

POLICY
CASE
STUDY

The policy mix for knowledge transfer between science and industry in Norway

Case study contribution to the OECD TIP Knowledge
Transfer and Policies project

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Please cite as:

Borlaug et al. (2019), "The policy mix for knowledge transfer between science and industry in Norway: Case study contribution to the OECD TIP Knowledge Transfer and Policies project".

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Executive Summary

This report presents the findings from a study of the policy mix for knowledge transfer between science and industry in Norway. The mandate for the study was to do a comprehensive mapping of the policy instruments and their interactions, based on a template developed by the OECD. In limiting this rather broad task, this report describes in particular instruments targeting knowledge transfer between higher education institutions (HEI) and industry/public agencies at the level of governance (funding and regulatory instruments), funding agencies and the HEIs themselves. We focus on three formal channels of knowledge transfer: commercialisation of research, collaborative research and mobility.¹ This summary presents the main findings from the mapping of national policy instruments and instruments at five HEIs and the (missing) interactions between them.

Development of the policy mix

Since the beginning of 2000 there has been a focus on commercialisation of research from HEIs in Norway, and several national and local instruments have been launched to support the development of patents, spin-offs and licenses. In addition, there has been increased emphasis on collaborative research between HEIs and the public/private sector, seen in the increase of number of collaborative research programmes and in funding of these activities. Lately, the issue of mobility between sectors have entered the agenda and we see new initiatives nationally and at the institutional level.

In terms of the relative importance of the policy instruments, collaborative research receives the largest public budget allocation as this is the channel which involve many HEI staff and employees in private/public sector. Both commercialisation of research and mobility are also prioritised areas..

Public policy is the key developer of the current composition of the policy mix. Industry supports cluster programmes and commercialisation of research through collaborative projects and bilateral agreement with the individual institutions.

Governance of the policy mix

The HEIs report to the Ministry of Education and Research and are incentivised on education and research through performance-based funding. The Ministry of Trade, Industry and Fisheries funds programmes in the Research Council of Norway (RCN) that supports the commercialisation of research and research projects in industry. This divide in responsibilities between the two Ministries may create barriers for integrating education, research and innovation.

The mapping shows that ministries, intermediary agencies (such as the funding agencies) and HEIs support the commercialisation of research in the different phases. IPR ownership was transferred from the academic staff to the HEIs in 2005 with the aim of enhancing HEIs engagement in commercialisation of research. The largest HEIs have taken

¹These were selected because commercialisation of research was the focus of the other country studies in the project, and collaborative research and mobility are channels characterised by a policy mix, but somewhat less studied – at least in the Norwegian context. Mobility is here understood as instruments that encourage staff to work in both HEI and industry/public agencies.

responsibility and established their own or are owners of technology transfer offices (TTOs) which support the development of spin-offs and assist in applying for funding. This is less developed at the smaller HEIs. However, commercialisation of research is not an activity which the Ministry of Education and Research supports and apart from the IPR ownership there are few incentives from the Ministry to the individual HEIs to support this type of activity. Nevertheless, the development of spin-offs is primarily a public task and the HEI TTOs have relatively good connections with all involved public agencies.

There are several schemes, administrated by intermediary agencies, for collaborative research projects. Participation in these mainly depend upon the initiatives of individual researchers/-groups at HEIs or in firms/public agencies. However, large schemes that run for several years such as cluster and centre programmes seem to impact the largest HEIs in the way that they plan and coordinate the applications in advance of the calls as partnership in these are recognised as important for knowledge transfer.

The later years bilateral collaborative agreements on research and education between individual HEIs and industry/public agencies have become a more widespread instrument for committing and tightening the relations. These may include goals of developing education, collaborative research and mobility. The number and scope of these agreements vary considerably between the studied HEIs, and those with a technical profile seem more prone towards such agreements.

In the field of health and life science, collaboration agreements between medical faculties and hospitals are institutionalised and supported by the Ministry of Health and Care Services. There are however few national policy instruments which support mobility between HEIs and industry/public agencies, and these types of instruments are primarily the responsibility of the individual HEIs.

The Ministry of Education and Research requires that all HEIs shall have a Council for cooperation with working life. The councils operate mainly at the strategic level in the institutions, and there are few concrete outputs of their establishment. An anticipated outcome is however increased awareness and mutual understanding between the institutions and their surroundings.

Current trends

The performance-based funding of HEIs does not incentivise commercialisation of research, collaborative research or mobility between HEIs and industry/public sector. Collaborative research projects granted by the RCN and EU count in the performance-based funding model, but the model does not differentiate between collaborative projects and basic research grants, thus it supports collaborative research indirectly.

In 2016, the Ministry of Education and Research introduced development contracts to stimulate a differentiation in the a individual HEIs' profile. The development contracts may involve targets such as commercialisation of research, collaborative research and mobility. Per se it has not yet been decided whether the development contracts shall include funding. If they do, this will incentivise the HEIs to develop and emphasise different channels of knowledge transfer.

Recently, the Ministry of Trade, Industry and Fisheries called for suggestions for instruments that may incentivise researchers to participate in spin-off creation and licensing of research. A recent report argues that the current practices of IPR ownership at the HEIs should be reconsidered and that a larger share of the ownership should be in the hands of the inventor-. The same Ministry has also just launched a large call for a review of public

agencies and instruments targeting industry development. It will include all programmes funding collaborative research administrated by different intermediary agencies. The aim is to reorganise the system in order to make it more efficient. Results of the review will be presented in 2020.

All three knowledge transfer channels have received increased attention both in white papers and in the development of new instrument and scaling up or renewal of already existing ones. One recent white paper investigated spin-offs access to seed funding and venture capital and stated that the lack of capital represents a severe barrier for potential growth of spin offs. It proposed the establishment of a fund in fund – a combination of public and private investment, which seem to be realised.

HEIs appear to have a growing consciousness around institutionalising relations to important stakeholders. These include, among others, inviting stakeholders to participate in Board of governors and different councils and committees and to agreements on bilateral collaboration.

Impact, synergies and trade-offs

An evaluation showed that the transfer of IPR and the introduction of an act relating to the third mission have contributed to institutionalising the TTOs at the largest universities. Despite national policies and a funding scheme for the development of spin-offs and licenses, the results in terms of economic revenues from commercialisations have not been impressive, but there seem to be a tendency for increased quality in reported projects and in the estimation of future revenues.

Evaluations of programmes administrated by the different intermediary agencies emphasise that the funding enhance the interaction on research and education between HEIs and industry/public agencies, but that it is difficult to trace or to attribute innovations in industry to specific programmes. Individual researchers or -groups are mainly responsible for initiating and participating in research collaboration funded by external agencies. In general, there seem to be less systematic information at the leadership level in HEIs about the extent and content of these collaborations, despite the fact that the HEIs report on collaboration on education and research with industry/public agencies in the steering dialogue with the Ministry of Education and Research. The introduction of development contracts in 2016 may change this as some of the them emphasise the HEI's role in regional and national development, and may as such push the institutions to more systematically engage in and support collaboration on research and education.

Interviews for this study show that some HEIs perceive bilateral collaboration agreements as a significant instrument for knowledge transfer. Mobility schemes where individuals from industry hold an additional position at a HEI are also characterised as a success in terms of getting access to highly relevant research problems. The academic merit system may, however, represent a barrier for recruiting individuals from industry or public sector to such positions – at least at HEIs which require a PhD or equivalent.

Introduction

This report presents the findings from a study of the policy mix for knowledge transfer between science and industry. The study was commissioned by the Norwegian Ministry of Education and Research and is part of an OECD-project organised by the Working Group on Innovation and Technology Policy (TIP). The aim of the project is to “investigate which policies are supportive for knowledge transfer between science and industry and how public policy contributes to innovation”.

Both higher education institutions (HEIs) and research institutes have central - but distinctive - roles in the Norwegian R&D&I system. Therefore, we have chosen to focus on policies and instruments primarily targeting formal channels of knowledge transfer from HEIs and exclude the relatively large and broad research institute sector from the analysis, as the institutes are set-up for knowledge transfer purposes.

Furthermore, we have broadened the scope, from a focus on spin-offs in the OECD project to analysing three main channels of knowledge transfer: (1) Commercialisation (spin-offs, licences); (2) Collaborative research; and (3) Mobility.

The rationale for doing so is that the development of spin-offs have already received considerable attention in the Norwegian system and several evaluations of the policy mix have been conducted. Collaborative research and mobility between sectors are more central channels of knowledge transfer for some HEIs, especially those with limited research in sciences and life sciences. To include different HEIs in the study and to see the different channels in relation to one another, we decided to also include collaborative research and mobility. .

The OECD template calls for analysis of the interactions between the national and regional level. Currently the regional level in terms of instruments for knowledge transfer has a minor importance in Norway. We have therefore chosen to include five Norwegian universities with somewhat different profiles to find out how they interact with national policies.

For each of the three knowledge transfer channels we describe developments in national policies and instruments and the current situation at five HEIs. We build upon previous evaluations and reports to map the instruments on the national level, the HEIs' reports to the Ministry of Education and Research on their cooperation with society, and interviews with selected informants at the five HEIs to get their perceptions of the different local and national instruments and the relations between them. In the interviews we emphasised in particular mobility schemes as this is a somewhat under investigated area.

We do not assess the *impact* of policy instruments or the policy mix on knowledge transfer as this is a rather complex task, but rather indicate, when appropriate, the potential effects based on previous evaluations of the instruments. We have also excluded instruments targeting student entrepreneurship at HEIs as this is somewhat outside the scope of the project and would have added considerable length to the report. That being said, it is important to bear in mind that education of students is the main channel of knowledge transfer between HEIs and industry/public agencies.

The report is structured as follows; first, we present the mapping of the national policy instruments for the three knowledge transfer channels. We have divided the mapping into funding of HEIs, laws and regulation and programmes and instruments administrated by

intermediary agencies. We end each section by describing current trends. . The second chapter concerns the five HEIs and their instruments for enhancing the three knowledge transfer channels. We end the chapter with a discussion of the three knowledge transfer channels.

Box 1. Characteristics of the Norwegian R&D&I system

Patterns of STI-knowledge transfer are by nature dependent on the structure of the system within which the transfers take place. In this chapter, we therefore give a brief overview of main characteristics of the Norwegian research and innovation system, with particular emphasis on the higher education sector.

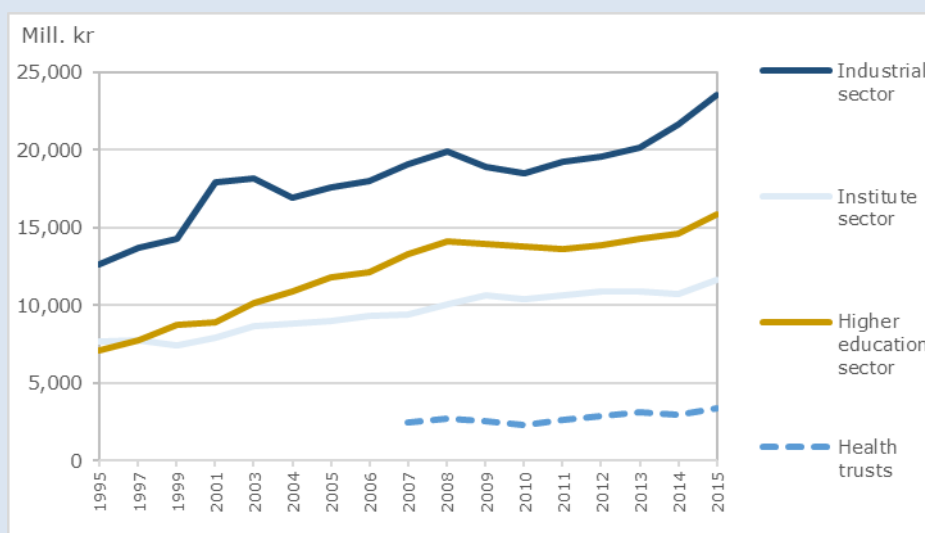
Main structure and division of labour

The Norwegian Research and innovation system (RDI) consists of relatively young institutions. However, since the second world war, and in particular during the last decades, Norway has been eager to adopt best practice from other countries. In some areas Norway has also been an early mover and a pioneer, for instance in terms of merging of sectoral research councils and in introducing performance-based funding systems.

An important aspect is the relatively low share of R&D funding in the business enterprise sector. This sector stands for less than 50 per cent of total R&D funding, compared to around 70 per cent in many other Nordic and European countries. This is mainly due to an industry structure where a large share of value creation is concentrated in resource-based sectors such as oil and gas and aquaculture, where added value is high with and R&D intensity more modest. The figure below shows the development in R&D-expenditure over time and by sector.

Figure 1. Total R&D expenditure in Norway by sector of performance

1995-2015, at constant 2010 prices



Source: NIFU/Statistics Norway-R&D statistics

The figure also displays the strong role of research institutes, accounting today for around 20 per cent of total R&D. Even though the relative importance of this sector has decreased since the mid-1990s, a certain division of labour prevails, which means that the role and intensity of universities in science-industry transfer should be seen in connection with the role assigned to research institutes. Furthermore, within health and medicine, the Health trusts plays a significant and increasingly important role. This “sector” consists mainly of university hospitals that are partly interwoven with the higher education sector. All together, this means that industry-science linkages in Norway involves a more complex set of actors than the university-industry relation we focus on in this report.

Another aspect to consider is the strong and steady growth of R&D in the HEI sector. This is mainly due to a strong increase in the number of students, including doctoral students and a correspondingly high growth in resources allocated to both R&D and higher education. As most HEI-funding in Norway (90%) comes from public sources, of which the most part is basic funding, there is reason to say that Norwegian HEI-institutions are rather generously funded (see Wendt, Söder and Lehpalahti (2015) for a Nordic comparison). This is also the observation from OECD in its most recent report on the Norwegian innovation system (OECD, 2017).

The structure within the HEI-system has also undergone significant changes recently. Until around 2010 Norway had a system with a handful of large universities and a rich flora of nearly 30 university colleges. Following an extensive and (in principle) voluntary merger process from 2013, the Norwegian HEI-system today consists of 10 universities and only a few specialised university colleges. This also has a bearing on systems for knowledge transfer, as this now largely happens within larger and more complex institutions.

Part I. Mapping the national policies and instruments

In this chapter, we map the national policy instruments for commercialisation of research, collaborative research and mobility.

1. Commercialisation of research

National policies and instruments for supporting commercialisation of research from HEIs are mainly found in laws and regulations and in programmes administered by intermediary agencies. It is the Ministry of Trade, Industry and Fisheries that has the main responsibility for commercialisation of research results.

1.1. Funding of HEIs

Funding of Higher education institutions in Norway is almost exclusively a central state matter. In total, the public funds 90 per cent of Norwegian HEIs' R&D expenditure. This includes general university grants (GU) allocated from the state budget, which in total make up 75-80 per cent of the HEIs' funding and covers expenses related to e.g. administration, education and research. The GU have two components: basic funding in the form of long-term and strategic funds, and performance-based funding. The model includes teaching and research, but not commercialisation of research. The HEIs report number of spin-offs and licence agreements to the Ministry of Education and Research, which has the responsibility for the HEIs. They are, however, not incentivised for these activities as they are for teaching and research. This has been up for discussion several times, but the conclusion has always been that including commercialisation as a part of the performance-based funding model will favour some institutions over others and will as such be unfair as many of the HEIs have a relatively low level of activity because of their research profile.

1.2. Laws and regulations

Like many other countries, Norway emulated the Bayh-Dole Act in the US, which one perceived as a successful policy tool to enhance technology transfer from the universities. In 2003 two amendments were made to the:

- Law on universities and university colleges
- Regulations on intellectual property rights

The first amendment ensured the "Third mission" of HEIs by stating that they have the responsibility for disseminating results from research, and for ensuring that research results are commercialised or used.² The second amendment transferred the intellectual property rights from the academic staff to the HEI.

The HEIs have to various degrees followed up the amendments. An evaluation of the amendments from 2015, showed that the larger universities established their own technology transfer offices (TTO) or had part-ownership in TTOs serving several public

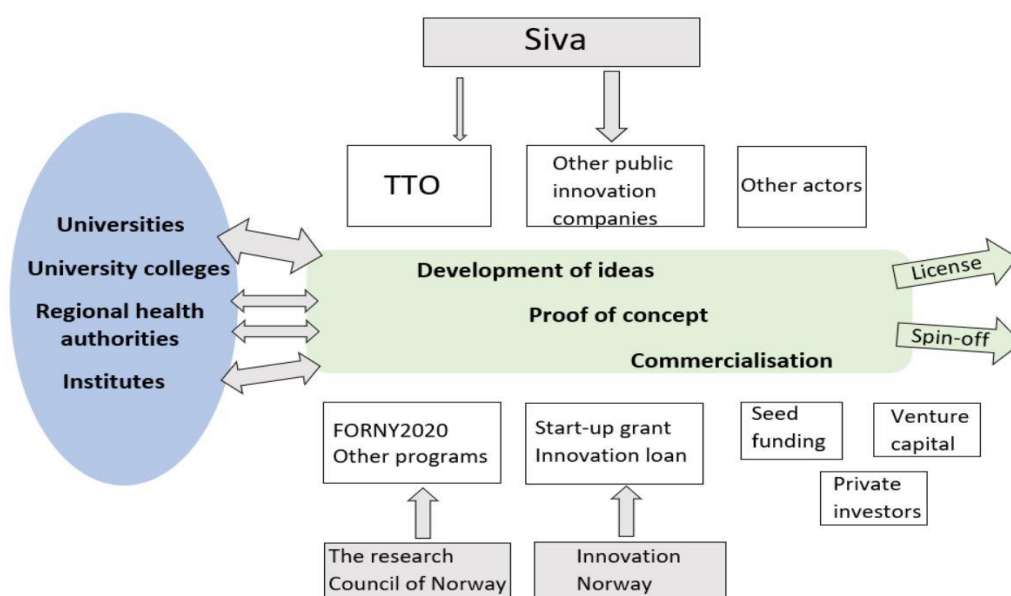
²See https://lovdata.no/dokument/NL/lov/2005-04-01-15#KAPITTEL_1-1; Paragraph 1-3, d),e)

research institutions, while the smaller university colleges commercialised their research through other channels - like collaboration projects with industry (Spilling et al. 2015). One of the conclusions from the evaluation was that the TTO function at the five largest universities are well established, but in order to institutionalise the function and the practices, the evaluation recommended that the universities should integrate the TTOs more into their core structures and use the TTO's competencies on other areas as well - such as negotiating research collaboration contacts. It suggested also that the TTOs should serve the whole university – not only the academic staff, but also the students.

1.3. Programmes and instrument administrated by intermediary agencies

There are several public instruments for supporting commercialisation of research. Here we will describe the most important public intermediary agencies. Their role in the system is illustrated in Figure 2.

Figure 2. The system for commercialisation of research Source



Source: Hansen and Borlaug (2008)

1.3.1. The Research Council of Norway

Unlike research funding agencies in many other countries, the Research Council of Norway (RCN) covers all disciplines and research-performing sectors, and also provides support for industrial R&D and research-based innovation. It administrated several programmes important for developments of spin-offs.

1.3.2. FORNY2020

The Research Council of Norway administrates the FORNY2020 programme which is the main instrument for supporting commercialisation of research. It got a central role after the amendments and the majority of the spin-offs developed by the TTOs have received funding from the FORNY2020. Most of the TTOs' activities are registered by the programme as it is one of the main funders of the early-phase of technology transfer. FORNY2020 was established in 1995 and has since after the amendments in 2004 experienced a strong growth in grants from the Ministry – from ca 40 MNOK in 2004 to 258 MNOK in 2017.³ 2016 and 2017 were extraordinary budget years as the Ministry of Trade, Industry and Fisheries increased its allocation substantially as part of the so-called “Entrepreneurship- plan”. We will return to this below under 2.1.4.

The FORNY2020 is designed to trigger the value-creating potential of projects conducted at publicly-funded research institutions. Through the TTOs, it provides funding to the development of spin-offs and patent applications at HEIs. The programme funds the following activities:⁴

- proof-of-concept and documentation that the research results can be put into practice;
- preparation of research results from publicly-funded institutions for commercialisation;
- development of research results with commercial potential into attractive investment objects
- development of ideas from students (from 2016).

The programme and its results have been evaluated several times. In general, the evaluations have been rather critical towards the results of the programme, arguing that a large amount of money have been used to support the development of projects, but resulting in few success histories (Borlaug et al. 2009; Rasmussen et al. 2013; Spilling et al. 2015). For instance, Rasmussen et al. (2013) found that approximately 20 percent of the 474 spin-off companies in the portfolio from 1995 until 2013 had a positive result in terms of growth or being bought by other companies. The majority of these spin-offs were established between 1995 and 2005, which illustrates that the way to the market is long. Furthermore, ca 26 percent were closed down or developments unknown and 29 percent were just registered or sleeping without any activity. The remaining 25 percent of the spin-offs were active and had significant activity in terms of operating costs, but mostly negative - often common for these types of companies. However, while the evaluations are relatively critical, they are also optimistic about future developments and revenues as they acknowledge that the support system for technology transfer has improved, but the system still lacks capital to invest in university spin-offs. We will return to this below.

³The allocations have decreased the two past years. Due to the financial crises the Ministry increased the allocations temporarily to 258 MNNOK in 2017

⁴Taken from RCNs homepage see: https://www.forskningsradet.no/prognett-FORNY2020/Programme_description/1253963921859

Table 1 shows the development in number DOFIs (Disclosure of invention), patent applications, license agreements and spin-offs reported by the TTOs.

Table 1. Development of DOFIs, patent applications, licence agreements and spin-offs

Activity	2008	2009	2010	2011	2012	2013	2014	2015	2016
DOFI	388	623	596	561	684	817	576	902	719
Patent applications			120	135	179	119	190	183	197
License agreements	21	26	27	36	53	54	62	123	124
Spin-offs	27	28	56	50	42	39	42	55	34

Source: Menon 2018

As the table shows, the number of DOFIs, patent applications and license agreements have increased over the years, while the number of spin-offs seem to be relative stable. Especially the two last years there has been a substantial increase in the number of license agreements and in general it seems to be a trend to focus on licences rather than spin-offs as the latter is perceived as relatively resource demanding in terms of time and finding a devoted entrepreneur.

In terms of sectors, we see that 60 percent of the commercialisation projects are within ICT (29%) and medical technology/pharmacy/diagnostics (29%), 14 percent within offshore/petroleum, 8 percent within marine/aquaculture, 4 percent within material technology and the remaining 16 percent in “the other” category.

The FORNY programme has been criticised for low flexibility. Calls for proof-of-concept funding was previously only once a year – now twice, but still this is considered by the TTO as too little as many projects demand funding that may be devoted rather fast in order to keep the enthusiasm and engagement of the researcher. For instance, if a researcher reports a DOFI immediately after the deadline for applications, the researcher may have moved on to other projects or even changed job in the meantime. However, measures have been taken by both the RCN and individual HEIs. Based on competition between the TTOs, RCN allocates so-called local project funding dedicated to early proof-of- concept to the TTOs, and some HEIs have established their own preliminary proof-of-concept funding for which both researchers and students may apply (Spilling et al. 2015).

In the same evaluation, the programme was criticised for targeting scientific staff only, omitting students whom often are willing and have the possibilities to become entrepreneurs and take risks. In 2016, the FORNY programme introduced the instrument STUD-ENT, targeting master students at HEIs. The students need the support of their HEIs and may get max1 MNOK (ca 100 000 €) a year based on a national competition. In 2018, 25 per cent of the applicants got funds.

1.3.3. Other research grants

The spin-offs that have received support from the FORNY, usually also receive funding from other public sources, such as other programmes administrated by the RCN. In the period 2005-2014 was 168 FORNY-spin-offs partner or head of project in 487 research projects funded by RCN. In sum, the projects have received 2.3 billion NOK, which is a considerable sum. Note, however, that the projects often have several partners and run for several years (Spilling et al. 2015).

Furthermore, the RCN administrates some large-scale programmes, like BIOTEK2021, which in addition to funding research also has so-called “optimisation funds” (per se the only programme, but the aim is to include this type of funding in other programmes as well). The first call came in 2012 and the purpose of the funding is to support research and development of biotechnology products, processes and services that have commercial potential, and where there is a need to develop and conceptualise the technology in order to adapt it to commercial use. During 2013–2016, around 50 optimisation projects received funding with approximately 290m NOK (Technopolis 2017).

1.3.4. The SkatteFUNN R&D tax incentive scheme

SkatteFUNN is also administrated by the RCN. It was established in 2002 and is designed to stimulate R&D in Norwegian trade and industry. Businesses and enterprises that are subject to taxation in Norway are eligible to apply for tax relief. Approved projects may receive a tax reduction of up to 20 per cent of the eligible costs related to R&D activity.⁵

Since 2002, the scheme has grown considerably and in 2016 7000 projects were given tax relief of approximately 5 billion NOK. In the period 2005–2014, 65 per cent of the FORNY spin-offs got a tax relief which together amounts to 1.1 billion NOK.

An analysis from Statistics Norway (2016) showed that SkatteFUNN has an effect: in general, for all granted firms the value creation increased with 1,8 million NOK and contributed to two new jobs per 1 million NOK in tax relief. For spin-offs, the value creation is somewhat lower – 800 000 NOK per 1 million in tax relief.⁶ A second evaluation in 2018 was also rather positive and concluded that the scheme contributes to increase firms’ investment in R&D which gives more innovation and productivity.⁷

1.3.5. Innovation Norway

The FORNY-spin-offs also capitalise on programmes administrated by other intermediary agencies. Innovation Norway, owned by the Ministry of Trade, Industry and Fisheries, administrates several programmes, which support the early phases of the commercialisation process. The main sources are “start-up grants”, “innovation contracts”, “innovation loan”, “commercialisation grant” and “environmental technology grant”. Nearly all FORNY spin-offs have start-up grants and two third have innovation contracts, which is the largest funding source. In the period 2005–2014, 218 MNOK was distributed through innovation contracts, which is about half of all funding to the spin-offs from Innovation Norway (Spilling et al 2015).

1.3.6. SIVA- the company for industrial growth

The FORNY spin-offs also use facilities that are supported by the public enterprise SIVA, also owned by the Ministry of Trade, Industry and Fisheries. The support is more indirect since SIVA supports incubators where spin-offs are given office-space and access to professional mentors, investors and business developers. They also support spin-offs

⁵For further information see:

https://www.forskningsradet.no/prognettbiotek2021/Sentrale_dokumenter/1253970728198

⁶<https://www.ssb.no/virksomheter-foretak-og-regnskap/artikler-og-publikasjoner/stor-okning-i-bruk-av-skattefunn-ordningen>

⁷Samfunnsøkonomisk analyse (2018) Evaluation of SkatteFUNN. Report 18-2018.

through investments funds, which are administrated by the incubators. We will return to this below in xxx where we describe the local systems for supporting spin-offs.

1.3.7. Public seed capital funding

One recurrent critic of the system has been the lack of seed-capital - both private and public. As shown above substantial financial resources are invested in the development of spin-offs, but these are not sufficient to cover the years of capital-intensive development before any commercial income can be expected, which is typical for university spin-offs. In Norway, there has been three generations of public seed capital funds in the period 1997-2015 (NoU 2018). The goal of a seed capital fund, as for other investment funds, is that the company after a certain period can be sold with profit.⁸ A revision of the first generation of funds showed that they did not manage to invest in and develop viable companies, and the state had a considerable loss on these funds. These were four regional funds and they were wound up in 2013. Note, however, that the funds were new and thus the expertise and competence to manage them relatively marginal.

In 2006 the next generation of funds were established. One part aimed at knowledge intensive companies in districts characterised by low business intensity. The other part covered the whole country, but different sectors; i.e. ICT, oil/gas, renewable energy, materials- and process technology, biotechnology/pharma and marine technology. Innovation Norway administrated the practical issues and the funds were owned by the Ministry of Trade, industry and Fisheries.

In 2012 the third generation was established, and like the second generation these covered the whole country and specialised in specific sectors. The critic – referred to above- has been that the funds may be characterised as risk averse as they invest in companies that are mature. One reason for this has been that the Ministry primarily have monitored the activity through financial reports disregarding other types of developments and potential impacts.⁹

1.3.8. Public venture capital funds

In addition to these, there are two large public venture capital funds - Argentum and Investinor. The first invests in the private equity market, and the latter, fully owned by the state, invests directly in companies and some of these are so-called FORNY companies. Investinor has today total assets amounting to 4.2 billion.

1.4. Current trends

Recently, the Government and different commissions have emphasised the importance of commercialisations of research results for economic growth and development. In 2015 the Government launched an entrepreneurship plan which stated that it is a need for strengthening the entrepreneurship culture at HEIs. The goal was to increase the economic revenues and value creation from publicly financed research by stimulating HEI researchers to commercialise their research.¹⁰ With the plan followed increased funding to

⁸Kapitalutvalget (NOU2018:5)

<https://www.regjeringen.no/contentassets/62f6dd4e0274432da6475e53f4b14d44/no/pdfs/nou201820180005000dddpdfs.pdf>

⁹Dokument 3:8 (2015–2016) Riksrevisjonens undersøkelse av såkornfondenes resultater

¹⁰Nærings- og fiskeridepartementet (2015). Gode ideer – fremtidens arbeidsplasser. Regjeringens gründerplan.

amongst other programmes in RCN, especially the FORNY-programme and Innovation Norway, and part of the growth was earmarked the STUD-ENT scheme. In 2016, the so-called Productivity commission which investigated the potential for economic growth and increased productivity in all sectors, also emphasised the importance of commercialisation of research for economic growth and called for incentives to the HEIs for supporting commercialisation.¹¹

Following up this, the Ministry of Trade, Industry and Fisheries commissioned a report to investigate different forms of incentives for commercialisation of research. Economic incentives through performance-based funding was not discussed, neither was incentives through the career system which is based on research and education activities. The report advises the HEIs to give a larger share of the income or ownership in the spin-off to the inventor or to the inventor's research group. Hitherto it has been common in most TTOs to divide the ownership and the income into three equal parts between the inventor, TTO and the HEI. A larger share to the researcher, the report argues, may give an increased incentive to engage in spin-off development which is perceived as consuming considerable time and resources, often taken from research and the work with scientific publications (Menon, 2018). Another issue is that that this will give the researcher control over the spin-off, a factor often seen as important by other investors and venture capitalists.

The mentioned White paper on capital comments that it is demanding to secure financing in the early development phase for potential growth companies and the amount of equity capital being channelled to promising early-stage companies is inadequate. Such companies are both in need of venture capital and, in particular, relevant competence on the owner side. The Commission therefore suggest the State to facilitate early-stage investments in order to secure access to long-term competent capital and competent owners, and recommends that the State allocate NOK 1 billion to a new, flexible fund of funds venture mandate, to be invested over a three-year period.

The Commission further recommends giving seed capital funds national and flexible mandates, facilitating more stable access to capital for relevant portfolio companies, and transferring the responsibility for following this up from Innovation Norway to a professional investment management community.

¹¹The Productivity commission (2015). Productivity – foundation for growth and welfare. NOU 2015:1.

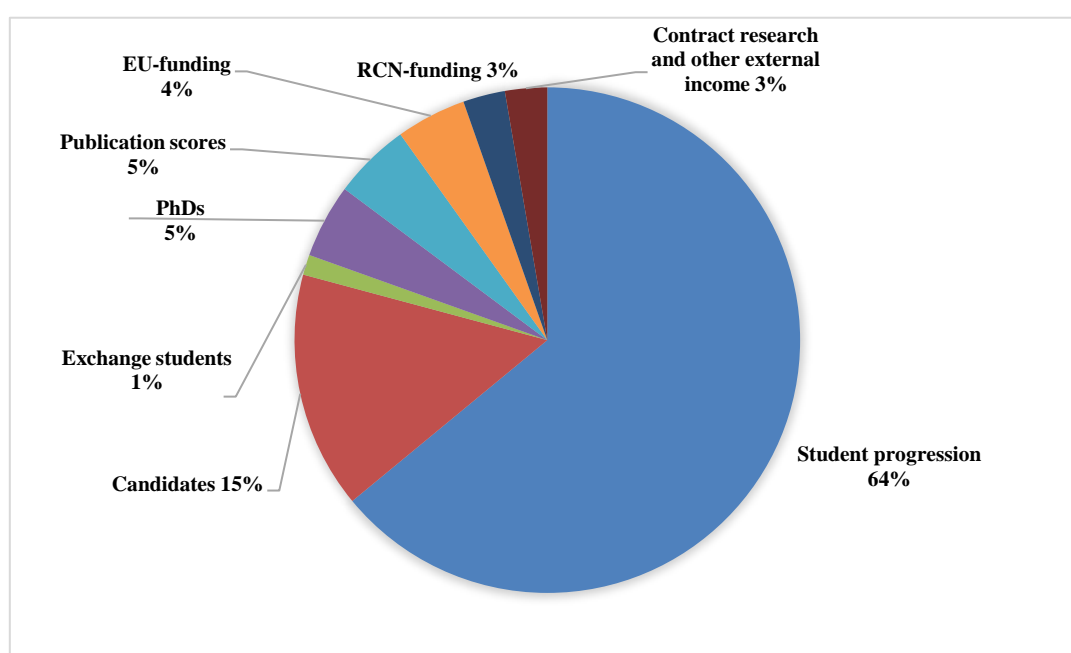
2. Collaborative research

Collaborative research projects funded by a third party – i.e. funding agencies, or contract research are one of the main formal channels of knowledge transfer between the sectors and important for research and innovation (Meyer-Krahmer & Schmoch, 1998; Perkman & Walsh, 2007; D'Este & Patel, 2007). A large share of these interactions are unknown to the HEIs and the Ministries as we will show below.

2.1. Funding of HEIs

As mentioned above, funding of HEIs in Norway is almost exclusively a central state matter, and the Ministry of Education and Research has the primary responsibility. Performance-based funding makes up approximately 30 percent of the block funding to the HEIs. Figure 3 shows how this funding was distributed in the 2018 budget according to the relative importance of performance indicators.

Figure 3. Relative distribution of HEI performance based funding in 2018 by performance indicators



Source: Ministry of Education and research (Blå bok, 2018)

As the figure shows, most performance-based funding is allocated according to the two main types of indicators 1) education incentives and 2) research incentives. The research indicators reward all types of grants from the RCN and the EU, in addition to scientific publications (Borlaug et al 2016). They do not specifically incentivise collaborative research projects between HEIs and public/private actors, apart from the incentive for contract research and other external funding, e.g. further education and training programmes (the so-called BOA-indicator). This incentive is however rather weak as it accounts for only 3% of total performance-based funding. Its behavioural impact is also unclear as the incentive was first introduced in 2017.

2.2. Laws and regulations

The Act relating to Universities and University colleges (§ 1-3 h) states that an institution should collaborate with other universities and university colleges, in other countries, local and regional society and working life, public sector and international organisations.

This means that the HEIs have a responsibility for collaborating with public and private sector on both education and research activities.

2.3. Programmes and instruments

There are two main national agencies that funds collaborative research – The RCN and Innovation Norway.

2.3.1. *The Research Council of Norway*

The RCN administrates the majority of grants that integrate collaboration between universities and private/public sector. Over the last five years, the allocation of funding from the RCN to firms has increased ca. 45 percent (from 1137 MNOK in 2013 to 1645 MNOK in 2017), and the allocation of funding to industry relevant research has also increased ca. 41 percent (from 3223 MNOK in 2013 to 4541 MNOK in 2017). In the same period the tax reduction scheme SkatteFUNN (see above) increased its budgeted reductions with 158 percent (from 2155 MNOK in 2013 to 5569 MNOK in 2017).¹² SkatteFUNN comprises a collaborative part where firms collaborate with research institutions – both HEIs and research institutes. In economic terms, the SkatteFUNN constitutes the largest public instrument for stimulating R&D investments in Norwegian companies

Apart from the SkatteFUNN, the main collaborative research programmes in the RCN are:

- Centre for Research-based Innovation (SFI) and Research centres for Environmental-Friendly Energy (FME), which offer substantial funding over a period of 8 years to research groups that collaborate with public/industrial partners.
- Large thematically oriented programmes within e.g. ICT, bio- and nanotechnology, renewable energy, ocean, food and bio economy, petroleum and gas
- User-driven research-based innovation (BIA) funds industry-oriented research and has no thematic restrictions

2.3.2. *Innovation Norway*

Innovation Norway organises the cluster schemes with support from Siva and the RCN. The schemes' goals are to increase the cluster dynamics and attractiveness, the individual company's innovativeness and competitiveness. The schemes target companies in particular, but the clusters also include research institutions. The scheme also receives support. There are three different schemes:

- Arena: These are immature clusters in an early phase, with different preconditions and potential. Arena funding is provided for 3-5 years.
- Norwegian Centres of Expertise (NCE). These are mature clusters with an established national position. NCE funding is provided for 10 years.

¹²Research Council of Norway. Annual report 2017.

- Global Centres of Expertise (GCE). These are mature clusters with a global position. GCE funding is also provided for 10 years.

The cluster-programmes have four strategic priority areas:

- Cluster development
- Knowledge cooperation; develop cooperation with national and international HEIs and other public research organisations on research, development and education
- Innovation cooperation; cooperation projects between cluster members
- Cluster to cluster cooperation; cooperation across sectors and technology areas nationally and internationally

2.3.3. SIVA

In collaboration with Innovation Norway and RCN, SIVA administrates a relative new scheme; Norsk katapult (Norwegian catapult).¹³ The aim is to provide common infrastructure for companies and research institutions for testing, visualising and simulate new technologies, products, process etc. Five centres are established within the areas of ocean, manufacturing, digitalisation, future materials and maritime operations. Some of the clusters host the centres.

2.4. Current trends

Recently, the Ministry of Industry, Trade and Fisheries launched a large call for a comprehensive review of public agencies and instruments targeting industry development.¹⁴ All instruments described above will be a part of this review. The goal is to establish a knowledge base for policy reforms, as well as structural reforms, including more efficient instruments and better task division between the public agencies managing them, and ultimately better ensuring that the public funding generates value creating and economically viable jobs.

The review will include issues such as how to achieve clearer responsibility and task sharing between the state and county authorities, as well as easy use of instruments and good interaction between instruments at local, regional, national and international level. The competences in the relevant agencies will be reviewed, and reallocation of instruments to the most competent agencies considered. Simultaneously, the counties are to be strengthened as policy actors and particular attention will be paid to the location of instruments related to small businesses and local/regional purposes, such as incubators, business gardens, mentoring programs, corporate networks and entrepreneur grants. A recent government report on the future task of counties, suggests a transfer of half of the grants to industry related research from the RCN to the counties in order to strengthen the regional level. This has generated considerable debate and some opponents claim that such a transfer will reduce quality and impair the competitiveness of Norwegian industry and increase administrative costs. The review of the agencies and the instruments is supposed

¹³<https://norskkatapult.no/>

¹⁴For further information see: <https://www.regjeringen.no/no/aktuelt/starter-arbeidet-med-a-rydde-opp-i-virkemiddel-jungelen/id2612290/>

to be finalised in 2020 and it might have consequences for the funding of collaborative research between HEIs and industry.

3. Mobility

Mobility of personnel between academia and industry or public sectors have received increased attention over the past years as a way to facilitate knowledge exchange and thus transfer of knowledge and competence between sectors. This is founded on the recognition that knowledge transfer takes place in a complex web of interactions between people, and that research skills and research-based knowledge are largely tacit and thus person bound. In this context, mobility is broadly outlined as “knowledge transfer through people” (Hristov et. al 2016:7).

Mobility may however take many forms and is not an agreed-upon concept for policy development. In their study of mobility and knowledge transfer, Iversen et.al (2014) examines researchers’ change of position from one sector to another, and they distinguish between inflow and outflow mobility. Such exchange is however largely dependent on labour market conditions, and less on policy instruments for mobility. Moreover, the exchange of knowledge is presumably mostly one-way. In their study of intersectoral mobility and knowledge exchange, Hristov and colleagues (2016) takes as a starting point the staff in higher education institutions, and they include both 1) staff exchange, 2) joint supervision of doctoral researchers, and 3) the setup of university spin offs as schemes that facilitate knowledge through the mobility of personnel. According to this, mobility may occur without people having to change position. These forms of mobility are accordingly more feasible as objects for national policy development in the higher education sector.

A recent mapping of national schemes for mobility for knowledge transfer between academia and the field of practice (including both industry and public sector) in a selection of European countries found however that there are few national structures that facilitate this kind of mobility (Frølich et al 2017). Only Finland has introduced a system for practice professors, where people from the field of practice with special competencies may be awarded professorships for special purposes without having the formal academic qualifications. One barrier to the establishment of such schemes in Norway is the qualification requirements of academia, as a PhD or equivalent is required to enter academic positions. National policies for appointments in the higher education sector does however not prevent institutions from employing people without a PhD or equivalent in non-academic positions. Accordingly, single institutions may establish schemes and structures that open for intersectoral mobility. This is also the case for joint supervision of doctoral researchers. While national guidelines claim that main supervisors should hold a PhD or equivalent, single institutions may facilitate joint supervision with co supervisors without a PhD.

3.1. Funding of HEIs

Recently, as part of the dialog between the HEIs and the Ministry of Education and Research, development contracts have been introduced. These are contracts between the individual HEIs and the Ministry with the aim of contributing to the development of the institution’s profile. It has a period of four years. Some HEIs have as a part of their contract the goal of developing mobility schemes. Per se there are no funding attached to the

development contracts. The issue is currently up for discussion. If funding will be attached to the contracts, then intersectoral mobility will be included as part of the performance-based funding for some HEIs.

3.2. Laws and regulations

Norway has a long-standing tradition for adjunct professors and additional posts, which are positions that are limited upwards towards 20% of a full-time position, and awarded to people without open competition for a limited period of time. The use of such positions is regulated by the Norwegian Act relating to Universities and University colleges. People are employed in adjunct positions because he or she has acquired skills or qualifications that the institutions is in need of, and the positions are accordingly designed to facilitate knowledge transfer through mobility. While these positions originally were introduced to facilitate intra-sectorial mobility – mobility within academia – it can also be used for intersectoral mobility. This has been particularly evident in health-related academic institutions, where people also often combine clinical and academic positions.

3.3. Programmes and instruments

A more recent development is the introduction of the industrial and public-sector PhD-scheme, administrated by the RCN. Under these schemes, companies or public organisations may apply for support for a three-year period for an employee seeking to pursue an ordinary doctoral degree. The doctoral candidate must be employed by the company/organisation and the doctoral research project must be of clear relevance to the company's/organisation's activities. The schemes are developed to spur greater interaction between academia and society at large, specifically to encourage knowledge transfer from researchers to society and build the research competence and capacity in firms and public agencies. The Industrial PhD scheme was introduced in 2008 and is funded by the Ministry of Trade, Industry and Fisheries. It received a positive evaluation in 2012, and had at that point financed more than 150 PhD students. The Public sector PhD scheme was introduced in 2014 and is funded the Ministry of Education and Research. Both schemes are administrated by the RCN.

The RCN has recently (2016) established a so-called “Researcher pool” to ease access to researcher competence for firms applying for SkatteFUNN (tax reduction). Researchers from HEIs and research institutes sign up on a list and describe their competence. Per se this is only available in the fields of ICT and tourism.¹⁵

A more institutionalised scheme is “competence brokering”. The RCN funds individuals which discuss ideas with firms and help them to find the right researchers in public research institutions. The aim is to stimulate more companies to use research in their innovation work.

3.4. Current trends

As already outlined above, several stakeholders have argued for strengthening the links between HEIs and industry/public sector by introducing new types of positions at HEIs. Mobility is one area that has got increased attention the past years and a position such as a

¹⁵<https://www.skattefunn.no/prognett-skattefunn/Artikkel/Forskerpool/1254021760815?lang=no>

practice professor has been warranted by e.g. the Confederation of Norwegian Enterprise (NHO). It seems that the suggestion will be turned down due to that the name ‘professor’ requires academic merits.

4. Summing up

In summing up this chapter, Table 2 provides an overview of the main national policy instrument for the three knowledge transfer channels.

Table 2. National policy instruments for knowledge transfer

Policy instruments	Commercialisation	Collaborative research	Mobility
Funding of HEIs	Not included in the performance-based funding system	Indirectly included in the performance-based funding system	Not (yet) included
Laws and regulations	IPR-ownership transferred from staff to institutions	Within HEIs mandate	Adjunct professors and additional positions regulated by law
Programmes and instruments	Different agencies and programmes support development in different phases	Several programmes/schemes administrated by intermediary agencies	Few programmes

As in many other countries, several policies and instruments for enhancing commercialisation of research have been introduced the two last decades. The responsibility for these are located in two different ministries; the Ministry of Education and Research which governs the HEIs and emphasises research and education activities in the steering dialog, the Ministry of Trade, Industry and Fisheries are responsible for funding support structures for the commercialisation of research and for general programmes supporting collaborative research. Such a division of responsibilities may be a barrier to a coherent governing of HEIs and their activities, resulting in weak integration of commercialisation activities and collaborative research into the daily operations of HEIs (Borlaug et al. 2016).

One step on the road has been amendments in the act emphasising the Third mission of HEIs and a transfer of IPR from academic staff to the institution. This contributed to the institutionalisation of TTOs at the largest universities and to increased funding of the FORNY programme which support the proof-of-concept and verification phases and the work of the TTOs. There are several government agencies that contribute in the development of a spin-off, and as the above shows; a significant amount of money has been invested. All together 3.9 billion NOK (excluding seed and venture capital) over a period of nine years.

In general, the collaboration between the different intermediary agencies in the system is good and they have distinct roles. The TTOs report, however, that they may get a fast track for applying for funding from Innovation Norway, as the commercial potential of the projects already have been evaluated by them, in other words the actors in the public system should trust the competence of the others. This may save time for the entrepreneurs.

Another bottleneck in the system seems to be the control of IPR by the TTOs and HEIs. While the transfer of IPR was a mean to commit the HEIs to provide for and engage in the commercialisation of research, the current practice of dividing the ownership of the IPR into three parts, where the entrepreneur/researcher only controls one third of the stocks seems to offer a challenge for the entrepreneur in the process of attracting investors. At the system level the access to seed capital is also a challenge. If the proposed fund in fund is realised this may contribute to lower this barrier.

The chapter further shows that several programmes administrated by the intermediary agencies target collaborative research, but rather few national policy instruments have been developed for increasing mobility between HEIs and industry/public agencies. Two exceptions are schemes at the PhD. level, and instruments such as ‘competence brokers’ which are persons located in a research/industry park which mediate between HEIs and industry. The HEIs have, however, autonomy to create new positions for intersectoral mobility themselves, as we will show in the next chapter.

Part II. Mapping HEIs and their local systems

The higher education sector is a key target group of national policies and instruments for knowledge transfer and commercialisation of research. Moreover, higher education institutions have themselves developed and launched a range of different initiatives and instruments to arrange for knowledge transfer and interaction between the institutions and external actors in both industry and public sector. By mapping the instruments and initiatives of strategically selected institutions, this section will illustrate the scope and diversity of institutions' activities for knowledge transfer, as well as the different structures and actors involved.

5. Higher education institutions in Norway

The higher education sector in Norway is divided into five different institutional categories: universities, university colleges of applied sciences, specialised university colleges, private colleges and academies of arts. In terms of R&D Expenditure and number of academic staff, universities are by far the largest subdivision of the higher education sector. This is a heritage of the traditional division of labour in the sector; with universities being more research intensive, and the university colleges having a larger responsibility for training of vocational professionals and for contributing to regional needs. The landscape of the sector has however changed markedly over the past ten years due to a wave of mergers between higher education institutions. The aim of the mergers was to increase quality in higher education and research by spurring a stronger concentration and division of labour in the sector. Per January 2019, there are 10 universities, 5 specialised university colleges and 6 university colleges in Norway. In addition, there is 17 private institutions with state funding.

The mergers have resulted in larger institutions, with a broader geographical as well as disciplinary scope. In the process of merging, institutions have consequently revised their strategies in order to carve out new strategic profiles based on their combined merits and adapted to their academic and societal role in the education and research system as well as their renewed role in their region.

5.1. Institutional governance

The governance of higher education institutions in Norway is regulated in the Act relating to Universities and University colleges. Their supreme authority is the institutional board, and rector can be either appointed or elected. In case the rector is elected she/he is also chairman of the board. In case rector is appointed, the Ministry will appoint an external chairman. The further members of the board consist of a combination of members of the staff and students, as well as at least four external members. The external members should be recruited on the basis of representing relevant industry, cultural or societal institutions, and it is assumed that board members should have complementary competencies. The external representation on the boards are considered to be an important means to strengthen institutions' relation towards the external environment (Borlaug et al. 2016).

The main tasks of the board are to draw up the strategy for the institution's education and research as well as related activities, and to determine the objectives and performance requirements of the institution, as well as the disposition of the institution's financial resources. In drawing-up strategies and objectives of the institution, the board is expected to include knowledge transfer initiatives and activities.

5.2. Higher education institutions and knowledge transfer

Norwegian HEIs have a three-legged mandate in the Act relating to Universities and University colleges. In addition to the conduct of research and teaching, universities are expected to “Disseminate knowledge of the institution’s activities and promote the understanding and application of scientific and artistic methods and results in public administration, cultural life and business and industry”.¹⁶ Institutions enjoy broad autonomy regarding how this task should be met, yet a menu of national soft policies and instruments for knowledge transfer, as we have shown above, are targeted at units and actors from the HEI sector. Many knowledge transfer initiatives and activities in HEI’s, are accordingly offspring of national instruments, and are consequently dependent on national support.

¹⁶https://www.regjeringen.no/globalassets/upload/kd/vedlegg/uh/uhloven_engelsk.pdf

6. Scope of mapping and case selection

The annual reports of selected institutions for the year 2017¹⁷ is used as a starting point for a mapping of institutions' schemes and systems for knowledge transfer. The scope of the survey of the annual reports has been to identify institutions' local initiatives and activities for collaboration with external actors and organisations, as well as support and implementation of practices for knowledge broker arrangements. The initial mapping is complemented with studies of other reports and documents that can inform on the institutions' schemes and activities.

The HEIs' annual reports form a key component of the dialogue meetings between the institutions and the government. In these, institutions report on their strategic goals, as well as a set of sectoral goals outlined by the Ministry of Education and Research. Institutions are also expected to provide brief descriptions and self-assessments of policies and activities targeted, at among other things, cooperation and partnerships with society and industry which typically contribute to knowledge transfer. Notably, these activities are not part of the performance-based system.

6.1. Selected institutions

The five higher education institutions included in this mapping represent institutions with different research and education profiles, size and funding structure, as well as different historical and regional contexts:

- The Norwegian University of Science and Technology (NTNU) is historically a technical university located in mid-Norway. Due to recent mergers with university colleges of applied sciences, the university now cover most disciplines and vocational educations, and it is spread over four different campuses.
- University of Tromsø - The Arctic University of Norway (UiT) is historically a comprehensive university located in Tromsø in Northern Norway. Due to recent mergers with university colleges of applied sciences in the region, the university now cover most disciplines and vocational educations, and it is spread across ten different campuses in the Northern region.
- University of Southeast Norway (USN) is the result of a merger between three regional university colleges, and they offer mainly vocational educations. It obtained university status spring 2018.
- University of Stavanger (UiS) is a regional university in Stavanger which offers mainly vocational educations. They gained status as a university in 2005.
- University of Agder (UiA) hosts a range of different study programmes, ranging from mathematics and engineering to public administration, pedagogics and social work. It was founded in 2007 when the former Agder University College was awarded status as a university.

¹⁷Annual reports are published at:
dbh.nsd.uib.no/statistikk/dokumenter_htmlRapport.action?undermeny=statistikk_dokumenter&tabellId=621

Table 3. Institutions surveyed

	Staff members FTEs	Total no. of students	State Funding, mill NOK	RCN Allocations, mill NOK	EU Framework programme Allocations, mil NOK
NTNU	7 135	40 180	6 595 498	1 018 183	161 511
UiT	3 487	16 475	3 059 497	234 445	23 828
USN	1 601	17 893	1 748 066	41 901	3 173
UiS	1 422	11 403	1 442 570	58 618	9 388
UiA	1 210	12 826	1 274 295	48 258	6 429

Source: DBH (2017) RCN = The Research Council of Norway. FTE = Full time equivalent.

All six institutions have decided on a long-term strategy which outlines their visions and goals, and selected priority areas. The strategies are the institutions' long-term steering document, and form the framework and level of ambition for the years to come. Taking the strategies as a point of departure, all institutions display a commitment to innovation and knowledge transfer, and their role as key actors in regional development:

- *NTNU* carves out a special mission for their institution, which is to develop the technological foundation for the future society, by among other things contributing “to competitive business and industry as well as a capable public sector through collaboration in new practices, processes and products”.¹⁸ They see innovation as a key trait of their academic environment, and innovation activities are singled out as a separate core task alongside teaching, research and dissemination. The pillars of their innovation strategy are collaboration with established business and public sector, and the creation of new businesses. This will be achieved by strengthening long-term collaboration with established business and public sector to improve the innovation capability, increase the number of innovations, commercialisation projects and start-ups from staff and students and include training in innovation in the students' education
- *UiT The Arctic University of Norway*¹⁹ stresses their special mandate and role in the region; in their strategy, they aim to “help promote economic, cultural and social development in the north through building knowledge and human capital”. Among other things, they will include innovation and entrepreneurship in all study programmes, and facilitate close contact between students and the business and industry community. Also, they stress the role of their TTO, and knowledge transfer to businesses and the industrial sector.
- *USN*²⁰ envision themselves as a regionally based entrepreneurial university with close collaborative partners in society and industry, and professional and industry-

¹⁸https://www.ntnu.edu/documents/139226/1278574844/20180228_NTNU_strategi_web_ENG.pdf/55963e61-038d-4f55-a7c8-c8e93c2c420b

¹⁹https://en.uit.no/om/art?p_document_id=377752&dim=179033

²⁰<https://www.usn.no/getfile.php/13505990/usn.no/en/Pictures/About%20USN/Strategies/USN%20strategy%202017%20-%202021.pdf>

oriented research and education. They aim at being internationally competitive and actively involved in the region. They emphasise practice-relevant educations in close collaboration with society and industry, as well as collaborative and practice-relevant research. Collaboration with society and industry in the region is outlined as key conditions for their entrepreneurial profile.

- *UiS*²¹ highlight their international and innovative profile, and they stress that they “will be a driving force in knowledge development and in the process of societal change”. Their objectives cover the core areas of education, research and dissemination/innovation, and the development of partnerships with end-users and private/public actors stand out in all three areas. They aim to promote innovation both in educational programmes and in research by providing opportunities for commercialisation, licensing and the creation of new companies.
- *UiA* highlight three areas in their strategy: Learning and education for the future; Global mindset; and Societal engagement and innovation. This refers inter alia to the university’s interaction with society, and they stress both knowledge development and strengthened efforts to commercialise research-based business ideas.

The sections below describe the knowledge transfer initiatives and activities which are developed to realise the institutions’ goals, in terms of collaborative arenas, coordination structures and mobility schemes.

²¹http://www.uis.no/getfile.php/13419590/Ansattsider/Grafisk%20profil/EN_Strategi%20for%20UiS%202017-2020-1.pdf

7. Collaborative arenas and activities

Institutions' initiatives and instruments aimed at or contributing to knowledge transfer and interaction with industry and working life are found across different levels of the institutions, from the central level to more local initiatives that are organised in close relation to research activities or study programmes. While we find that all institutions have established and take part in well-known infrastructure aimed at commercialisation such as TTO's, incubators and industry clusters, we find a greater variety in the structures established to coordinate commercialisation and knowledge transfer across different schemes and initiatives, as well as the initiatives launched to stimulate interaction between education/students and industry and working life.

In the next sections, we first present institutions' coordination initiatives before we present examples of schemes for interaction and knowledge transfer related to R&DI and education respectively.

7.1. Comprehensive coordination structures

All institutions have established comprehensive structures on a central level to coordinate knowledge transfer and interaction with society. At NTNU, USN and UiA, these are described as central elements of the development agreements between the institutions and the Ministry of Education and Research launched in 2016. The purpose of the agreements is to enter into more binding aims for the institutions, and to carve out more strategic and distinct profiles. The comprehensive structures at NTNU and USN are thus newly established following the agreement, and they operate as umbrellas for existing and new initiatives at the institutions. At UiT and UiS, on the other hand, the comprehensive structures have been in place for a few years, and they have other origins and organisational structures.

7.1.1. *Councils for cooperation with working life*

Institutions have established councils for cooperation with working life (Råd for samarbeid med arbeidslivet – RSA), encompassing both internal and external members from relevant sectors. This was imposed by the Ministry of Education and Research in a white paper in 2008 (St. meld. 2008-2009). The motivation behind the establishment of RSA was to facilitate cooperation between education and working life to be more structured and better rooted in the institutions' plans and strategies. While the RSA's were originally motivated by concerns over the relevance of study programmes to working life, an evaluation of the arrangement (Tellmann et. al. 2017) showed that many of the institutions have extended the mandates of the councils to cover collaboration on research and innovation, which can be interpreted as the institutions wanting to use RSA to collaborate within all areas of the institution. However, the councils operate mainly at the strategic level in the institutions, and the evaluation displayed few concrete outputs of their establishment. An anticipated outcome is however increased awareness and mutual understanding between the institutions and their surroundings.

7.1.2. NTNU

NTNU has several instruments for coordinating internal activities and external relations. In spring 2018, NTNU launched a strategic programme for knowledge-based innovation which is organised under the pro-rector for innovation. The costs of the initiative are shared between the faculties and the Rectorate. The programme is launched under the heading ‘Innovation for a better world’, and aims to increase “the conversion of NTNU’s knowledge, ideas, technology, methods and results from research into useful, specific innovations”. Its main instrument is the employment of 15 innovation managers located at different faculties and professional communities at NTNU. Their primary task is to aid the commercialisation of research and develop a culture for innovation.²² The programme also includes resources for developing the competence of the innovation managers.

NTNU has also other instruments which they underline as part of their stimulus package for innovation. These are:²³

- New innovation grant scheme for PhD candidates
- Cooperation with NTNU TTO
- NTNU Discovery
- Further commitments to student innovation

NTNU has several platforms for collaboration with public and private sector. They have bilateral collaboration agreements with for instance Equinor the largest oil and gas company in Norway, NAV - the Norwegian Labour and Welfare Administration and others. The agreements involve, amongst others, coordination of potential areas of research and education, and is normally financed by pre-seed funds from the collaborating partner and in-kind from NTNU - with the ambition of attracting third party funding.

At the governing level, the University board and faculty boards have representatives from public and private sector. The Council for cooperation with working life at NTNU is organised following a decentralised model, with three thematically organised councils, reflecting three core fields at NTNU; namely technology and business; health and health-related technology; and school, culture and welfare. The councils assemble staff and external partner from relevant industry and public sectors, and shall contribute to a comprehensive, strategic and systematic cooperation between NTNU and work and community life on education, research and artistic activities, development and innovation. They are expected to develop collaborative projects with time. Additionally, NTNU has several cooperation agreements with working life dedicated to ensuring relevance in study programmes.

Currently, NTNU is, in accordance with the development agreement, working on developing indicators which can measure innovation from the university.

²²For more detailed information see: <https://www.ntnu.edu/innovation-resources/knowledge-based-innovation>

²³For more information see: <https://www.ntnu.edu/innovation-resources/knowledge-based-innovation>

7.1.3. *UiT*

UiT established in 2013 a Centre for career and working life as a central support and coordinating unit. The Centre aims to strengthen cooperation between education and working life, e.g. through internship agreements, industry involvement in bachelor's and master's theses, and continuing education. The centre moreover organises an annual seminar – the P.F. Hjort seminar, named after the first rector who was a strong proponent of the university's responsibility for engaging with the community and promoting societal development. The seminar is an arena for discussion of how linkages between UiT and industry and working life can be strengthened and contribute further to value creation in Northern Norway. The centre also operates as secretariat of the Council for cooperation with working life ('Råd for samarbeid med arbeidslivet'), and at the moment, UiT is in the process of launching a new council.

7.1.4. *UiS*

UiS uses the council for cooperation with working life as a platform for interaction and strategic coordination with relevant external partners and schemes established for innovation and knowledge transfer. They have developed a decentralised structure with a central "Verdiskapingsforum" (Forum for value creation). The Forum is headed by the Rector, and includes representatives from parliament, local and county governing bodies, directors of relevant local and regional organisations, as well as more broad representation and specially selected individuals. A key event is an annual conference on relevant topics organised by the Forum. Moreover, there are four associated thematic interaction groups that are linked to the institution's strategic priorities and focus areas. They all represent different types of meeting points that the university have with their surroundings. These are a) a coordination group for innovation initiatives, aiming to gather the innovation initiatives and arenas in the region; b) a coordination group for large projects and cluster development that aims to ensure regional support for research and innovation projects, and to develop industrial clusters for innovation and concrete cluster applications; c) a coordination group for innovation and commercialisation, which aims to strengthen the links between student entrepreneurs and research-, industry- and entrepreneurial business development (including inter alia the local TTO); and d) a coordination group for Ullandhaug that serves as a meeting place for leaders of the institutions at located together with the university. The activities of group b) have resulted in several successful grant-applications to RCN together with external partners from the region.

7.1.5. *USN*

In the development agreement with the Ministry of Education and Research signed in 2016, USN launched three priority areas that contribute to the coordination of activities aimed at interaction and knowledge transfer. Each area is assigned a project leader which ensures coordination and fulfilment of the goals in the development agreement. *USN Partnerskap* shall further develop and strengthen interaction with industry to develop new work-oriented education programmes and research, development and innovation activities. It coordinates four schemes: USN Industriakademi, R&DI experts, networks and interactions with working life, and industry-sponsored professorships (all more fully described later). *USN Profesjon* is established to strengthen the cooperation between research, education and the field of practice within health and social studies and teacher education. It coordinates several mobility schemes, including combined positions and exchange schemes (described more fully later). The aim of *USN Digital* is to develop integrating digital structures to inter

alia facilitate interaction between staff and students at eight different campuses and to make it into one virtual campus and to develop ties to external partners.

At USN, they have established two councils linked to two out of three priority areas of the institution. One is linked to USN Partnerships, and the other is linked to USN Profession. Both bring together relevant actors and is expected to facilitate dialogue and interaction in the priority areas.

USN has also an offensive strategy in developing ties to different industry clusters. For instance, they are currently in the process of establishing an office at Herøya Industry Park to enhance the interaction with the industry. The industry park is located 6 km from the USN campus area. This is initiated by the USN itself and is not incentivised by national instruments.

7.1.6. UiA

Following the development agreement with the Ministry of Education and Research, UiA has launched UiA Nyskaping. This is an effort to foster creativity and innovation amongst students and staff, by providing professional support for transforming innovations into commercially viable projects. As the commercialisation unit at UiA UiA Nyskaping manages the IPR on behalf of the university and works in close collaboration with the external commercialisation partner, Innoventus Sør, to commercialise research. UiA Nyskaping is tightly integrated into the regional business community, especially through collaboration with the regional chambers of commerce. An example of this collaboration is the mentor programme partnership which consists of over 50 mentors from the business community, mentoring student or staff projects.

7.1.7. Institutional partnership initiatives and agreements

As stated in the strategies of all five institutions, interaction and close contact with partners in industry and public sector is valued as vital to the institutions activities. For all, this is visible in the network of partnerships and collaboration agreements that the institutions have developed with external actors. While the content and the reach of these varies, they are expected to condition interaction and knowledge transfer.

NTNU has entered into several collaboration agreements. One example is the partnership with Trondheim municipality, which has resulted in the project Universitetskommune 3.0 (see Box 2). UiT has entered into collaboration agreements with several actors in the region, including Kunnskapsparken i Nord and Mo Industripark AS as well as several of the municipalities which host campuses. USN has developed collaboration agreements with both the municipalities and county municipalities that host USN's eight campuses. The agreements are expected to offer a frame for collaboration. UiS and UiA also emphasise collaboration, and are formalising it with actors in the field of practice related to vocational study programmes. UiS has a collaboration agreement with the Stavanger Chamber of Commerce aiming at facilitating knowledge transfer. Prioritised tasks include communication of topics for bachelor and master theses (from industry to students and vice versa), giving students relevant work experience, making the private sector use the Industry PhD scheme, continuing education, collaboration on innovation projects as well as enabling mobility between the university and the industry. UiA has extensive collaboration with several municipalities and is represented in regional development across numerous arenas (e.g. "Regionplan 2030"). Innovation and commercialisation are among the long-term goals of these collaborations.

Box 2. University municipality 3.0: NTNU and Trondheim municipality

In January 2018, NTNU and Trondheim Municipality signed a 4-year bilateral collaboration agreement.* The collaboration aims at providing access to relevant and up-to-date knowledge and skills needed in the municipal sector through committed long-term cooperation between the municipality and the university. It will establish arenas for research, innovation and education in areas of strategic importance for the sector. Moreover, it aims at establishing a new model for continuous two-way knowledge and competence transfer between the academia and the municipality.

Five thematic areas have been selected for the collaboration, all relating to key tasks and competence needs of the municipality: Education and child development, Health and welfare, Urban development, Innovation and transition, and Digitization and technology/Smart Municipality.

The collaboration project is mandated to (1) establish a joint committee for research, development, innovation and education (including continuing education, practice and research education) within all five thematic areas, (2) establish a governance structure that enables the coordination of decisions and priorities for the municipality and the university, (3) establish common schemes and guidelines for the exchange of personnel between the municipality and the university (shared positions, Public PhD fellowships, project positions, guest lecturers, etc.), and (4) define and follow up subprojects within the five thematic areas.

* <https://innsida.ntnu.no/wiki/-/wiki/Norsk/Universitetskommune>

7.2. Schemes for collaboration and knowledge transfer

In the following, we present the schemes developed to condition knowledge transfer of the research and innovation, as found in the annual reports of the institutions. In addition to the schemes presented, all institution host centres and research projects financed by the RCN and/or Horizon 2020 which include partners from industry and working life, and accordingly facilitate interactions and knowledge transfer. For example, USN is partner in projects financed by the following national programmes: NCE, SFF, VRI, SFI and FME, in addition to several others. These projects and partnerships are not further described here, as they are the outcome of national instruments and not institutional schemes, but they are recognised as vital in the institutions' interactions for knowledge transfer.

We also present the schemes established to link education to industry and working life, and for commercialisation of student ideas projects. These are often coupled with research projects, and the boundaries between education and research-related schemes are accordingly not always very strict.

Table 4. Schemes for collaboration and knowledge transfer

Host institution	Scheme	Aims	Organisation and activities
All	Business clusters	Increased competitiveness in the region	Cooperation and networking
All	FORREGION/Kapasitetsløft	Strengthen research capacity in areas of particular importance for business in these regions.	Funds from RCN FORREGION for recruitment of new researchers, study offers, postgraduate and further education programs, to enable industry to borrow researchers, student assignments or loans from business people to research.
All	Gift professorship	Strengthen specific research areas, enhance knowledge transfer	NTNU and USN have several professorships financed by counties and industry. UiS, UiT and UiA have some.
NTNU/UiT/UiS/UiA	TTO	Commercialisation of research and innovation	<p>The TTO's are owned by the institutions in partnership with nearby organisations.:</p> <p>NTNU TTO: NTNU, Helse Midt-Norge</p> <p>Norinnova: UiT, Universitetssykehuset Nord-Norge and Norut.</p> <p>Valide: UiS, Nofima, Stavanger University Hospital, the International Research Institute of Stavanger (IRIS), Norwegian Institute of Bioeconomy Research (NIBIO), Norwegian University of Life Sciences (NMBU) and the Western Norway University of Applied Sciences (HVL).</p> <p>Innoventus Sør: collaborates with UiA and UiA Nyskaping.</p>
NTNU/UiT/UiS/USN/UiA	Incubators	Provide support for businesses that try to establish new commercial activity, usually based on innovation.	<p>NTNU Accel is owned by NTNU and SIVA, as well as several private actors.</p> <p>Norinnova is the incubator of UiT, co-owned with SIVA.</p> <p>Valide is the incubator of UiS, co-owned with SIVA.</p> <p>Vestfold innovation park: Proventia; Driv-incubator located at USN campuses</p> <p>Innoventus Sør: collaborates with UiA</p>

NTNU	NTNU Discovery	Commercialisation of research; business establishments	Organised under the strategic programme for knowledge-based innovation. Offers early-phase funding of ideas and projects that have the potential to become commercially viable
	Innovationstipend	Increase the conversion of knowledge at NTNU into concrete innovations	Organised under the strategic programme for knowledge-based innovation. Give PhD candidates the time and opportunity to develop innovation ideas further in order to realize innovation.
	Universitets-kommune 3.0 (see Box 2)	Increased innovation and better interaction between NTNU and municipal units in Trondheim.	A comprehensive research, development and innovation cooperation agreement between NTNU and Trondheim municipality; including among other things schemes for exchange of personnel, guest lectures, piloting of research.
	Bilateral collaboration agreements	Increase interaction on education, research and innovation	NTNU has several bilateral collaboration agreements with both public and private companies. Involves common funding of research projects, development of education.
	Technoport	Create good relations between academia and business.	In addition to the annual Technoport conference, the association organises many smaller events and meeting places for students, researchers, start-ups and established business.
	NTNU Bridge	A portal between NTNU students and working life, for collaboration on topics for assignments, internships and jobs.	Students and employers can register and search for/contact potential employers/employees. Teachers may also use NTNU bridge to get in touch with potential external collaborators
	Ph.D innovation programmes	Contribute to commercialisation of research to enhance health services	School of health innovation IPR courses
UiT	Innovation sabbatical	Stimulate staff to commercialise research results	The same premises as for research sabbatical. Staff may apply for sabbatical for commercialising research
UiS	Centre for entrepreneurship	Stimulate increased innovation and interaction between education, research and business at UiS and in the region.	The centre host inter alia a master programme and courses for non-students in entrepreneurship.
	Plogen	Stimulate innovation activities.	Scheme for early phase funding of technology development projects, organised by Valide.
USN	USN Forny-prosjekt	Strengthen research-based innovation	USN do not have an own TTO, but refers to operating similar functions on their own under the FORNY-project, as well as partnering with Innovation Kjeller and SILICA, a regional incubator.

USN Profesjon	Promote cooperation for knowledge transfer between municipalities and USN related to health and social studies and teacher education.	USN and the municipality will establish close, equal and binding cooperation with the aim of developing and strengthening professional education, increase R & D within the respective professions and professional educations, and collaborating more closely on student practices.
Campus contacts	Increased and simplified interaction between the institution and the municipalities that host the institution	Centrally positioned staff from USN are designated contacts for the municipalities where the institution is located. They are expected to represent a door in to the institution for both private and public actors and organisation in the municipality.

The above shows that there are great differences between the HEIs in terms of the extent to which they have institutionalised the different channels of knowledge transfer. Both NTNU and UIS have a well-developed system for commercialisation of research through their TTOs and supporting schemes. NTNU and USN have developed several instruments to ensure collaboration with firms and public agencies. In general, the collaboration agreements seem to target first and foremost education of students, and to some extent research activities. This illustrates that formalised collaborations at the institutional level emphasise students as the main channel of knowledge transfer, while research collaboration is anchored both on the institutional and individual researcher or -group level.

Compared to the others, UiT and UiA seem to have less institutionalised instruments and activities for enhancing on collaboration regionally and nationally.

7.3. Mobility schemes

As discussed in the previous section on mobility, this is a concept that may refer to several different ways and activities that stimulate exchange of staff and movement between sectors. Here, we focus on staff exchange exclusively, and we include a) schemes that are intended to facilitate intersectoral outbound mobility of academic staff, and b) schemes that are intended to facilitate inbound mobility, facilitating the mobility of people from the field of practice to academia.

In the following we present the mobility schemes of the surveyed institutions, as presented in the annual reports.

Table 5. Mobility schemes of the surveyed institutions

Institution	Name of scheme	Inbound or outbound	Description of scheme
All	Public PhD's and industry PhD's	Inbound	This is a scheme financed by the RCN, which facilitates knowledge exchange and competence building. RCN finances the doctoral education which is conducted while the candidate is employed in a company or in a public organisation. Research is expected to have clear relevance to the company or the organisation.
NTNU	Working life contact in the humanities	Inbound	The faculty of Humanities has employed working life contacts in small part-time positions to facilitate closer contact and interaction between academic environment and working life.
	Professor II	Inbound	Professors with main position in public or private sector
	Combined positions	Inbound and outbound	The University municipality agreement aim at establishing combined positions between Trondheim municipality and NTNU. Aim to develop research competence in the municipality and relevance competence at NTNU. (see Box 2)
USN	Combined positions	Inbound and outbound	Positions developed in collaboration between the field of practice and the institution. The purpose of the inbound positions is to make the teaching more practical and relevant to the students, and for the outbound that employees in the institution contribute to research and professional development in the field of practice. The positions usually comprise 10-50% man-years for a period of two years. A professional from the field of practice can have such a combined position for a total of three periods, i.e. a maximum of 6. ²⁴

²⁴The exact details for the positions are not decided yet, and are currently under hearing in the institution.

USN	Exchange scheme ("Hospiteringsordning")	Outbound	Staff from USN may spend a period of time in the field of practice. The exchange may be the starting point for further cooperation on teaching, and may also be the start of a research collaboration or development and operation of a joint R & D project. The aim of the scheme is to facilitate knowledge exchange between the field of practice and the academic fields of health and social studies, as well as teacher training. The scheme is funded by the institution.
	R&D&I experts	Inbound	USN has established a number of part time positions (20%) which are reserved for people with their main positions in industry and business. Good industrial understanding and knowledge of own business are key criteria rather than academic merits. They are expected to contribute to innovation and knowledge exchange between the institution and inter alia the business clusters in the region.
UiT	Industry-mentors	Inbound	Adjunct positions reserved for people from the industry who contribute with teaching and supervision in educational programmes. The positions are organised by the institution, but financed by the VRI-programme under RCN.
UiS	Mobility grants	Outbound	The mobility grants are for international mobility (not mainly inter-sectoral) and intended for UiS postdocs and associate professors who want to carry out research abroad. It funds stays at foreign research institutions or research active companies/public institutions "preferably located outside Norway".

Mobility schemes are relatively new in the institutional context, and USN, which has developed this most extensively, is in an early implementation phase of the schemes. It is therefore too early to conclude on their impact. Informants indicate, however, that the schemes have had the intended effects as they have realised increased collaboration on research and education with the partners through strengthening relations and giving insights into the partners research problem areas. The industry mentor scheme at UiT has, , been active over several years, and so far, 48 people have been employed under this scheme. These contribute first and foremost to education and supervision of students. Also, the scheme for public and industry PhD's have been active over a few years. Both schemes are funded by the RCN.

8. Concluding comments

Below we address the relations between the national and local instruments regarding the three knowledge transfer channels.

Commercialisation of research

NTNU and UiS have well-developed local systems and instruments for commercialisation of research which are complementary to the national instruments. One example is the opportunity for local funding which serves as a pre-proof of concept funding and is easier available than the national “FORNY”-programme funding, as these have more frequent calls. Interestingly, UiT has recently introduced innovation sabbatical – an instrument we do not find at the other universities. It is relatively new and there are no reports on the effect of the instrument on commercialisation and knowledge transfer. UiA and USN have, perhaps due to their more applied role, less focus on commercialisation of research through spin-offs and licenses, as most of the research may be commercialised through collaboration with industry.

Collaborative research

Several instruments at the national level target research collaboration between HEIs and private and public actors. The long-term and relatively well-funded schemes such as Centres for research-based innovation, administrated by the RCN, seem to impact the HEIs in the way that they plan and coordinate the applications in advance of the calls, it is thus not solely dependent upon the initiatives of individual researchers. Some of the HEIs have several bilateral collaboration agreements with municipalities, counties, public agencies and firms. The agreements often include the goal of attracting third party grants from e.g. RCN. We have the impression that such agreements have become a more common means to ensure a two-way knowledge transfer through education and research. Nevertheless, research collaboration is still first and foremost the responsibility of the individual researchers and -groups.

Mobility

As shown in chapter 3, attention has been given to the possibility of introducing the position “practice professor” as a national scheme, but because professor is an academic title the suggestion has been turned down. However, as Part II shows, the HEIs themselves have taken responsibility and established positions to ensure knowledge transfer through

mobility. . For instance, the position “R&DI-expert” at USN is created for attracting individuals with knowledge of industry’s research problems, but the experts do not need academic competence (i.e. PhD.). We observe, however, that the institutions have different practices and norms in terms in this matter. NTNU for instance emphasises that such position should as a principle require academic competence. While the institutions have autonomy to introduce different types of positions, the academic merit system seems to pose a barrier to this type of knowledge transfer,

Based on the mapping, we may group the different mobility initiatives into three categories:

- Professor II positions
- Exchange schemes/mobility grants
- Mobility positions (experts, mentors)

The first is a common instrument in the system but requires academic merits. The second is, according to some of the informants, a less attractive instrument as it entails leaving the academic environment for a period, which for some staff may be seen as detriment to the career since promotion mainly is based on academic merits. The last category seems to be under development, and the HEIs have the opportunity to introduce their own type of positions. One way to incentivise and strengthen this may be to include it as a part of the development contracts the HEIs have with the Ministry of Education and Research.

Taken together, we may conclude that the policy mix for the three channels of knowledge transfer differs in terms of ministerial responsibility and governance and the HEIs’ emphasis on these. The Ministry of Education and Research owns the HEIs and steers education and research through performance-based funding, steering dialogues and development contracts. Commercialisation of research is the responsibility of the Ministry of Trade, Industry and Fisheries, and some of the HEIs have institutionalised local systems for technology transfer. Collaborative research, on the other hand, seems primarily to be the responsibility of intermediary agencies (RCN and Innovation Norway), the institutions through bilateral collaboration agreement with industry/public agencies and individual researchers and – groups. It is also addressed in the steering dialogue and the development contracts of some of the HEIs. Mobility is primarily the responsibility of the individual HEIs.

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