers its primary tasks to be the prioritization and selection, through national competition, of the best researchers with the best research ideas within all scientific fields and also the funding of expenses which are directly linked to the research projects of these researchers.

The role of the Swedish Research Council as regards targeted initiatives is to instigate initiatives and prepare underlying documentation to determine the selection of fields for these initiatives. This often takes place together with other funding bodies and the government. The handling of applications is otherwise very similar to the corresponding process for researcher-initiated research, i.e. an assessment is carried out in a national competition and support is allocated to the research which is of the highest scientific quality. A discussion is presented below concerning how fields for targeted initiatives should be selected and what the management and funding forms should be. Forms of national coordination and the link to international initiatives are accorded particular emphasis.

Target initiatives can also be carried out in contexts other than with respect to a particular research focus. This could for example concern the funding of a special category of researcher (in different career age segments, the most successful researchers, etc.) or the funding of different types of research units (from individuals to major research environments). The funding of graduate research schools and research infrastructures may also involve support with a clear focus. The above aspects of research and research funding are important for the research system and of course for the activity of the Swedish Research Council, and are discussed below.

In the following sections, the Swedish Research Council presents its views on research funding within the fields that are most pivotal for the agency. Each field is described and accompanied by recommendations, partly as regards how the Swedish Research Council’s funding can produce the best possible results for the research as regards knowledge development and other societal needs, and partly as regards interaction with other funding bodies.

Funding of researcher-initiated basic research

Goal: In the increasingly tough global competition, Sweden is strengthening its position as a leading research country.

As mentioned above, funding of researcher-initiated basic research is a form of funding which focusses on researcher-initiated research where scientific quality is an absolutely decisive factor in determining how the funding is allocated. The best research ideas are selected in a process with open calls for proposals, tough competition and diligent peer review and prioritisation based on the following criteria: scientific quality, the researcher's qualifications, innovation and originality, and feasibility. The Swedish Research Council plays a unique role in the Swedish research system, as it is the only funding body to offer this type of funding within all scientific fields. The Swedish Research Council's funding, which primarily takes place in the form of project grants, is the dominant external funding source for research at the country's universities within most scientific fields in terms of monetary amount. The Swedish Research Council currently supports a total of around 2,400 projects with an annual budget (2014) of approximately SEK 2.3 billion. This amount represented 64 percent of the Swedish Research Council's total research funding (excluding research infrastructure) during the year.

A high proportion of high-quality project applications with very promising research ideas cannot be supported because of the inadequacy of the budget. This is apparent from the subject overviews recently prepared by the Swedish Research Council's scientific councils and committees (Swedish Research Council 2015b). All scientific councils and committees therefore put forward strong arguments for more funding to be allocated to the researcher-initiated basic research project grant.

In addition to the researcher-initiated basic research project grant, the Swedish Research Council has also developed grant forms with the same aim of funding researcher-initiated research, but with a focus on leading researchers who are active in Sweden. The grants are larger and have a longer grant period than the project grants. Many reasons lie behind this initiative. First and foremost, a longer term approach to funding the best Swedish researchers gives an opportunity to tackle complex scientific issues which could lead to research breakthroughs. The longer grant period also reduces the workload of researchers when applying for grants.

Collectively, the researcher-initiated basic research project grant and the initiative relating to Sweden's leading researchers comprise the Swedish Research Council's principal support for researcher-initiated research. The Swedish Research Council's recommendations for the development of these support forms are presented below.

Funding of researcher-initiated basic research – recommendation 1

Increased budget for researcher-initiated basic research project grants

The budget for the researcher-initiated basic research project grant should be increased in stages over the impending four-year period. The Swedish Research Council intends to source the majority of the funding of this initiative by transferring funding from some of the initiatives which expire during the corresponding four-year period. However, this will not in itself be sufficient to achieve the goal; hence the Swedish Research Council recommends that the government contribute additional funding to an increased budget for the researcher-initiated basic research project grant.

Argumentation

International comparisons of bibliometry-based surveys of the quality of Swedish research clearly show that Sweden has not experienced the same positive development as the most successful countries in Europe, such as Denmark, the Netherlands and Switzerland (the government's Budget Bill for 2015, prop. 2014/15:1; Swedish Research Council 2015a). The Swedish Research Council considers that the most effective measures for improving the quality of Swedish research will be a combination of: 1) an increase in the budget for the Swedish Research Council's researcher-initiated basic research project grants, 2) more strategic steering of

direct government funding for research for universities and university colleges in the direction of long-term goals and clear career paths and appointments (see the section entitled "Research institutions and researchers' conditions") and 3) greater investment in local research infrastructure.

The review of the approximately 5,000 applications for project grants submitted to the Swedish Research Council every year clearly shows that the highest priority applications which cannot be funded within the current budget are of very high scientific quality. Many of these are considered to be largely equivalent to the applications which are currently receiving funding in terms of quality. Allocating funding for a further hundred projects would be a very effective way of steering the quality of Swedish research in a positive direction.

The researcher-initiated basic research project grant encompasses all types of research, from basic and curiosity-driven research to research into societal needs and the development of solutions to today's problems and challenges. In this regard, there are also many examples of interdisciplinary issues and research being conducted involving major research infrastructures around the world. The researcher-initiated basic research project grant therefore not only contributes a high level of (intra)scientific quality, but also research findings which have an impact outside academia. The internationalisation of Swedish research and Swedish universities is being supported via the researcher-initiated basic research project grant, as many research projects are being carried out through international collaboration and also often fund international doctoral and postdoctoral students.

Funding of researcher-initiated basic research – recommendation 2

Expand the initiative relating to leading junior researchers and established top researchers

The Swedish Research Council proposes that the current initiative relating to leading junior researchers and established top researchers be expanded through the injection of funding by the government. The initiative should have the same scope as the initiative under the Research and Innovation Bill in 2012 relating to leading junior researchers, established top researchers and international recruitment of top researchers. The recommendation entails two separate initiatives which encompass the recruitment of leading international researchers in different age categories to Sweden:

- Every two years, 50-60 grants are awarded to leading junior researchers in the category 8–12 years after PhD graduation in order to give them an opportunity to establish themselves as leading international researchers. In total, this support should cover at least 150 junior researchers.
- Every two years, 10 grants are awarded to established top researchers, giving them long-term support with an opportunity to develop the research environments which they themselves created. In total, this support should encompass around 50 established researchers.

To prevent situations where a number of funding bodies award too much funding to the same individuals, it is proposed that the Swedish Research Council, together with other funding bodies which specifically support leading researchers, work together to coordinate such initiatives. Gender equality must be given particular consideration in this context, as reviews of the government's previous so-called 'excellence initiatives' indicate that awareness and specific initiatives are needed to create an equal gender distribution (Swedish Research Council 2015g; Sandström and Wold 2015; Sandström et al 2010). The mobility of researchers between universities must also be encouraged and facilitated.

Argumentation

Many countries which are successful within research (such as the Netherlands, Denmark and Switzerland) provide long-term support to a limited number of top researchers. This support has a higher grant level than ordinary project support. The European Research Council (ERC) has long had this type of funding, which has proven to be very attractive and successful. The main aim behind the support recommended above is to provide the country's leading researchers with the right conditions to enable them to devote themselves to complex issues which require long-term planning and funding at a consistently high level. This grant form can make Sweden a more attractive country in which to conduct research, and in this way the grant can be used both to get leading researchers to remain in Sweden and to recruit international top researchers.

The researchers in question for this type of grant – this particularly concerns the category ‘established top researchers’ – are research leaders who have built up a research environment around their research. There are many excellent examples of such environments both across Sweden and of course internationally. Research environments are important in this context, partly to create a breeding ground for the next generation of researchers and partly to attract internationally leading researchers. The recommended initiatives therefore constitute long-term support for continuity in competence development. If this is to function optimally, it is important that research organisations also take responsibility for supporting research environments around the particularly prominent researchers. The support will therefore require collaboration between research funding bodies and research institutions.

Targeted initiatives

Goal: Sweden concentrates its strengths within a number of key research fields based on national research agendas.

Targeted initiatives are currently being carried out by all research funding bodies. For many funding bodies, the focus is synonymous with the task of the funding body. Due to its size and subject-related breadth, the Swedish Research Council should play a key role in this context, not least through drawing up a basis for selecting fields for targeted initiatives. The initiatives will have the greatest impact in the research system if they are carried out through national coordination between research funding bodies. These are the starting points for the recommendations below.

Targeted initiatives – recommendation

Establish ten-year research programmes

A number of ten-year research programmes should be established during the impending ten-year period. The programmes should be targeted at research which is of strategic importance to Sweden and in areas which Swedish research demonstrates an ability to develop further or where it is considered important to build up a national strength. The programmes will also form a national basis for international collaboration, e.g. within areas which provide a link to major societal challenges. It is important that the programmes are built up over a number of years, particularly in areas which are not currently considered to be established, in order to facilitate the high-quality recruitment of researchers.

The programmes can utilise different grant forms and, in addition to national co-funding, collaboration should take place either bi- or multilaterally at Nordic, European or global level. The Swedish Research Council sees various opportunities for funding the programme. For the Swedish Research Council’s part, it is possible to be a sole funding body for some programmes, but for most programmes, the general rule should be a model where a number of funding bodies work together.

Evaluations of the individual programmes should be carried out after five years and the outcome of these evaluations should impact on future funding. Gender equality, internationalisation and collaboration should be integrated aspects in connection with both the establishment of the programmes and the selection of fields, implementation and evaluation.

Argumentation

The core of a research programme is a strategic research agenda which is developed in a collaboration between research institutions and research funding bodies. In some cases, the Swedish programme is preceded by a European programme, e.g. in the case of the Joint Programming Initiatives (JPI), which have already drawn up a strategic research agenda which can form a suitable starting point. A programme committee should be established for each programme, tasked with leading the effort to formulate a research agenda, as well as another body tasked with coordinating the funding and evaluating the research.

National long-term research programmes have many advantages over the current system of isolated targeted initiatives, which lack the coordination that a strategic research agenda and collaborative funding can offer. Research programmes can bring together researchers from different universities and enrich the scientific communities around the country. For the research funding bodies, collaboration means avoiding overlapping initiatives, and ensures that the support is allocated so that interdisciplinary aspects are given the necessary coverage and that both basic research and applied research can be supported.

For the universities, the programmes will enable smaller, but excellent, research units to operate in a wider context, which can facilitate renewal and recruitment. The programmes also present opportunities to maintain quality and further develop the research field. Through national programmes, research at universities can be brought together and nationwide research environments created. Such a concentration of effort will provide a strong scientific basis for higher education, as it will give smaller research environments the opportunity to collaborate with larger, cross-university research environments. In this way, the scientific basis for higher education at different universities can be both broadened and deepened. The national research programmes will also help to raise the profile of Swedish research internationally and enable Swedish research to have a greater impact internationally, not least as Swedish nodes in major European and international collaborations.

The selection of research programmes shall be based on Swedish interests and areas of strength, as well as areas where excellence can be achieved through a national concentration of effort. Strategic initiative areas for Sweden have been identified for instance within the framework of the Swedish Research Council's research overviews. Together with corresponding discussions amongst other research funding bodies, it will then be possible to raise the proposals for research programmes to a national level. When selecting research programmes, a balance must be struck in relation to an international research agenda. This particularly applies to initiatives which are carried out at European level, particularly the societal challenges which are one of three main focuses within the framework of Horizon 2020 (H2020). In this respect, the establishment of national research programmes can play a decisive role as regards Sweden's collaboration with other Member States and the European Commission's further development of the ERA (European Research Area) through greater coordination of Member States' national programmes, priorities and activities (Moedas 2015). A balance should also be struck in relation to global collaborations and research collaborations within the framework of Nordic cooperation. It is intended that the research programmes will act as platforms for international collaboration, which will facilitate and clarify Sweden's research strategies in an international perspective.

The Swedish Research Council refrains from giving specific examples of fields for national research programmes here. As mentioned above, related issues have been discussed in the research overviews published by the Swedish Research Council. It is nevertheless important both that more research funding bodies participate in discussions of this kind before proposals for programme areas are put forward, and that the discussion is then broadened to also involve the government and research institutions.

Research environments

Goal: The number of world-leading Swedish research environments will rise during the impending ten-year period.

A research environment is an entity which shares a research idea and vision for its research and which works according to clearly defined common objectives. Within many research fields, a strong research environment is essential in order to tackle complex issues. It is also important to highlight the importance of research environment for education. A strong research environment takes responsibility for the provision of knowledge not only to its own environment, but also to society in general within broad fields linked to the field within which the research is being conducted.

Research within specific fields is often characterised by a limited number of strong research environments at a number of universities or university colleges. The research being conducted at these environments is strong, but this is not necessarily the case at other research environments within the same field at other universities.

The key to effective support for research thus primarily lies at individual level and environmental level, rather than field level.

There are many recipes for developing effective research environments. One possible division into three categories is as follows: 1) an environment which is formed around a research infrastructure, 2) an environment which brings together different competences in order to tackle complex and often interdisciplinary issues, and 3) an environment which is formed around a successful researcher or a small group of successful researchers. These categories are not mutually exclusive.

Research environments can vary considerably in size, they can be organised in many different ways and they also do not need to have a common physical location; there are many examples of successful distributed research environments. A distinct common denominator is the common research idea, good research management and a well-defined framework for the way in which collaboration should be carried out, both within the environment and externally.

A strong research environment has a number of positive effects for the research and the research system, as it can tackle complex issues, be a prerequisite for important research breakthroughs and form an attractive focal point for the best researchers. In this way, the recruitment of leading employees will be facilitated, both nationally and internationally. Activities which are difficult for an individual research group to carry out, e.g. research schools and various forms of technical infrastructure support, can also be linked to a strong research environment. A strong research environment also contributes to basic education and knowledge provision within much broader areas than those at which the research is primarily targeted. The combination of qualified researchers with both broad and specialist competence provides the very best foundations for high-quality education, as researchers take up teaching posts at universities and university colleges.

The Swedish Research Council considers that primary responsibility for developing and providing basic funding for research environments rests with the universities. This type of long-term strategic support, which is also closely linked to the appointment of key personnel at these environments, is best-suited to funding from the universities' direct government funding. However, the Swedish Research Council considers that some co-funding in the form of environment support can also originate from external funding bodies, and that this support should also be relatively long-term in nature, with regular follow-up and evaluation.

During the most recent ten-year period, there has been a marked focus on support for strong research environments, firstly through the so-called Linnaeus and Berzelii Centres, and thereafter through the initiatives aimed at environments within the framework of the Strategic Research Areas (SFO). Evaluations show that these environments have been successful and attracted considerable external funding over and above the allocated funding (Swedish Research Council 2015h; Swedish Research Council 2014a; Swedish Research Council 2012; Vinnova 2013; Vinnova 2009). At the same time, this accumulation of funding, which is essentially positive for the environments, means that funding for research which is conducted outside centres of excellence is limited. The Swedish Research Council therefore considers that it is important to strike a carefully considered balance between initiatives relating to research environment support and those relating to forms of support which are also open to individual researchers, such as career support and the researcher-initiated basic research project grants. The research environment support should also be made considerably more flexible as regards the size of the environments than was the case for the initiative relating to Linnaeus environments, for example.

It should be noted that research environment support can be formulated either as support for researcher-initiated research, i.e. an open call for proposals where assessment and prioritisation are exclusively based on scientific quality, or as a targeted initiative within a particular field. In the latter case, research environment support can be one of the funding instruments, together with aid from the European Commission, for example.

Research environments – recommendation

Create the prerequisites necessary for long-term sustainable research environments within which internationally leading research is conducted.

Together with the universities and any other funding bodies, the Swedish Research Council should carry out an initiative to create the prerequisites necessary for long-term sustainable research environments within which internationally leading research can be conducted. The Swedish Research Council intends to establish a grant form which facilitates this type of support. An impending initiative relating to research environments may also encompass support for research schools linked to the research environments. Research schools with a link to a strong research environment offer efficiency gains through cohesive researcher education for the environment. Both internationalisation and gender equality must be integrated components in connection with the assessment and evaluation of research environments.

Argumentation

The evaluations of strong research environments which have been carried out in Sweden, such as the Linnaeus environment initiative, clearly show the value of such environments (Swedish Research Council 2014a; Swedish Research Council 2012). There is already a number of established environments in Sweden which there is every reason to protect. Some of the most successful Linnaeus environments belong to this group, as well as environments around infrastructures where very highly qualified research is also conducted. In order for Sweden to derive the maximum benefit from these environments – built up through previous initiatives and now in full bloom in order to produce successful research for many years to come – the universities, together with other funding bodies including the Swedish Research Council, should take responsibility and allocate resources which guarantee the continuation of the most successful research environments in the country. Provision should also be made for new initiatives, as research is continually developing and changing, and complex new issues which are best tackled in a research environment will also arise.

Career support

Goals:

- Promising recent PhD graduates gain international experience in order to broaden their competence and expand their networks.
- Promising junior researchers have the opportunity to establish themselves as independent researchers and lead research projects.
- Promising junior researchers have the opportunity to consolidate their research initiatives in order to establish themselves at the highest level.

In order for Swedish research to remain competitive internationally, it is imperative to support career development, particularly during the establishment phase, for promising junior researchers. Essential renewal of research can be achieved in many ways, one of which is to ensure that promising junior researchers have the opportunity to develop as independent researchers.

This section presents a discussion of the Swedish Research Council's views on how the research support should be formulated and dimensioned in order to promote the development of promising junior researchers into leading researchers. The Swedish Research Council considers that it is important that the government strengthens the resources available for career support during the establishment and consolidation phases. The funding should be allocated through national competition and to all fields of research. In addition, the allocation should be carried out in a gender equal manner, contribute to international mobility and also take account of researchers who chose a career path which entailed a change in research focus or research outside academia.

That the career system for researchers within higher education institutions is not functioning optimally is apparent from both the debate and the research overviews recently prepared by the Swedish Research Council and in various studies of the career system. For example, these studies indicate that there are not enough junior

researchers employed in qualification positions of the types ‘research assistant’ and ‘assistant lecturer’. The qualification positions have also been pushed later and later in the career progression and the path to such a position often involves many short-term temporary posts. The section on the research system describes how the career system can be improved with the aim of creating better preconditions for junior researchers to develop into leading researchers. A predictable system would be expected to promote quality-developing factors such as gender equality and mobility, both nationally and internationally.

Career support – recommendation 1

Increase the opportunities available to recent doctoral graduates to gain international research experience

The government should allocate funding to increase the opportunities open to recent doctoral graduates to gain international research experience. The initiative should be carried out within the framework of international postdoctoral grants which is allocated through national competition.

Argumentation

Geographic mobility amongst researchers is important for the vital exchange of knowledge, ideas and methods. Supporting international postdoctoral positions, where researchers have the opportunity to work at a foreign university or other research institution at an early stage in their career, can enable recent postdoctoral graduates to establish an international network. This will also offer a chance to develop as a researcher by broadening the research focus at a new environment, for example.

Postdoctoral positions can be divided into three main groups: those who come to Sweden from other countries, those who travel out from Sweden funded by the recipient institution and those who travel out from Sweden funded from Sweden. The first group is primarily supported by grants to research groups, e.g. through the Swedish Research Council’s project grants or various forms of research environment support, and are omitted from this discussion. In the last group, the Swedish Research Council is one of the major funding bodies in the country through the grant form ‘international postdoc’. Every year, around 80 such postdocs are funded out of approximately 500 applicants. However, the funding for these international postdoc positions needs to be strengthened with the aim of giving more junior researchers the opportunity to gain international research experience. International positions also represent important experience for those who choose not to continue their career as a researcher at a university or university college in terms of both their future career and for Sweden. The number of grants for international postdocs therefore needs to be greater than the number of grants distributed later in the career.

Career support – recommendation 2

Career support should be given to junior researchers during the establishment and consolidation phases through national competition.

The government should contribute funding for career support for junior researchers during the establishment phase (2-7 years after PhD graduation) and the consolidation phase (8-12 years after PhD graduation). The funding should be distributed through national competition.

Argumentation

It can be difficult for junior researchers to compete on the same terms as established research leaders with up to 25 years’ experience. The Swedish Research Council has therefore always had grant forms aimed at giving promising junior researchers good opportunities to develop into independent researchers. Today, the Swedish Research Council’s career support for junior researchers, after postdocs, consists of establishment grants which are intended to give promising junior researchers the opportunity to develop their independence as a researcher and to establish their own focus.

Later in the career progression, there are consolidation grants which are intended to enable promising junior researchers to broaden and develop their research focus. It has been claimed in various research policy arenas that these leading junior researchers are being overfunded. However, an analysis of grants awarded to junior researchers by the Swedish Research Council indicates that the number of grants awarded to researchers at the start of their career is relatively low compared with the corresponding age range for established researchers, although there is some variation between fields of research (Swedish Research Council 2014b). The initiative aimed at the most promising researchers discussed above under the section on funding of researcher-initiated basic research should be viewed as part of the initiative relating to researchers who are in the consolidation phase of their career. The Swedish Research Council's proposal for funds for career support to be distributed through national competition may come into conflict with the universities' own strategic recruitment of junior researchers. A dialogue is therefore needed between the Swedish Research Council and the universities concerning how the conditions regarding who can apply for the new career support should be formulated. It is not unreasonable to consider that employment at a Swedish university at the time of application should be introduced as a requirement.

RESEARCH INFRASTRUCTURE

Goal: Sweden's research infrastructure and Swedish participation in international research infrastructure makes internationally leading research possible.

Cutting-edge technology and high-class research infrastructures form the basis for scientific breakthroughs and competitive research within many research fields. Successful infrastructures drive technological and knowledge-related development forward and act as meeting places for researchers, both nationally and internationally. They promote quality in the research, boost the prerequisites necessary for Swedish competitiveness and contribute to the development of society.

The infrastructure landscape is complex. Within physics, astronomy and certain areas of biology, major international facilities are required, whereas within medicine, the social sciences, the humanities and other areas of biology, a scalable combination of locally, nationally and internationally distributed infrastructures is needed. Examples of distributed infrastructures are technology platforms for molecular biology, biobanks, databases and installations linked to animal experiments. Quality-assured databases which are comparable both nationally and internationally are pivotal to research within many areas of the social sciences, environmental sciences, medicine, the humanities and educational science.

Digital technological developments have a unique role which is expected to revolutionise many areas of research (Swedish Research Council 2014c). A cohesive view of the e-infrastructure which concerns digital communication, storage, computation and database access, both nationally and internationally, is therefore needed. Sweden also needs to secure access to the competence that is necessary for the effective utilisation of e-technologies within smaller technologybased research fields.

Ongoing technological development and the needs of researchers for cuttingedge technology requires not only the development of new infrastructure, but also the updating of existing infrastructure. Infrastructure costs have therefore risen steadily since the Research and Innovation Bill in 2008 – even if one overlooks the new initiatives carried out in the European Spallation Source (ESS) and in the infrastructure for register-based research. There is no evidence to suggest that this development will taper off. The accelerating pace of technological development indicates rather the opposite, i.e. further cost rises. In this context, it is important to note that all research infrastructure development requires longterm and stable funding, clear responsibility for the funding and evaluation, and investments to be balanced against other research undertakings. This is key to the recent and current investments in MAX IV and ESS, the largest investments in research infrastructure that have ever been made in Sweden. It is absolutely vital to the utilisation of these infrastructures that the future responsibility for adequate long-term funding and scientific follow-up is clear.

A new model for the delegation of responsibility, prioritisation and reinvestment at local, national and international levels is in the process of being implemented. The aim is for the model to encompass all levels of infrastructure and to be fully implemented in 2018. In the first step, the Swedish Research Council and the Swedish universities have together formulated a model for the joint prioritization and funding of national infrastructure. The model includes recurrent needs inventories based on input from the universities, other funding bodies and research groups. The next needs inventory will result in updates to the Swedish Research Council's Guide to infrastructure in 2016, which in turn will form the basis for future targeted calls for proposals based on highly prioritised new infrastructure projects. The recommendations presented below are more general in nature and concern the very largest investments in infrastructure.

Research infrastructure – recommendation 1

Develop a better balance between initiatives relating to research and initiatives relating to local, national and international research infrastructure, as well as a clearer funding model for national and international research infrastructure.

Research and research infrastructure must support and enrich each other to ensure the favourable development of the Swedish research system. Sweden therefore needs to strike a better balance between initiatives relating to

research and initiatives relating to local, national and international research infrastructure. Such a balance can be achieved through basing infrastructure decisions on overviews of Swedish research, inventories of infrastructure needs, and strategies and priorities for both research funding and the funding of research infrastructure. Such a decision-making process requires clear and transparent engagement from the entire Swedish research community, encompassing the universities, funding bodies, research groups and Sweden's government and parliament. In connection with decisions concerning new infrastructure, all stakeholders must be aware that investments in new infrastructure will often radially change the preconditions for the research.

With the implementation of the new model in 2016, the universities will gain a clearer role as a co-funding provider of national infrastructure, which will require them to prioritise the development of essential infrastructure.

The new model for infrastructure funding will be developed to encompass Swedish participation in international infrastructure, which will require clarification of the responsibility amongst all stakeholders in the research system, with Sweden's government and parliament as mandator and main funding body (see recommendation 2).

Argumentation

The infrastructure landscape for research will undergo comprehensive change in the coming years with the aim of bringing about a carefully considered and balanced whole, which is long term and facilitates renewal. In line with international development, both the need for research infrastructure and the associated costs are expected to increase. The rapid pace of technological and knowledgerelated development means that needs will change and new needs will arise, and that new technical opportunities to acquire new knowledge will open up. The strategic deliberations that the Swedish Research Council and other research funding bodies will make over the impending five- to ten-year period will be of decisive importance as regards access to cutting-edge tools for Swedish research. The Swedish initiatives must relate at all times to infrastructure elsewhere in the world, primarily the Nordic region and Europe, but also globally.

If the prioritisation and funding of infrastructure are to meet the needs of researchers, local, national and international infrastructure must be weighed up against each other. According to the Research Bill of 2008, local infrastructure and associated specialist expertise must be funded by universities and university colleges, rather than the Swedish Research Council. The Knut and Alice Wallenberg Foundation has also withdrawn its support for local infrastructure. This has weakened the funding of smaller and moderately expensive equipment and associated specialist expertise over the past decade, as noted in the Swedish Research Council's subject overviews for both natural science and technology, and medicine and health. This weakening of funding is considered to be a key reason behind the reduced competitiveness of some areas of Swedish research. In the Swedish Research Council's new model for infrastructure, the infrastructures are organized into fewer and larger entireties with a longer term undertaking for all stakeholders and clearer follow-up. Expanded responsibility for the prioritisation and cofounding of national infrastructure is imposed on the universities, which also have the role of executor. The Swedish Research Council remains a pivotal funding body with responsibility for national coordination and follow-up, and for establishing a balance concerning strategic relevance from a national perspective.

As regards the prioritisation and funding of major international infrastructures, the participation of Sweden's government and parliament is essential. Initiatives of this type are often of considerable strategic benefit to Swedish trade and industry and society in general, and political engagement in international negotiations is vital.

Research infrastructure – recommendation 2

Clarify the role of the government in connection with the prioritisation and funding of international infrastructure throughout the entire life-cycle of the infrastructure

Decisions concerning Sweden's participation in the major international infrastructures are made by the government and parliament, and the responsibility for such participation is then delegated to the Swedish Research Council. It is important that the use of international infrastructure by Sweden is reviewed from a

research perspective and that the government's role in connection with prioritization and funding throughout the entire life-cycle of the infrastructure is clarified. Adequate funding, a long term approach and follow-up are essential to ensure effective Swedish research participation in international infrastructures.

Argumentation

International infrastructure is often tied to conventions, where accession and withdrawal run over many years and are regulated through agreements between states. As a first step in connection with decisions concerning accession, the benefits of participating in international infrastructure for Swedish research and societal development must be examined in relation to the associated cost. The enormous investments in international infrastructure often have many motives alongside the research-related benefits, such as returns for industry, social relevance and international coordination. These investments require earmarked and long-term state funding.

The Swedish hosting of the European Spallation Source (ESS) is unique in this context. The responsibility for funding the Swedish undertaking for the construction and operation of ESS rests with Sweden's government and parliament, with the Swedish Research Council acting as scientific advisor and taking responsibility for scientific and strategic follow-up (see recommendation 3).

During the period 2016–2025, major new infrastructures within physics and astronomy will be initiated and existing infrastructures where Sweden is a member will be upgraded. The costs are expected to be substantial. The Swedish Research Council is responsible for scientific prioritisation, whilst engagement from the government and parliament is needed regarding strategic prioritisation and funding. This applies, for example, to the development of the international radio astronomy project SKA (Square Kilometer Array) in South Africa and Australia, where the Swedish Onsala Space Observatory is responsible for important technological development and expertise. It also applies to the upgrading of instruments at CERN in Switzerland and the upgrading of the international radar facility EISCAT based in Kiruna. A sustainable solution must be developed to meet the substantial cost fluctuations for Swedish membership of CERN and other convention-based infrastructures. These fluctuations are caused by changes in exchange rates and the Swedish GNP, which lie outside the control of the Swedish Research Council.

Assessments and new decisions concerning Swedish participation in international infrastructure is a more protracted and complicated process than that concerning national infrastructure. Ahead of the call for infrastructure-related proposals in 2017 and future prioritisations, the Swedish Research Council must initiate and carry out an overarching evaluation of Swedish participation in international infrastructure.

Research infrastructure – recommendation 3

Clarify the economic and scientific responsibility for ESS and the long-term relationship between ESS and MAX IV

To ensure that the exceptional investments in the ESS and MAX IV facilities are developed to their full potential for Swedish research and industry, a number of measures are needed in both the shorter and the longer term.

The Swedish owner responsibility for ESS requires strategic measures for review and follow-up. Sweden and Denmark jointly host ESS, which imposes special demands on these countries even if the facility is formally European. The Swedish Research Council should be given a clear assignment relating to ESS which includes continually carrying out scientific follow-up during both the construction phase and the future operating phase.

With the planned rate of construction, the funding of MAX IV has been approved through to 2018. Four measures relating to MAX IV are recommended. Firstly, MAX IV needs to take on a scientifically leading role, as regards research focus, anticipated user groups and user pressure. Secondly, the facility must be internationalised to maximise usage. Above all, an inventory of the collaboration with neighbouring countries in Northern Europe needs to be prepared. In this regard, active participation from the government in bilateral discussions is essential. Thirdly, in exactly the same way as for ESS, the Swedish Research Council should be given responsibility for follow-up concerning MAX IV. Finally, a stated ambition concerning the long-term funding of MAX IV is required from Sweden's government and the Swedish Research Council during both the

construction and operating phases. This will enable national and international investment and supplementary funding to be attracted.

Argumentation

ESS is a European research facility which is operated as an ERIC[1] with Sweden and Denmark as host countries. Sweden has a special responsibility, as the spallation source is being constructed in Lund, in the southern part of Sweden. Given the multinational nature of the facility, it is natural for the main economic responsibility to rest with the Swedish government. However, the role of the Swedish Research Council regarding ESS needs to be clarified. In addition to scientific follow-up, the Swedish Research Council can facilitate active participation from the universities and industry through special initiatives and support for strategic recruitment.

At least during the period through to 2020 – and, with further development, for considerably longer – MAX IV will be the world's leading synchrotron light facility and will represent an exceptional regional resource for Northern Europe. The initiative behind MAX IV has its origins in the Swedish research community and is based on unique national expertise within accelerator physics and a strong tradition as a user of synchrotron light. As a natural consequence of this, the Swedish Research Council was the principal funding body for the facility during the initial construction phase. With regard to the level of future operating costs, a long-term commitment from the government is needed to ensure that the funding of other research is not eroded.

Research infrastructure – recommendation 4

Invest heavily in the development of e-infrastructure

The government should allocate new funding to the Swedish Research Council for the development of research environments and research infrastructure within e-infrastructure. The following three aspects need to be given particular attention: 1) Research projects with comprehensive needs concerning supporting e-infrastructure must be identified and specific resources allocated within the project. 2) All research infrastructures need to budget for supporting e-infrastructure. The realism in the planning will be included in the assessment of the infrastructure's maturity. 3) Previous investments in experimental infrastructures need to be supplemented with the subsequent funding of IT resources for large-scale computations and storage, as well as networks for digital communication.

Powerful initiatives relating to advanced user support and training must permeate the entire research system and encompass general competence development and increased access to e-expertise.

It is also important that the organisation, delegation of responsibility and funding of the national assignment for open access to research data is given a clearer structure.

Argumentation

From both an international and a national perspective, e-infrastructure for research is becoming increasingly important within most fields of research. In 2014, the Swedish Research Council instigated a survey of previously undefined and unfunded e-infrastructure needs for a number of infrastructures (Swedish Research Council 2014c). The survey identified a need for further investment in the Swedish e-infrastructure initiative of the order of SEK 300–400 million for the period 2015–2019 for these infrastructures which have already been approved and are under construction or development.

E-infrastructure encompasses everything from computers, databases and networks to software and user support. Simulations, visualisations and computerbased research are rapidly becoming a natural part of an increasing number of research fields, which means that the fundamental conditions for research are set to change fundamentally.

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[1] European Research Infrastructure Consortium

Today, Sweden has a world-class e-infrastructure and a better understanding than most countries of the interaction between e-science and e-infrastructure. The government's initiative relating to e-infrastructure within the Strategic Research Area Initiative (SFO) in 2008 was of great importance to the development of the area. It is important that Sweden continues to invest heavily in competence and resources for e-infrastructure and e-science in a structured manner.

The report entitled *Swedish Science Cases for e-infrastructures* (Swedish Research Council 2014d) describes how the level of quality of both basic and cutting-edge research can be raised if the digital tools are developed and adapted.

A critical factor within IT- and computation-intensive research fields is the limited access to e-expertise which provides advanced user support to other researchers. '

Assuming current trends continue, the funding of e-infrastructure will become a key issue within most fields of research. Users currently often perceive resources for e-infrastructure to be free, but if the expansion is to continue, new funding models must be developed for e-infrastructure.

THE RESEARCH SYSTEM

The Swedish research system comprises a number of stakeholders. The largest stakeholder group, in terms of its role as research institution and research funding body, consists of private sector trade and industry with a natural focus on product-related research and development and with funding mainly coming from its own resources. The other major group of research institutions is the country's approximately 40 universities and university colleges, which make up a multifaceted group. The group encompasses everything from major research-intensive universities and university colleges to smaller university colleges, which primarily provide teaching.

Most universities receive direct government funding for research and research training (third-cycle cources and study programmes). The research conducted at the country's universities is 40% funded by such direct government funding for research. Sources of external research funding, i.e. grants from other funding bodies which are often allocated directly to individual researchers and research groups, make up the single biggest component of all funding of research conducted at the universities. However, there are major differences between individual universities and university colleges as regards the proportion of direct government funding relative to external funding, a situation which also applies to different research focuses, as discussed in more detail below.

As regards the proportion of direct government funding for research relative to total research income, Sweden is in a mid-table position internationally. There is considerable variation between countries, although there is a distinct change in the direction of reductions in direct government funding for research for most countries (Figure 1). The situation for a small group of countries, including Sweden, has however been relatively stable. No country seems to display a trend with rising direct government funding for research. Compared with Sweden, a number of successful research countries, such as Denmark, the Netherlands (no data is shown in Figure 1) and Switzerland, have a much higher proportion of direct government funding for research, while another successful research country, Great Britain, has a lower proportion of direct government funding. Many leading universities around the world are characterised by a very high proportion of funding through their own funds, in some cases up to 80 percent.

In this context, it should be noted that the opportunities open to the universities as regards specialisation and strategic considerations are closely linked, partly to the amount of direct government funding for research and partly to the opportunity to save funding for future investments. As a high proportion of the universities' revenues is derived from external funding bodies with their own strategies, the universities' scope to act is very limited, as consequently is their scope to make strategically important decisions concerning the funding of research and infrastructure. This situation must change.

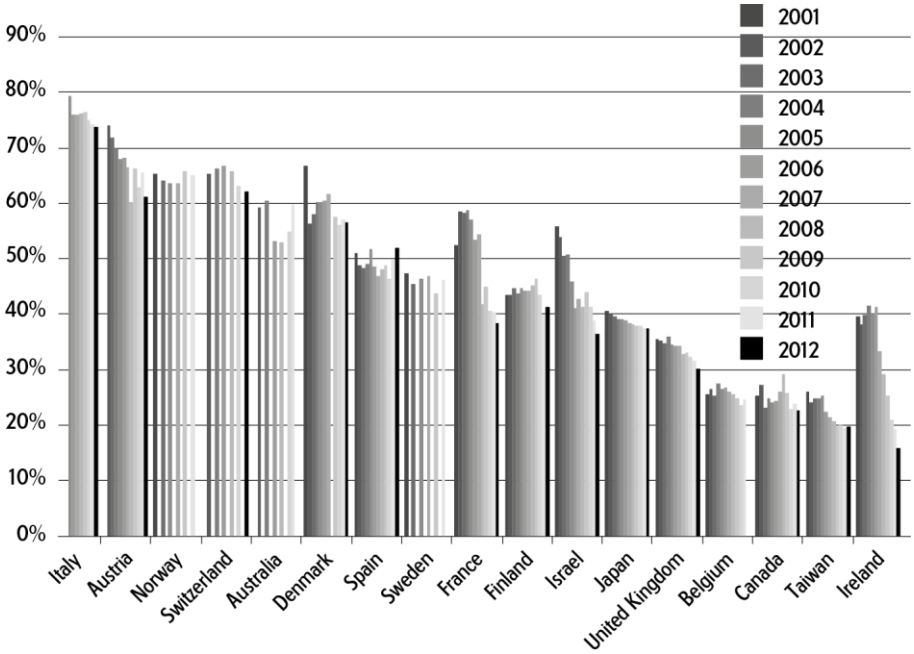

Figure 1. Proportion of research and development revenues comprising direct government funding for research at universities in 17 countries. Underlying data taken from OECD StatExtracts (26.03.2015). For some countries, including Sweden, statistics are only available for every two years.

The Swedish Research Council considers that the Swedish research system has excellent preconditions, but faces a series of challenges which need to be met if the system is to achieve its full potential. This section discusses some of these challenges and proposes goals and recommendations. Common to these challenges is that they require a greater degree of strategic prioritisation from university managements. The goals also presuppose a clearer distribution of roles between funding bodies and research institutions, where the research funding bodies allocate funding through a competitive procedure to the best research ideas, while the research institutions provide stable conditions for their researchers.

National career system

Goal: Sweden has a functioning national career system which is based on principles of open advertising of all teaching and research posts, as well as clear and transparent recruitment and promotion processes.

No capable researchers – no successful research. The most promising students and recent PhD graduates must therefore consider a career as a researcher to be attractive. The conditions of junior researchers have long been the subject of discussion, and the issue was considered in the report from the Academic Career Inquiry entitled “Careers for quality” (SOU 2007:98). The report was then considered in the so-called Autonomy Bill (prop. 2009/10:149). The situation for junior researchers at the country’s universities is however still characterised by considerable uncertainty and temporary posts. An analysis of the career structure of junior researchers (Swedish Research Council 2015c) confirms that the proportion of career junior researchers who hold a qualification position as a research assistant or assistant lecturer has fallen sharply, and that these qualification positions are also being held later in the career progression. Within most fields of research, the average qualification period (the period through until a person is appointed to a permanent position within a higher education institution) is now considerably longer than six years, which is the period covered by postdocs (two years) and the new qualification position (four years).

Many junior researchers wishing to continue their research career within the higher education system are therefore forced to take many different temporary positions. Such positions can be filled without any requirements concerning formalroutines for the assessment of qualifications. A researcher can therefore be part of the research system for many years through holding temporary and short-term project posts without any assessment of qualifications and skills being carried out to determine whether the researcher possesses the skills needed to pursue a long-term career in the higher education system.

The following academic posts currently exist within the Swedish higher education system:

- **Postdocs**, two years. Can be held within two years after obtaining a PhD, excluding non-qualifying periods for parental leave, etc. Is an agreement between the unions and employers' organisations.
- **Qualification position**, four years. Regulated through the Higher Education Ordinance. Many universities have decided to introduce research assistant and assistant lecturer posts as qualification positions, with the latter giving an opportunity to be assessed for a permanent position.
- **Lecturer**. Regulated through the Higher Education Ordinance, generally a permanent position.
- **Professor**. Regulated through the Higher Education Ordinance, permanent position (excluding artistic research).
- **Research posts**. Not regulated through the Higher Education Ordinance, but follows the Employment Protection Act (LAS). Not a teaching post, but covered by the category 'technical and administrative personnel', unless specified otherwise in the university's employment regulations.

International and national mobility is increasing the quality of research by promoting innovation and stimulating the exchange of research ideas and the development of new research methodology. Rising national mobility, particularly as regards mobility during the period between PhD graduation and the graduate's subsequent career, represents one of the biggest challenges for the Swedish research system (Bienenstock, A. et al. 2014; Swedish National Agency for Higher Education 2012). Denmark, the Netherlands and Switzerland are countries with successful research with greater international mobility than Sweden. Swedenbased researchers differ from researchers in other EU Member States in that they are less likely to cite good funding or employment as an important motivational factor behind mobility. The reports indicate that weak career systems and deficiencies in the recruitment process are the most important barriers to mobility (Idea Consult 2013). The Swedish Research Council therefore considers the career system to be one of the key questions for improving the quality of Swedish research.

The Swedish Research Council's analysis of gender equality and the Swedish Higher Education Authority's annual report for universities and university colleges (Swedish Research Council 2015d; Swedish Higher Education Authority 2015) indicate that progress is being made as regards gender equality both within research and within the higher education system generally. However, there is still a considerably lower proportion of women than men amongst professors. According to the Swedish Research Council's analysis of career paths in the higher education system (Swedish Research Council 2015c), it takes longer for women than men after graduating with a PhD to obtain a position as a professor. This lag is already apparent around the time of qualification positions. A further structural difference is that women within the humanities and social sciences are more often employed as lecturers with a higher proportion of teaching, while men within these fields of research tend to hold positions with more research time to a greater extent.

National career system – recommendation

Clearer career paths and recruitment processes and fewer temporary positions

The government should:

- consider the possibility of extending the new qualification position in order to facilitate assessment for permanent employment
- initiate a dialogue with universities and university colleges concerning the transition from qualification positions to permanent employment

- shorten the time span within which researchers can be considered for temporary qualification positions to five years after graduating with a PhD (excluding non-qualifying periods relating to parental leave, sickness, clinical general and specialist medical practice, etc.)

The universities should strengthen the opportunities open to junior researchers and teachers to conduct research, promote international and national mobility and enhance gender equality by:

- establishing recruitment processes which mean
  - that recruitment is a strategic issue for the university
  - that assessment criteria in local employment regulations accord greater emphasis to mobility
  - that the assessment criteria are formalised and have a high degree of concretion with the aim of promoting greater gender equality
- increase the number of qualification positions in accordance with Section 4 of the Higher Education Ordinance
- sharply reduce the number of researchers in the category "other research and teaching staff" in order to avoid short-term temporary positions without any further opportunity to gain qualifications or promotion

All stakeholders in the research system should improve the conditions of researchers with regard to career opportunities through:

- monitoring and analysing career development for men and women in the higher education system
- monitoring and analysing mobility patterns in the higher education system

Argumentation

The Swedish Research Council believes that the research system will only be able to attract promising junior researchers if they are offered good conditions with a clear and transparent career path. The universities need to utilise the new qualification position which was introduced through the Higher Education Ordinance in 2012 to a much greater extent. The qualification position must lead to a permanent position if the applicant already fulfils established quality requirements as regards scientific and pedagogical qualifications. An increase in the duration of qualification positions to five or six years would enable assessment to start as early as a year before the position is due to be terminated. If the assessment can be initiated well in advance of termination of the position, any candidate who is not promoted will have sufficient time to find new career opportunities.

The main change that will be necessary to bring about an effective career system is that responsibility for competence provision should be preceded to a greater extent by a strategic process to assess needs and opportunities. Recruitment should not simply be a question for individual research groups, but a strategic issue which is handled at faculty or equivalent level. Such an approach may also enable the universities to search more actively for specific skills in order to supplement and develop their education and research profile. To be able to establish priorities, the university managements need a clear strategy for what they want to achieve in both the short and the long term. That recruitment is seen more as a strategic issue for the university should also promote greater mobility. This issue is closely linked to the universities' direct government funding for research, which is decisive for their opportunities to establish strategic priorities as regards recruitment at all levels. In the directive for the Leadership Inquiry (U2014:11), the ability of university managements to establish strategic priorities is an important component with the aim of creating good preconditions for highquality research and education (dir. 2014:70).

The Swedish Research Council's observations concerning gender equality (Swedish Research Council 2015i) indicate that gender equality is increasing through greater formalisation of the assessment process. When different informal structures or unspecified assessment criteria can impact on an assessment process, gender equality is adversely affected. Formalisation ensures that the formal quality aspects end up in focus. This applies both to the distribution of research support and appointments in the higher education system. If international experience and national mobility are to be accorded greater emphasis in connection with appointments, formalisation will also strengthen gender equality and equal treatment in general.

Striking a balance between introducing more provisions in the Higher Education Ordinance and giving the universities the freedom to decide for themselves is not an easy task. On the one hand, the universities should have considerable autonomy to make their own appointments. On the other, reports and analyses show that, at least for a certain period of time, there appears to be a need to centrally regulate issues concerning promotion for qualification positions due to the worrying situation facing junior researchers. That this is also an important question for the government is also underlined by the establishment of a special inquiry (U 2015:05) to review conditions and career paths for junior researchers (dir. 2015:74).

Researchers' conditions

Goal: Universities and university colleges provide stable and good conditions for their researchers and teachers.

Occasionally it is claimed that the resources available for research are declining and that more and more people are fighting over a shrinking cake. The Swedish Research Council's analyses show that total economic resources increased by 46 percent and direct government funding for research by 41 percent (adjusted for inflation) during the period 2001-2011. New funding has been injected into the research system in the last four research government bills (Table 1). In the first two government bills during the 2000s, the biggest increase in research resources took place through the research councils, whilst the increase in the 2008/09 government bill was primarily distributed directly to the universities.

	Research councils		**Universities, other (incl. SFO grants)**		**Universities, direct government funding for research**		**Other**		**Total**
	MSEK	%	MSEK	%	MSEK	%	MSEK	%	MSEK
2000	772	60 %	37	3 %	392	31 %	78	6 %	1 279
2004	1 804	77 %	1	0 %	520	22 %	15	1 %	2 340
2008	1 180	24 %	1 765	35 %	1 550	31 %	505	10 %	5 000
2012	2 425	61 %	310	8 %	900	23 %	365	9 %	4 000

Table 1. Allocation of new funding in the research bills to the research councils and universities expressed in SEK million and as a percentage of the total amount. Processed from Wallberg-Henriksson (Wallberg-Henriksson 2012).

During the same period, the number of employees at universities and university colleges rose by 21 percent. Alongside this, however, the composition of the staff changed radically. Within the category "Research and teaching staff", the increase is 32 percent. If one looks at a more narrowly defined group of researchers and teachers, which only includes professors, lecturers, qualification positions and research posts (with a PhD), the growth is no less than 59 percent (Swedish Research Council 2014b).

The situation becomes clearer if the available resources are presented per researcher/ teacher as defined above[2]. The resources per individual are unevenly distributed between the research fields because the staff composition differs between the fields and the proportion of external funding varies considerably. Two areas

[2] The calculations are based on total R&D revenues (excluding costs for research training programmes, i.e. third-cycle courses and study programmes) within the sector and personnel statistics from Statistics Sweden (SCB).

have seen significant reductions per researcher/teacher: agricultural sciences and medicine and health sciences. Within medicine and health sciences, this is due to the fact that the number of researchers/teachers in the higher education system has risen sharply (Swedish Research Council 2014b). Other areas have had relatively stable resources. Overall, there has however been a slight fall in direct government funding for research relative to the number of researchers (Figure 2). A reduction is also apparent in recent years as regards total resources per researcher (Figure 3).

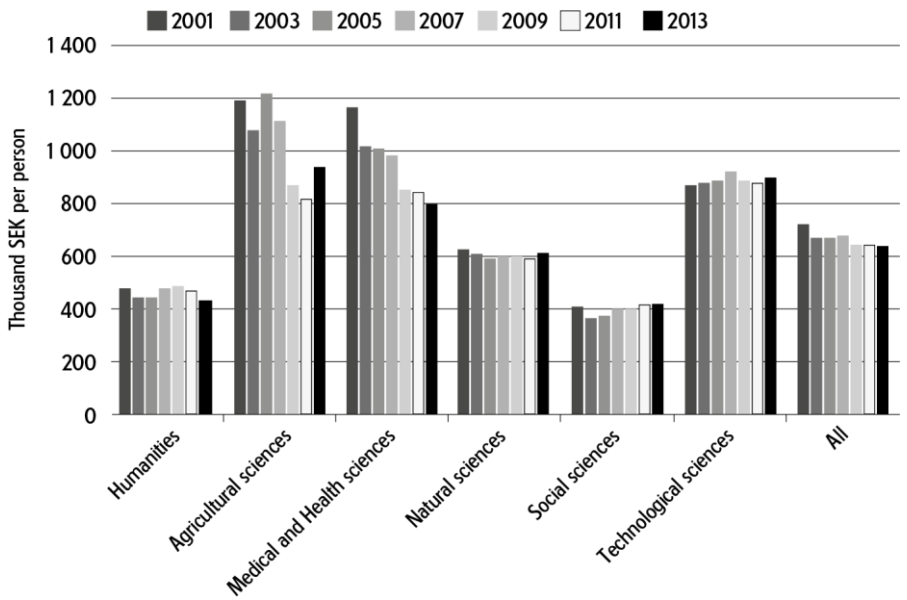

Figure 2. Amount of direct government funding for research per researcher. Underlying data from SCB at 2015 prices.

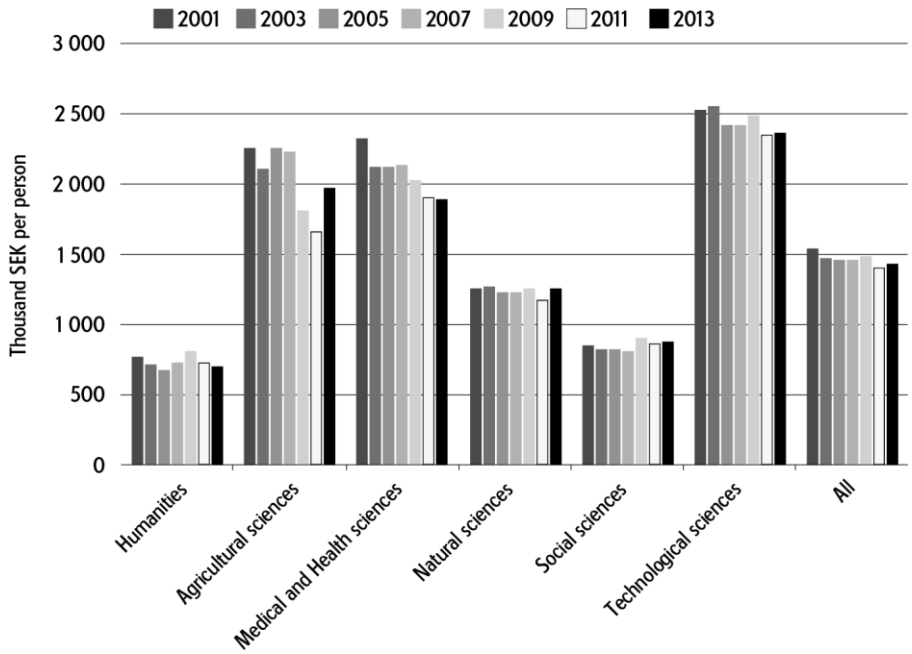

Figure 3. Total R&D resources per researcher Underlying data from SCB at 2015 prices.

In summary, it can be said that the substantial increases in grants have been accompanied by extensive recruitment of researchers and teachers with research duties, which has led to some reductions in the amount of resources available per researcher/teacher, expressed in terms of fixed monetary value. The Swedish Research Council considers it unfortunate that the funding allocated has been used to such a great extent by the universities to appoint new researchers. This impacts on research innovation and quality. It is important that the resources are instead used to secure good and stable conditions for researchers and teachers who are already in the system, and the consequence of this will probably be a decrease in the number of researchers and teachers with research duties.

Researchers' conditions – recommendation

The universities should fund research time, premises costs, support staff and infrastructure to a greater extent.

The universities should:

- develop their ability to establish strategic priorities
- give capable researchers and teachers better opportunities to conduct research by providing stable conditions in the form of research time, support resources and infrastructure
- secure good and appropriate forms of recruitment and employment for researchers and teachers.

Argumentation

Stable conditions for researchers and teachers create an attractive environment and promote originality, risk-taking and a long term approach. This will not be created automatically by increasing direct government funding for research. What is needed is the higher prioritisation of resources for creating the right conditions for successful research.

Successful research requires advanced support resources in the form of highly qualified specialists, e.g. in order to develop and maintain infrastructure and instruments. It is also important that the universities take strategic responsibility for all the university's needs. It is partly a question of long-term funding in order to offer permanent positions and partly a question of creating career progression opportunities for these specialists. Greater strategic prioritisation of resources should also increase the universities' opportunities to provide smaller and moderately expensive infrastructure.

Direct government funding for research

Goal: Direct government funding for research is being utilised in a manner that is effective for the country, as it is allocated in accordance with a model which promotes better quality and profiling of Swedish research.

Although Sweden allocates substantial resources for research in relative terms, the country is a small one in terms of population. The limited resources which the direct government funding for research represents must be utilised in the best possible way in order to improve the quality of Swedish research. To achieve this, the clearer delegation of roles between the universities is essential, particularly as regards research focuses which are small. The Swedish Research Council believes that an essential national breadth in terms of subject fields can be maintained within both research and education through collaboration between the universities. The issue is also raised in the government bill entitled "Research for a better life" (prop. 2004/05:80).

Assessing the fields within which universities can work together and profile themselves is a task for the universities' managements. It is important that the government's policy instruments incentivise the universities into taking responsibility for this strategic task. A national research evaluation system based on peer review assessment can provide a basis for the selection of collaboration and profiling.

Direct government funding for research – recommendation

Introduce a new assessment system for the allocation of direct government funding for research

The government should:

- replace the current performance-based model for allocating a certain proportion of direct government funding for research and research training with a national research assessment system in accordance with the Swedish Research Council's proposal[3] for quality-assuring direct government funding for research

The universities should:

- seek out collaboration for increased profiling and in order to create strong research and education environments.

Argumentation

The Swedish Research Council considers that the current system for allocating direct government funding for research does not strengthen quality-driving factors such as clearer priorities and greater coordination between the universities relating to different research focuses. This is underlined in a study concerning the way in which grants are allocated between Swedish universities (Nelhans and Eklund 2014). In their report, the authors state that too much influence from mechanical and automated principles, such as the Swedish indicator method, for evaluating research is making it difficult for the universities to exercise control over their own focus and profiling.

The national evaluation system proposed in the report entitled "Research quality evaluation in Sweden, FOKUS" (Swedish Research Council 2014e) represents a viable alternative to the current overly mechanical and retrospective method used to evaluate research. Through such a system, which is based on peer review instead, consideration can be given to the fact that research quality is a complex concept which cannot easily be measured solely using indicators. Carefully chosen assessment aspects and criteria will also facilitate the assessment of potential and future development. In this way, a national evaluation system can support the universities in their strategic work and incentivise quality development which will benefit both themselves and the research system in general. Through a national evaluation system based on peer review, all the universities will have a basic evaluation which is comparable with all research being conducted in the country within the respective research fields.

A national evaluation which is carried out on a single occasion will involve a review of the research situation and present good opportunities to identify areas of strength at both national and university level. The national evaluation can therefore act as a scale for comparisons and as a basis for strategic decisions by the universities and other stakeholders as regards the focus of their own activities and collaboration with others. It will be possible to identify and reward high-quality research through FOKUS, regardless of the focus, volume and university. This means that both small and young universities and larger, more established universities will have the same opportunities to be rewarded for their research if it is of high quality. In FOKUS, smaller and profiled universities will have an opportunity to demonstrate their strengths in a better way than is the case with the current model, which takes no account of the fact that the universities have different preconditions. As in the case of the British Research Excellence Framework (REF), it will be possible to identify pockets of excellence (Swedish Research Council 2013).

Such an evaluation will also result in access to better data, even during periods between evaluations, which can be used in follow-ups and analyses. This has been a marked positive secondary effect in the Australian evaluation system Excellence in Research for Australia (ERA) (Swedish Research Council 2014e).

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[3] Model for resource allocation: Research quality assessment in Sweden – FOKUS. On 18 December 2014, the Swedish Research Council submitted its proposal for a model concerning how a certain proportion of the universities' direct government funding for research and research training should be allocated through a competitive procedure.

For a small country like Sweden, it is important to be able to consider the country's research from an international quality perspective and to be able to systematically monitor developments over time. This provides a basis for identifying the initiatives which need to be prioritised, at both university and political level. A national evaluation will also provide an excellent basis for demonstrating to taxpayers and opinion-formers what initiatives relating to basic research and applied research lead to and why the initiatives are important.

In summary, the Swedish Research Council believes that a performance-based model which includes peer review will drive up quality more than the current indicator-based model. In addition, such a model will make it possible to specifically reward quality-improving factors, such as the regrowth of new researchers, internationalisation, development of research environments, education affiliation, collaboration, mobility and gender equality, as well as breakthroughs outside academia.

Research funding bodies and their role in the research system

Goal: Research funding bodies work together to a greater extent to improve the coordination of research funding.

That Sweden has a large number of funding bodies for research at universities and university colleges is essentially positive. The large number of stakeholders demonstrates faith in the ability of research to drive forward economic development and an expectation that the research system will deliver solutions to many of the societal challenges that we face. The idea behind virtually all public sector research and higher education being covered by the same system is to exploit synergies and establish a better link between both different research focuses and education and research.

At the same time, there are also challenges associated with such a system and with the large number of research funding bodies, which in addition to purely government funding bodies also includes funding from the EU, public foundations (established using tax revenues), private foundations, private enterprises, charity foundations, etc. All research funding bodies are managed in different ways and have different starting points and aims behind their research funding. Alongside general scientific development, which is the primary aim behind the Swedish Research Council's support, funding is provided for research for many other purposes, including transport and telecommunications, energy supply, environment and nature conservation, health and healthcare, education, social care and agriculture. The many funding bodies, with their different aims, could lead to undesirable and unintentional gaps and/or overlaps in the funding of different research fields and research environments.

The Swedish Research Council interacts closely and extensively with the research community as regards both the scientific assessment of applications and the analysis of research fields. An example of how this is utilised in the collaboration with other research funding bodies is the collaboration with the Swedish Energy Agency concerning calls for proposals for research funding for basic energy research, where the Swedish Research Council carries out the scientific quality assessment. Another example can be taken from the field of development research. In 2013, responsibility for support for Swedish research of relevance to low income countries and lower middle income countries (development research) was transferred from Sida to the Swedish Research Council. The motive was to provide a better basis on which to integrate development research in other research fields. The Swedish Research Council believes that assessment criteria, quality assessment and a close collaboration with Sida and its research support, have all been developed further since the responsibility was reassigned. Such collaboration can also be developed with other research funding bodies. Within many fields, the coordination and interaction between bodies is less well developed. Examples include the fact that both Forte and the Swedish Research Council have a responsibility for care research, and that clinical research is split between the universities and county councils and funded by a large number of stakeholders.

The role of research funding bodies – recommendation

Reduce the overlaps and gaps in assignments and research funding

The government should:

- review the current research council structure with regard to the extent of overlaps and gaps with the aim of introducing a more effective system for research funding.

The research councils should:

- strive to bring about increased collaboration and coordination concerning research funding with the aim of avoiding overlaps and gaps in the funding and with the aim of making it easier for researchers.

In order to also improve the coordination between stakeholders other than the state research councils, the Swedish Research Council considers that it is important to expand the coordination with other major national research funding bodies, e.g. within the framework of the above-mentioned research programmes (see the section on targeted initiatives), and to pursue a dialogue concerning the funding of researchers in different career age segments.

Argumentation

The research can be boosted through the availability of more alternative funding bodies to turn to. However, many funding bodies operate within adjacent fields without any clear delegation of roles or coordination, which is leading to both overlaps and gaps in the support for fields of research and researchers in different career age segments. In a system where external grants are higher than direct government funding for research paid to universities and university colleges, demanding requirements are imposed on cooperation between the external funding bodies in order for the research funding to be effective. Otherwise, there is a risk of excessive adaptation towards what is viable for the funding bodies and of research being characterised by a short-term approach, uncertain findings and an inflated administrative burden.

The Swedish Research Council considers that the responsibility for coordination primarily lies with the research funding bodies themselves. However, the government should commission a study with the aim of assessing the scope of overlaps and gaps between the focuses and areas of responsibility of the four state research councils. The national research programmes proposed above can help the various research funding bodies to work together within key areas.

Collaboration and breakthrough outside academia

Goal: Research findings are applied effectively to bring about societal, economic, cultural and environmental improvements.

Research has a major impact on the development of industry and society. This applies both globally and nationally. The ability to apply new knowledge in innovations and solutions to overcome societal challenges is a key issue for Sweden. The process for handling this is called ‘collaboration’. The results of the collaboration process encompass breakthroughs and improvements outside academia, e.g. within economics, society and social services, culture, health and welfare, quality of life, etc.

There is a strong tradition of collaboration amongst the Swedish universities, but this collaboration has primarily taken place on the initiative of individuals, groups and research environments, while the managements of the universities have played a more passive role. The strength in this tradition is precisely that the initiative originates from below, with the result that the collaboration is driven forward by personal engagement between the collaborating parties. Yet this is also a weakness: good opportunities for collaboration can remain unutilised in the absence of personal engagement. That is why resources must be allocated in order

to integrate the collaboration in the research process in a much clearer way. The universities must then adopt a strategic approach.

It is absolutely vital that integration of the collaboration does not lead to the impoverishment of the depth or quality of the research task. In many cases, the integration can take place through the allocation of resources with a focus on collaboration as a supplement to basic research resources.

Studies, such as that by Benner and Sörlin (Benner and Sörlin 2015), indicate a link between scientific excellence and research breakthroughs outside academia, which suggests a mutual win-win situation when collaboration is integrated with other activity in leading research environments.

In this context, it is important to note the very long-term effect that leading research environments have as regards collaboration with society in general. The close links that research environments have with higher education entail future collaboration via many students who will work for Swedish companies and within the Swedish public administration. These students will contribute critical analysis and research-initiated renewal.

Collaboration and breakthrough outside academia – recommendation

A national evaluation of breakthroughs outside academia needs to be introduced at Swedish universities as part of the evaluation model for research quality proposed by the Swedish Research Council.
Breakthroughs of research findings outside academia must influence the allocation of direct government funding for research. The Swedish Research Council has recently proposed a model for evaluation which also includes breakthroughs outside academia (Swedish Research Council 2014e). The proposal also encompasses a pilot study where such an evaluation is carried out. The findings of this pilot study, together with experiences gained through Vinnova's call for proposals for funding in order to promote collaboration, should be followed up before breakthroughs outside academia are evaluated in full. International experiences and experience gained through evaluations at individual universities should also influence the design of the evaluation model.

Argumentation

The major challenge in measuring and evaluating breakthroughs outside academia is the considerable time span between a research idea showing potential and the breakthrough outside academia actually occurring. The process which leads to the breakthrough is often also difficult and anything but a fixed sequence of events from basic research to application and innovation. An assessment should therefore be carried out to determine whether, and if so how, the collaboration process can be included in the national evaluation model.

International collaboration

Goal: Swedish researchers are encouraged to take part in and are supported in international collaborations which help to improve the scientific quality of Swedish research.

Successful international research collaboration almost always has its origins in common research interests, rather than the countries which the researchers come from. Within most research fields, international collaboration represents a natural and integrated part of the activity. However, the opportunities for joint funding play a major role as regards specific collaborative projects. The funding opportunities vary considerably, depending on the countries involved in the collaboration, which of course is influenced by the choice of collaboration partners. In this description, international collaboration involving Swedish researchers is split into three different levels: Nordic, European and global.

Research collaboration at Nordic level

Nordic collaboration relating to research and innovation has a long tradition and is an important aspect of the international research collaboration in areas where the research being conducted by the Nordic countries

complements each other and generates added value and synergies. The Nordic countries are successful research countries and have a geographic and cultural proximity which makes collaboration natural. There are also excellent prerequisites for driving policyrelated issues where there is often a consensus concerning the research's structure and preconditions, the ERA development (see below) and the distribution of infrastructure costs.

The involvement of the Swedish Research Council in Nordic collaboration primarily takes place through participation in the NOS organisations[4] and Nordforsk. Among other things, it is a question of funding common research programmes and collaboration concerning research infrastructure at policy level and concerning individual research infrastructures.

The Swedish Research Council considers that the objective for the Nordic collaboration should focus strongly on collaboration concerning policy issues in order to strengthen shared interests in European and global research policy. In this regard, in addition to collaboration within the frameworks of NOS and Nordforsk, bodies such as Nordhorcs[5] can also play a key role in identifying policies and strategies from the Nordic countries' research councils. It is important that joint Nordic initiatives are firmly anchored in the individual countries; only then will these initiatives contribute both to the research being conducted in the individual countries and to the common Nordic research landscape.

Research collaborations at European level

There is political agreement amongst the Member States that the European Research Area (ERA) should be realised. The ERA is based on the active participation and desire of Member States to coordinate both research strategies and research funding through streamlining and harmonising their research systems. A roadmap with strategic objectives has been drawn up at European level. Now that this has been prepared, the Member States are expected to start implementing the measures though appropriate strategies and action plans at the 2016 yearend. The Swedish Research Council considers that Sweden should take a leading role in this process.

In accordance with the government's objectives for the international participation, the Swedish Research Council wants Swedish researchers to continue to play an important part in, and to contribute substantial resources to, European research collaboration. In the EU-funded Seventh Framework Programme, Sweden was amongst the ten most successful countries and was awarded SEK 1.7 billion, approximately 4 percent of the funding distributed by the Framework Programme. However, the award percentage fell somewhat towards the end of the programme period (Vinnova 2015).

The European Research Council (ERC) supports researcher-initiated research of the highest scientific quality. In this regard, Swedish researchers have been less successful compared with more immediately applicable initiatives within the EU's Framework Programme. This particularly applies to female researchers: female Swedish researchers were awarded 21 percent of the total of 185 Swedish ERC grants awarded. This proportion is less than the overall rate for the ERC (28 percent) and lower than for countries such as Great Britain, Germany, France, the Netherlands, Denmark and Finland. Swedish researchers are also under-represented within the social sciences and humanities.

Societal challenges have had a major impact in Horizon 2020 and as regards the Member States' joint programming planning in the so-called Joint Programming Initiatives (JPI). The Swedish Research Council was very active in the process which led to the Lund Declaration (Lund Declaration, 2009), which resulted in the realignment of European research towards major societal challenges. Lund Revisited will be arranged in December 2015 to follow up the Lund Declaration. The new declaration is based around the previous one, and will result in joint decisions and a shared vision of how challenge-driven research should be shaped and formulated in the future. The Swedish Research Council believes that the new declaration should be based on a broader vision concerning global societal challenges and refers to it as "global challenge relevant research"

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[4] Collaborative bodies for the Nordic scientific councils: NOS-HS, NOS-M and NOS-N

[5] Nordic Heads of Research Councils

instead. Challenge-relevant research encompasses both challenge-driven research and excellent research, infrastructure and innovation. Together with the global perspective, challenge-relevant research provides scope for new ways of thinking and collaboration across borders. It is also an effective way of capturing ideas and results from basic research.

In this large-scale, pluralistic and integrated research collaboration, which also includes collaboration with other stakeholders in society, a shared vision concerning a number of structural prerequisites and standards is essential. This applies for example to:

- Research integrity to safeguard the quality of research through a shared vision of processes for peer review, advanced result indicators, etc. This will curb cheating and misconduct in research and ensure independence in research.
- Alignment between the EU Member States' research systems. This will entail both Member States and the European Commission ensuring that the research system interacts and is compatible with common research priorities. The aim is to make the utilisation of the Member States' research investments more effective. An example of alignment is shared research agendas for tackling societal challenges and the avoidance of bureaucratic and regulatory thresholds for projects and collaborations.
- A shared vision concerning the availability and utilisation of the research. This is partly a question of open access to findings, the dissemination of findings in the interaction between research, society and trade and industry, and of eliminating legal and political obstacles, e.g. for intellectual property rights and innovation.

The European Commission's further development of the ERA, which entails greater coordination of the Member States' national programmes, priorities and activities, directly relates to the last two points above (Moedas 2015). Sweden is already heavily involved in JPI. The Swedish Research Council leads and coordinates the JPIAMR (Joint Programme Initiative on Antimicrobial Resistance) and Sweden participates through the Swedish Research Council and other Swedish research funding bodies in nine out of ten JPIs. The instrument JPI is of great importance to the coordination of research and resources at global level. It has been aligned with the prerequisites of the various societal challenges and is carried out in flexible forms. The Swedish Research Council considers JPI to be a successful concept and, for Sweden, it should be possible to link it in an excellent way to one or more of the ten-year research programmes proposed under the section entitled "Targeted initiatives".

Sweden participates extensively in partnership programmes such as ERA-NET, Articles 185 and 187. This participation helps to improve the coordination of national and European research and enables Sweden to exert an influence on the European research agenda and the formulation of programmes and initiatives to the benefit of Swedish research. The research-funding agencies coordinate the participation through the EU Coordination Group (EU-Sam), which Vinnova hosts. this work and the strengthening of the funding of partnership programmes has been very successful and EU-Sam should be asked to continue its work. The ERAPolicy Committee, whose aim is to "monitor and analyse developments in the European research area ERA", will have a key role to play in the continuing ERA work and Sweden's involvement in this regard is of great importance.

Research collaboration at global and bilateral level

International collaboration at global level primarily takes place through bilateral agreements. Sweden currently has research agreements with India, Japan, Canada, China, Mexico, Singapore, South Africa, South Korea and USA. The Swedish Research Council also has separate agreements with organisations in Brazil, India, China, Russia, South Korea and USA. Within the framework of the collaboration with ESS, the Swedish Research Council also has agreements with organisations in Italy, France, Germany, Great Britain and Denmark.

The Swedish Research Council considers that bilateral agreements are only justified with countries where such agreements are essential in order to establish a research collaboration. In cases where this is necessary, the agency endeavours to establish thematic/subject-related collaborations which are as broad as possible. It is important that agreements concerning bilateral collaboration are strictly preceded by an analysis of the value for the research in Sweden.

In the introduction to the section, it was emphasised that international research collaborations are above all researcher-initiated and that it represents a natural and integrated aspect of the activity within most research fields. The Swedish Research Council's support for development research particularly promotes research collaborations with researchers from low income countries and lower middle income countries. Development research strongly contributes to the development of Swedish research which has global relevance.

International collaboration – recommendation

Develop a national strategy for international research collaboration

The research-funding bodies should be tasked with developing a cohesive strategy for international research collaboration at global, European and Nordic levels in order to facilitate better coordination and prioritisation of Swedish initiatives. The Swedish Research Council should be tasked with coordinating the work to develop the strategy.

Argumentation

At a global level, research is increasingly being accorded greater weight in order to solve society's problems and act as a driving force in the social economy. The competition for knowledge and resources is becoming increasingly tough, and this is changing the preconditions for research goals, funding and conditions. In the altered research landscape, the future orientation of Swedish research is important, and a strong international profile is a decisive variable. Publications from international collaborations are generally of better quality than their national equivalents and achieve greater impact. Participation in international collaborations and contexts gives valuable networks and increases the scope to influence the direction and budgets of international research programmes such as the EU's Horizon 2020. Continually drawing comparisons with international counterparts exposes strengths and weaknesses and leads to an active process aimed at bringing about improvements. In this regard, there are opportunities which it is critical to exploit in order to be amongst the world elite as a research country. Sweden has been a successful country internationally, but there are currently signs that the country's position is currently not as strong as it has been. A strategy for Swedish research collaboration should coordinate and clarify the work of the various Swedish stakeholders with respect to a series of pivotal objectives, such as increasing Swedish participation in international research projects, increasing Swedish influence over the EU's research agenda, increasing the proportion of the EU's research budget which is allocated to Swedish researchers and generally developing capacity and competence to exploit the opportunities to generate added value for Swedish researchers which arise at international level.

The state research funding bodies already collaborate in many fields as regards international collaboration. This collaboration is to some extent fragmented and the initiatives still overlap in some areas. In order to strengthen Sweden's position as a strong research country, the research funding bodies should play a more active role in the debate concerning international research policy. They should develop a shared vision as regards role delegation and measures, e.g. in order to drive forward the development of standards and conditions in a cohesive Sweden perspective, based on Swedish core values concerning internationalization as a quality-driving factor in research.

A cohesive Swedish strategy for international collaboration should be formulated at Nordic, European and global levels in order to increase the effectiveness of Sweden's international engagement and in interactions with other countries and organisations.

Gender equality

Goal: A gender equal research system

The proportion of women amongst recent PhD graduates and within various job categories in Swedish universities has gradually increased in recent decades and is now approaching 50 percent on average for all academic fields. The exception is the highest rung on the career ladder, the professor category, where 24

percent are women. The proportion of women amongst professors is rising only slowly and is actually appearing to level off. A number of longitudinal studies show that women find it more difficult to progress to the highest positions within academia. In the group which defended their PhD thesis in 1991, eight percent of the men, but only four percent of women, were appointed as professors within the following twelve-year period. The trend for men to become professors more frequently applies to most fields of research, and women also take longer than men to progress up the career ladder (Swedish Research Council 2015c; Swedish National Agency for Higher Education 2011).

Within the humanities and social sciences, there is a more even gender distribution compared with other research fields, except amongst professors. The natural and engineering sciences have consistently had a skewed gender distribution, with women in a minority in all career stages, with a somewhat more even gender distribution within natural sciences. However, the proportion of women amongst lecturers within engineering sciences also increased by ten percentage points during the ten-year period 2003-2013. Within medicine and health, the proportion of women rose sharply within all career stages over the same period of time. Except in the case of professors, women are in the majority. For example, women account for approximately 60 percent of recently appointed lecturers within medicine and health (Swedish Higher Education Authority 2013). Overall, the proportion of women amongst lecturers is almost 50 percent. It is reasonable to expect this trend to also lead to a more even gender distribution amongst professors over time.

Studies have been conducted which show that women have been disadvantaged by initiatives targeting centres of excellence and excellent researchers. Women have received a considerably lower proportion of this funding (19 percent) than would correspond to their proportion of professors (24 percent) or their proportion of Swedish researchers who have the highest number of citations (30 percent), (Sandström and Wold 2015).

In order to accelerate progress towards gender equality in higher education institutions, the Swedish Research Council wishes to put forward two recommendations. These are primarily aimed at the government, but also have a bearing on the universities, the Swedish Research Council and other research funding bodies. The Swedish Research Council wishes to stress that efforts to promote gender equality are also likely to promote equality and diversity within the higher education system.

Gender equality – recommendation 1

The government should give all universities and university colleges a clearer task as regards recruitment targets, the follow-up of gender equality and gender equality integration.

In addition to the current recruitment targets, each university should be tasked with following up and reporting gender equality broken down between different personnel categories and scientific fields. Special attention should be paid to new recruitments where the universities should be tasked with setting their own recruitment targets. In addition, the male/female distribution amongst temporary appointments should also be reported, along with the distribution between men and women within positions with an emphasis on teaching and research respectively. Consequences of successful or unsuccessful efforts to promote gender equality should be introduced and can be included in the model for the national evaluation of research, as has already been proposed by the Swedish Research Council.

Argumentation

The higher education system is the largest within the state sector, and it is a sector of considerable, and growing, importance for society as regards education, research and collaboration. Measurable targets from the mandator – the state – together with requirements concerning follow-up and reporting are giving the universities' managements clear incentives to work on gender equality issues. The engagement of the managements is also decisive for the outcome of this work.

Gender equality – recommendation 2

Gender equality must be integrated in all strategic initiatives.
Gender equality must be taken into account both in the selection of research areas for initiatives and in the form of calls for proposals, preparation and followup of approved initiatives.

Argumentation

There is an important and decisive distinction between integration and followup: integration is preventive. By integrating gender equality, it should be possible to minimise the risk of negative effects on gender equality. The Swedish Research Council wishes to emphasise that the purpose of the recommendation is both to promote gender equality and to improve the quality of research conducted within the higher education system. Strategic initiatives of different kinds have often resulted in male researchers being favoured over female researchers. It is therefore vital that gender equality is integrated into every aspect of strategic initiatives as early as the planning stage.

Open access to scientific information

Goal: Scientific information, both publications and research data, are openly available.

The Swedish Research Council has been tasked by the government with drawing up national guidelines for open access to scientific information. In the report (Swedish Research Council 2015j), the Swedish Research Council proposes that Sweden should have a vision according to which all scientific publications and artistic works which are the result of research funded by the public sector from 2025 must be published immediately via open access, i.e. simple access free of charge. Articles must be published in open access periodicals. All scientific publications must have a CC licence[6]. The Swedish Research Council is not simply proposing that the findings of research funded by the public sector be made openly available; the vision prescribes a switch regarding scientific publications from a subscription-based system to open access.

The Swedish Research Council is also proposing that Sweden should have a vision according to which all research data (including associated metadata) which is entirely or partly developed using public sector funding must be made openly available as soon as possible, taking into account legal and technical restrictions which apply to certain types of data. Achieving this goal is a protracted process which imposes requirements on national and international coordination and necessitates substantial investments in infrastructure which facilitates effective acquisition and long-term storage, as well as the making available of research data. In order to drive forward development and motivate all stakeholders into working actively on the issue, the Swedish Research Council is proposing that pilot calls for proposals be carried out during the period through to 2020. In connection with the pilot calls for proposals, it will be a requirement that data which forms the basis for a scientific publication must be made openly available if it is produced within a research project which is either entirely or partly funded by the public sector.

[6] Creative Common licence

Open access – recommendation 1

The government should propose national guidelines in accordance with the Swedish Research Council's proposals.

Argumentation

The Swedish Research Council considers that the single most important initiative for introducing open access to scientific information is a clear stance on the part of the government, both at policy level and in concrete terms in the form of financial support. Such a stance has support in the European Commission's recommendation in 2012 concerning access to and the preservation of scientific information. The European Commission presents a series of arguments as to why open access to scientific information creates better conditions for research – better data quality, reduced need for repetition, faster scientific development and the combating of misconduct – and it is good for society. In addition to research benefits, there is a clear focus on societal benefits: research findings which are developed using public sector funding should be shared by the whole of society (European Commission 2012).

The level of preparedness for implementing national guidelines in Sweden can be described as good with regard to publications. Many Swedish research funding bodies have had rules in place concerning open access publication for many years. Alongside this, the universities have built up infrastructures for handling the requirements, known as repositories, and university libraries have also trained their staff to support open access publication by researchers. Many universities and research institutions now have guidelines within the area or are in the process of drawing up such guidelines. Researchers also have many years of experience of open publication; it is not just Swedish funding bodies who impose requirements, many funding bodies in the international arena also do so.

The SwePub database

Goal: In 2018, it is possible to conduct bibliometric analyses of scientific production at all Swedish universities and university hospitals.

Using bibliometry and other indicators to measure scientific production at national level is pivotal for understanding how competitive Sweden is compared with other countries. However, such analyses are pivotal to understanding how Swedish researchers within different fields of research are contributing to scientific production, how they are collaborating and in which channels they are choosing to publish their scientific findings.

SwePub is a national database for scientific production containing scientific publications from Sweden's universities and university colleges in particular. This aggregated database was established in 2009 to collect and make available metadata concerning research publications from the local publication databases at Swedish universities. Through SwePub, the areas of Swedish research which are poorly represented in the databases Web of Science and Scopus can be studied, in the first instance the research subjects within the humanities and certain areas of the social sciences. The National Library of Swedish has been tasked by the government with further developing SwePub in collaboration with the Swedish Research Council. The aim is to provide the right foundations to enable SwePub to function as an adequate and comprehensive data source for bibliometric analyses and studies of publication patterns at national level. Examples of analyses for which SwePub could be used after further development are publication volumes (e.g. number of publications per year broken down between fields of research), publication patterns (e.g. which periodicals and publishers occur within different fields of research) and collaborations (e.g. between Swedish universities and their respective shares in international collaborations).

A comprehensive national database for measuring scientific production is also a prerequisite for the national evaluation system which is proposed in the report entitled "Research quality in Sweden, FOKUS" (Swedish Research Council 2014e).

SwePub – recommendation

Resources and a clearer remit concerning the management and development of SwePub

The government should give a clearer assignment and resources to the National Library of Sweden to administer the SwePub database. In the assignment, the government should specify how the database is to be managed, preferably through a governing body (steering group) with representation from the National Library of Sweden, the Swedish Research Council and the Association of Swedish Higher Education. The steering group should reach decisions concerning matters such as which guidelines and requirements should apply to the input of data in the local databases at the universities, in addition to the guidelines established by the government.

Universities, university colleges and university hospitals, should be tasked by the government with making available information concerning all scientific publications in their local databases in accordance with the guidelines issued by SwePub's steering group. At the same time, the Swedish Research Council and the National Library of Sweden should also be tasked with establishing, administering and further developing an authority register covering SwePub publication channels. Assignments and resources should be given to the National Library of Sweden to continue the work relating to a suitable interface for the transfer of bibliographic information to Prisma, the research application system which is common to the state research councils.

Argumentation

The National Library of Sweden has been gradually improving the database since 2014 and all Sweden's universities and university colleges except two now submit data to SwePub. However, the quality of data in SwePub is not yet sufficient to enable bibliometric analyses at national level to be conducted.

Participation in SwePub is based on voluntary agreements between the parties involved, which leads to difficulties quality-assuring the content and thereby reduces the opportunities to use SwePub for bibliometry and analysis at national level. If the government wishes to establish a national database for scientific production, a voluntary approach will not be sufficient if the database is to have the coverage and contain data of the quality that is needed for bibliometric analyses at national level. The government should therefore task universities, university colleges and university hospitals with submitting information concerning all scientific publications in SwePub, in accordance with the guidelines issued by SwePub's steering group.

In the Primsa application system, researchers can register their scientific production in the form of publications by importing publication metadata from databases such as SwePub. This data can then be reused in applications for research grants from the research councils. Being able to import and store this data from a national data source such as SwePub would save a lot of time for researchers who are preparing applications and enable the simple linking of publications to the feedback reporting of completed research projects.

National system for handling misconduct in research

Goal: Sweden has a national legal system for handling misconduct in research

A high level of researcher integrity and unconditional observance of good research practice are essential for all research and the application of research. Every year, Sweden invests around SEK 30 billion of taxpayers' money on research at the country's universities. This is a sign that Sweden's government considers research to be important for the country's development and welfare. Swedish citizens have the right to expect research funding to go to researchers who act in accordance with good research practice and who do their utmost to create knowledge which offers society value for money, both as regards social and cultural development and as regards development within technology, medicine and health. This is vital to ensure both that the general public trust the research community and that research contributes to public welfare.

Misconduct – recommendation

A study should be commissioned to propose a national system for handling misconduct.

Argumentation

Research is a cumulative activity which is based on previous research findings. Researchers and users of research findings must be able to be confident that they are standing on firm foundations. If there are deficiencies in these foundations, the prerequisites necessary for progress will be absent. Thus, a decisive factor in ensuring progress is that people have confidence in researchers following good scientific practice and not plagiarising anyone else's, not distorting or embellishing their own results and not lying about results. It must also not be permissible to accuse anyone of cheating without the matter being investigated and the accused being given the opportunity to be exonerated.

Sweden currently has no effective national system for handling misconduct in research. The major deficiencies relate to the considerable degree of local influence in connection with the handling of issues relating to suspected misconduct and the substantial discrepancy between the consequences and other measures which different universities implement when researchers are found guilty of misconduct. Both national and international experience shows that geographic and psychological proximity between the person who raises the alarm over suspicions and the person who carries out the assessment increases the risk of a problem being swept under the mat. It is therefore important that investigations into suspected cheating are lifted above the local level.

The Swedish Research Council has identified the following deficiencies in the current handling of misconduct in research:

1) There is no clear legally workable and generally applicable definition of what "misconduct in research" actually is. The meaning must be clarified and harmonized at national level.
2) The legal certainty associated with assessments of cases of suspected misconduct is deficient. There is no clarity as regards the competences that are needed.
3) The sanction system for confirmed cases of misconduct must be clarified and be consistent nationally. The same "conduct" can currently have different consequences in different parts of the country.
4) There is no support in the existing regulations for the way in which investigations into cases of suspected misconduct should be carried out as regards international collaboration. For example, who should carry out the investigation?
5) Processing times are too long. Long processing times lead to a difficult situation for both the person who reports a case of suspected misconduct and the person who is reported.
6) It is unclear how and when the universities should approach the Central Ethical Review Board for assistance in assessment a misconduct situation.
7) It is unclear who and what can or should be investigated and what the scope of the investigation should be.
8) When a doctoral student is suspected of misconduct, there is uncertainty as to whether the matter should be dealt with as a case of scientific misconduct or considered by a disciplinary board.

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The government has established an overarching goal for Swedish research policy which states that Sweden shall be a leading research country characterised by high-quality research and education. To achieve this goal every aspect of the Swedish research system must be reviewed. In this report, the Swedish Research Council proposes specific goals for the Swedish research system, along with recommendations concerning what needs to be rectified in order to attain these goals. These goals and recommendations are based on research overviews and structural analyses of various aspects of the Swedish research system. The proposals set out in the report are divided into three main sections: research funding, research infrastructure and the research system. The first two of these sections are largely aimed at the Swedish Research council's remit to fund research of the highest scientific quality within all research fields and prepare long-term plans to secure access to research infrastructure for Swedish researchers, while the section on the research system is aimed at structural aspects throughout the system encompassing both research funding bodies and research institutions.

This report was first published in Swedish in September 2015 under the title: "Forskningens framtid! Vägval för framtidens forskningssystem: Målbild och rekommendationer".

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Vetenskapsrådet har en ledande roll för att utveckla svensk forskning av högsta vetenskapliga kvalitet och bidrar därmed till samhällets utveckling. Utöver finansiering av forskning är myndigheten rådgivare till regeringen i forskningsrelaterade frågor och deltar aktivt i debatten för att skapa förståelse för den långsiktiga nyttan av forskningen.