

Analysis of sector mobility – effects, drivers, and good practices in Denmark, Germany, and Switzerland

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Contents

Preface.....	3
Chapter 1 Executive summary	4
1.1 Introduction	4
1.2 Effects of sector mobility	6
1.3 Driving forces	7
Chapter 2 Background and definitions	10
2.1 Introduction	10
2.2 The frame of the analysis	11
2.3 Definition.....	12
Chapter 3 Approach.....	14
3.1 Introduction	14
3.2 Identification of environments with high levels of mobility	14
3.3 Design of the case studies.....	17
3.4 Analysis of effects, driving forces and role models	18
Chapter 4 The size and content of sector mobility in the case studies	21
4.1 Introduction	21
4.2 Switzerland and Germany	21
4.3 Denmark.....	24
4.4 Summary	26
Chapter 5 Effects of sector mobility	27
5.1 Introduction	27
5.2 Effects in academia	27
5.3 Effects in the companies	31
5.4 Final discussion	33
Chapter 6 Driving forces behind sector mobility	35
6.1 Introduction	35
6.2 National or regional drivers	36
6.3 Drivers at the university, faculty or department level	37
6.4 Drivers among researchers	38
6.5 The importance of other knowledge transfer mechanisms	40
6.6 Drivers in the companies.....	40
6.7 Concluding analysis	42
Chapter 7 Role models	45
7.1 Introduction	45
7.2 Professor Gisela Lanza, Institute of Production science, KIT.....	45
7.3 Professor Bertrand Merminod, Director of EPFL's Geodetic Engineering Lab.....	47
7.4 Professor Thomas Rades, Department of Pharmacy, University of Copenhagen	48
7.5 Professor Ulrike Grossner, ETH Zürich	49
7.6 The Karlsruhe Service Research Institute at the Karlsruhe Institute of Technology	50
7.7 Nokia Bell Labs and The Department of Electronic Systems Aalborg University	52
7.8 Professor Henrik Ramlau Hansen Department of Finance Copenhagen Business School	54
Appendix: Interviewees.....	55

Preface

In recent decades, the political debates on the Danish university sector has consistently focused on the societal impact of public investments in research and innovation.

Excellent university research plays a key role in developing novel solutions for the grand challenges of the 21st century, including climate change, public health or the disruptive transformation on businesses and society in the wake of new “industry-4.0”-technologies and business models.

The Danish Council for Research and Innovation Policy is strongly committed to finding new ways in which the value-creation of Danish university research and the bridges of knowledge between research and businesses can be strengthened and enhanced.

This analysis focuses on sector mobility of senior researchers between academia and industry. This “brain circulation” of experienced researchers, conveying new ideas, knowledge and experiences from both worlds, can provide a valuable contribution to research, education and innovation in industry.

However, the existing knowledge on sector mobility of senior researchers indicate that the prevalence is low, both in Denmark as well as in other countries. The analysis at hand strives to understand sector mobility, the drivers behind and its effects on research environments and industry. It has been commissioned by the Danish Council for Research and Innovation Policy as part of the Council’s larger project on sector mobility, carried out in 2016.

The analysis has been prepared by IRIS Group and Lauritzen Consulting in the second half of 2016. The study is based on over 60 in-depth interviews with “sector mobile” researchers, university management representatives, cluster organisations and companies in Denmark, Switzerland and Germany. The analysis consists of a main report and a collection of six in-depth case-studies of environments featuring a high degree of sector mobility. The study also highlights individual role models of “mobile” researchers.

As the study shows, successful sector mobility of experienced, senior researchers entail a range of positive effects, e.g. increased university-business collaboration, employability of students as well as innovation in companies. The report also shows that successful sector mobility does not come easy. In the examined cases, a range of specific conditions and drivers were present, enabling mobility in the first place. The analysis uncovers some of the most important drivers and provide inspiration and practical examples on how to encourage sector mobility elsewhere.

The featured cases include the Technical University of Denmark (DTU), University of Copenhagen (UCPH), Aalborg University (AAU), the École Polytechnique Fédérale de Lausanne (EPFL), the Eidgenössische Technische Hochschule (ETH) in Switzerland and the Karlsruhe Institute of Technology in Germany (KIT). Moreover, interviewees from the Ludwig-Maximilians-Universität in Germany as well as Copenhagen Business School has contributed to the analysis.

The Council wish to thank all who have participated and we hope that the report will serve as valuable inspiration that can contribute to further sector mobility in Denmark and elsewhere.

Chapter 1

Executive summary

1.1 INTRODUCTION

This analysis is prepared by IRIS Group and Lauritzen Consulting for the Danish Council for Research and Innovation Policy (DFIR). The study focuses on sector mobility of senior researchers between academia and businesses. This group of researchers are generally characterised by a low level of sector mobility, but their experience, extensive networks and reputation is expected to have a particularly strong impact on the institutions and businesses they move between.

The definition used, encompasses situations in which a senior researcher has left an academic institution to work the equivalent of full-time for at least three months in a company or vice versa, as well as concurrent employment at the university and a private company for at least three months.

The backdrop is a number of recent analyses, which on the one hand indicate that sector mobility entails a range of positive effects for research environments and private companies. On the other hand, they indicate a relative low degree of sectoral mobility among senior researcher. This can be ascribed to barriers, pertaining to the movements of researchers between universities and research environments in private companies.

This analysis focuses on *effects and driving forces* behind sector mobility. The aim is to provide a solid, knowledge based foundation to enable DFIR to develop concrete recommendations on how to increase sector mobility. Moreover, it highlights role models in terms of researchers and research environments that illustrate the potentials and value creation connected with sector mobility.

The conclusions are based on qualitative, in depth case studies of five regions, including two Danish regions and three regions in Germany and Switzerland.

Prior to the analysis a number of non-Danish universities were selected to be included in the case studies. They were selected based on high performance in international research rankings, as well as a high degree of interaction with business sectors. Our task was subsequently to identify 1) environments at these universities representing a high degree of sector mobility and 2) corresponding clusters/sectors with a high degree of cooperation with these environments.

Moreover, we identified similar Danish university-business clusters characterised by a (relative) high degree of sectoral mobility (in both directions) compared to other departments at the universities.

The table below provides an overview of the case studies.

Table 1.1. Selected environments for case studies in Germany and Switzerland

University	Environments with (relative) high sector mobility	Connected sector/cluster
ETH Zürich:	Energy related research environments at three different faculties.	The energy cluster in Switzerland.
EPFL (Lausanne)	Department of Civil Engineering and Environmental Engineering and Department of Computer Sciences.	Companies using advanced IT, computing and system analytical methods in Western Switzerland.
Karlsruhe Institute of Technology (KIT)	Karlsruhe Service Research Institute	The ICT cluster in Baden Württemberg
University of Copenhagen (KU)	Department of Pharmacy	Life science in Greater Copenhagen
Technical University of Denmark (DTU)	DTU Wind Energy, DTU Electrical Engineering and DTU Compute	Energy and Healthtech in Greater Copenhagen
Aalborg University (AAU)	Department of Electronic Systems	Electronics in Northern and Western Jutland
Copenhagen Business School (CBS)	None. But specific mobile researchers are inter alia present at the Department of Finance and Department of Corporate Governance	Financial sector and management in larger corporations

The case studies were carried out in September and October 2016 based on in situ interviews that typically covered;

- 1-2 directors at institute or faculty level.
- 3-4 leading researchers.
- A key person from the central office for innovation and business cooperation.
- 2-3 research based companies taking part of the cluster and that have experiences of sector mobility with the selected university research environment.
- A regional cluster organisation, or another key organisation, engaged in mobility, recruitment, and university-business cooperation in general.

No case can be labelled as best practice or a perfect approach to sector mobility. But they represent interesting cases and examples of both incoming and outgoing mobility of senior researchers, as well as examples of shared professorships where researchers work for both academia and businesses.

1.2 EFFECTS OF SECTOR MOBILITY

The case studies reveal a range of effects for both academia and enterprises. Most of these effects seem to be general in nature, as they are present in all, or most, of the case studies. The 12 transversal effects are listed in the box below.

Box 1.1. General effects of sector mobility of senior researchers

Effects in academia

- Higher degree of industry and application-oriented research focus and topics.
- Strengthened competences regarding attraction of external funding.
- Stronger network and door-openers to collaborative partners in the business sector.
- More result and relevance oriented culture and work practices.
- Advancement in research careers and managerial responsibility.
- More relevance and practical orientation of educational activities.
- Role models for students, PhDs, and young researchers, motivating (and even helping) them to pursue a career in industry or starting new businesses.

Effects in businesses

- Easier and more direct access to a university talent pool at both Master's and PhD-level.
- Better and less complicated matchmaking with researchers at the university in question, as well as with environments at other universities.
- Increases in other forms of knowledge collaboration, especially joint R&D-projects and student projects.
- Access to cutting-edge research results crucial for innovation in the company, especially with regards to industry 4.0-related research.
- More long-term and stable relations to the research environment, making research-collaboration more long-term and forward thinking.

With regards to academia, a number of effects relate to the ability of the environment to address societal needs successfully in their research (including higher success rate in attracting challenge-based external funding). Often mobile researchers become “gatekeepers” that connect the environments to the business community and facilitate better functioning and broader networks.

Private sector competencies and work approaches are in many cases also transferred successfully to the university via incoming mobility. This creates more effectiveness in both research projects and educational activities. Moreover, mobile researchers connect PhD-students with businesses and sharpen their research approaches.

Easier access to talents is the most frequently emphasised impact among the interviewed businesses. The recruitment of researchers from academia, as well as shared professorships, have opened doors to talented PhDs and graduates in many of the interviewed companies.

We also identify effects related to cooperative research and innovation projects. In short, mobile researchers make it easier for companies to tap into new university research. Furthermore, they initiate a virtuous circle by spurring further cooperation, which in turn spur more sector mobility. A number of interviewees also argue that mobile researchers can be an important stepping stone in the creation of long-term stable relationships characterised by mutual trust.

1.3 DRIVING FORCES

Sector mobility is prompted by a number of mutually dependent drivers. Moreover, these drivers exist at many different levels, including at the national level (in the form of national framework conditions), university level, faculty/department level, drivers in industry and finally personal motivation factors among researchers.

The *personal motivation factors* differ between researchers, and these are both connected with upsides and downsides related to academic research vis-à-vis business research. For instance, research freedom is an upside related to academic research, while “red tape” – i.e. complex administrative procedures – is a downside. Similarly, higher wages and better equipment might be an upside related to business research while emphasis on short-term goals can be a downside.

Mobile researchers are often apt to identify opportunities and challenges in both academic and business contexts, and the weight of each driver might vary during their careers, which in turn affects sector mobility.

In the table below we list the identified *non-personal* driving forces.

Box 1.2. Driving forces behind sector mobility

1. National and regional framework conditions and strategies

- **Government co-funding of joint research projects:** in Germany, the “Exist Programme” co-finances leaves for researchers spending time developing spinouts.
- **Special career tracks:** specific industry-friendly career agreements for Swiss researchers.

2. Drivers at university level

- **General university strategy and focus on sector mobility:** in a few cases (Karlsruhe and Aalborg), we found a strong strategic focus at the university level to be an important driver.
- **Specific mobility promotion instruments at university level:** relevant instruments, such as rules and practices for leaves and shared professorships.

3. Drivers at department level

- **Tradition and culture in selected departments:** most of the identified environments have a long-standing tradition and culture for industrial cooperation, which clearly influence sector mobility.
- **Research profile and match with industry needs:** a “high-quality and strong” research profile as well as research excellence increase the perspectives for sector mobility significantly.

4. Drivers related to other knowledge transfer mechanisms

- **Amount of joint research projects:** a prior record of joint projects entrenches personal networks and trust, Factors that are often decisive when researchers are recruited to/from the private sector.
- **Commercialisation of research results:** likewise, researchers from universities, who display a high degree of licensing of IPR or spinout-creation, tend to be more open to sector mobility. The driver is generally indirect, fostering an entrepreneurial culture in environments open to business-collaboration.

5. Drivers in businesses

- **R&D-intensive cluster/sector:** is a fundamental condition for attraction of academic researchers from senior positions.
- **Business involvement in university research:** business involvement in the public research agenda within basic research and private financing of public research stimulate interest among researchers in working in both sectors.
- **Publication culture:** allowing and/or encouraging researchers in businesses to publish. This makes it easier for researchers to go back to academia, and it also “brands” the enterprise as research-intensive.
- **Physical proximity:** short distances between universities and companies stimulates curiosity and networks, as well as lowering the transaction costs for applying for jobs in another sector. Ideal conditions are campus spaces for companies and cooperative projects, and innovation parks at/by campus.

In general, the first group of drivers – national and regional strategies – is not very strong in any of the six cases. This does not necessarily indicate that national framework conditions are not important.

University strategies and specific use of mobility instruments are important drivers in the case studies including Aalborg University, Karlsruhe Institute of Technology, and at specific departments at the Technical University of Denmark, e.g. DTU Photonics. These universities have focused strategically on enhancing exchange, e.g. through shared professorships. In these universities, sector mobility has been strongly encouraged by the university leadership.

At the department level, a strong research profile that connects to regional business strongholds seems to be a fundamental prerequisite for sector mobility. Consequently, the conditions for sector mobility are strongest in environments with a long tradition for cooperation. The more connected the environments are at different levels, the easier it is to move between the environments.

In line with these drivers, the presence of other knowledge-transfer mechanisms (spinouts and a range of cooperative research and innovation projects) also seem to influence sector mobility positively. In some cases, the choice of researchers to shift sector is taken after a record of successful joint research projects. Shared professorships are often created as a part of a wider agreement, which includes a number of cooperative projects.

Finally, a fundamental driver on the business side is a high R&D-level in companies – a precondition for a researcher to consider a career movement between sectors. Moreover, the existence of a culture that allows private researcher to publish in academic journals can also spur

sector mobility. It can even be a precondition when researchers choose to move back to academia.

Chapter 2

Background and definitions

2.1 INTRODUCTION

Collaboration between universities and the private sector has been at the forefront of European innovation policies throughout the last decades. Concepts such as the triple-helix, modus 2-knowledge, the so-called “third mission” of universities and the “entrepreneurial university” all allude to a growing focus on maximising the impact of publicly funded research on business and society.

In recent years, the concept of intersectoral mobility (i.e. mobility between higher education and private businesses - termed “sector mobility” in the rest of the report) has been subject to increasing focus and interest. International organisations have emphasised that sector mobility can be an effective and essential vessel to further knowledge transfer between the two sectors. Also, sector mobility can enhance the impact of other kinds of knowledge transfer¹.

A recent study concludes that sector mobile researchers take part in 10-25 percent more cooperation across sectors in their current positions than immobile researchers².

Furthermore, recent analyses conclude the level of sector mobility in Denmark, and many other countries, is quite low. Only 1 percent of university senior researchers leave universities for other sectors each year. In addition, only 13 percent of these researches move to the private sector³. Also, incoming mobility at Danish universities is low – less than 5 percent of senior researchers are recruited from the private sector⁴.

Because of this, the Danish Council for Research and Innovation Policy (DFIR) in 2016 decided to shed light on mobility of researchers across sectors, and how this type of mobility can be stimulated and improved.

In line with existing international reports on the subject, the Council assumes that sector mobility represents an untapped potential for value creation. Thus, according to DFIR, the movement of researchers from one sector to the other might be of value, both to the researcher, as well as to both the recipient and delivering organisations. Moreover, it might contribute to growing collaboration and a stronger impact of joint projects.

¹ See for instance ERAC (2014); “Intersectoral Mobility”

² EU More-2 (2014); “Researchers rapport”

³ DFIR Brief (2016); “Bevæger danske forskere sig mellem sektorer”

⁴ For instance, EU More 2 (2014); “Report on survey of researchers in EU” HEI, (2013) & NordForsk, Crossing Borders – Obstacles and incentives to researcher mobility “

The aim of this analysis is to provide a solid knowledge based foundation for DFIRs work on sector mobility, which in turn will led to the development of recommendations designed to to further sector mobility. The recommendations are expected to be published at the end of 2016

Focus on driving forces

The analysis takes its point of departure from a number of barriers to sectoral mobility that have already been identified in previous analyses⁵. These include salary differences, cultural barriers, parallel career tracks/habits, the evaluation and qualification criteria in public research (merits), recruitment policies, etc.

The barriers are particularly profound when it comes to mobility from private research entities to universities. For instance, mobility from academia to industry is often seen as a one-way street, as a low production of high-ranked scientific publications, resulting from working in industry, often prevents a return to an academic position. Moreover, the differences in wage levels constitute an obvious barrier in terms of outgoing mobility from businesses.

Thus, while many recent analyses focus on the size of mobility and barriers, less evidence exists on the driving forces behind sector mobility.

Therefore, the aim of this analysis is to provide insight into good practices, effects, and drivers behind sector mobility in the environments where it is present. Moreover, the purpose is to identify concrete role models in terms of researchers and research environments that illustrate potentials and value creation connected with sector mobility.

2.2 THE FRAME OF THE ANALYSIS

To create a clear basis for their recommendations, the Council defined the scope of the analysis, including that;

- The analysis should focus on environments (in terms of relations between universities and regional sectors/clusters) in three countries: Denmark, Germany, and Switzerland.
- The international part of the analysis should encompass cases at the following universities, which are all highly ranked on international ranking lists;
 - ETH Zürich
 - Ecole Polytechnique Federale de Lausanne (EPFL)
 - Karlsruhe Institute of Technology (KIT)
 - Ludwig-Maximilians-Universität (LMU - Munich)
- The international part should furthermore encompass at least four environments in the private sector (i.e. sectors or clusters) contributing to sectoral mobility to/from the four

⁵ European Science foundation (2013); “New Concepts of Research Mobility”

universities. These environments should also be located in the respective regions (Bayern, Baden-Württemberg, and Switzerland).

- The Danish part of the analysis should include at least four research environments (institutes) at Danish universities and related environments in the private sector.
- The environments in all regions should be characterised by a high degree of sector mobility (in both directions), as well as university-business collaboration in general.
- The environments should constitute research strongholds, both with regard to excellence and private sector specialisation.
- The private sector environments should be constituted by clusters/sectors consisting of companies with organised research and development (i.e. R&D-intensive companies).

Concerning the international part of the analysis, no preliminary research on sectoral mobility in different countries, institutions, and environments have been conducted prior to this analysis. Thus, the selected universities do not necessarily represent a high degree of sector mobility (compared to other universities), nor have formal policies, or strategies facilitating sector mobility.

Instead, the universities are selected because they represent research excellence and they are recognised in their respective regions for collaboration and knowledge transfer in general.

2.3 DEFINITION

In principle, sector mobility of researchers encompasses mobility at all levels starting with PhDs between academia and other sectors (public and private organisations).

In this study, however, the focus is on mobility of *senior researchers*, i.e. associate professors and professors. This group of researchers is more experienced and therefore they are expected to have a stronger impact on research strategies, culture, etc., when they move from one sector to the other.

Furthermore, there is already a high degree of outgoing mobility of younger researchers from universities due to the fact, that PhD-production clearly exceeds the number of vacant research positions at the universities. Hence, the need to identify driving forces and role models is highest among senior researchers.

In this study we define sector mobility in the following (specific) manner;

Sector mobility between academia and industry is defined as either;

- 1) an event in which a senior researcher has left an academic institution to work the equivalent of full-time for at least three months in a company, or vice versa, or
- 2) concurrent employment at the university and a private company for at least three months.

Thus, sector mobility encompasses:

- mobility from a university to a permanent research position at an established company;
- mobility from a university to a spinout company (in terms of a permanent position or a (temporary) part time position for at least six months);
- mobility from industry to a permanent research position at a university;
- temporary mobility from industry to a university or vice versa, typically in terms of project related positions;
- shared research positions with concurrent employment at the university and a R&D-entity in industry.

The preconditions of a duration of at least the equivalent of full-time for three months are set to exclude very short periods of mobility, e.g. short leave periods connected to spinout activity.

By senior researchers, we mean scientists, who, as a minimum, hold a position as associate professor. In European Framework for Research Careers⁶, these researchers are labelled so-called R3 and R4 scientists;

- R3 are established researchers, who have developed a level of independence.
- R4 are leading researchers (typically professors), who are leading their research area or field.

⁶ European Commission (2011); "Toward a European Framework for Research Careers"

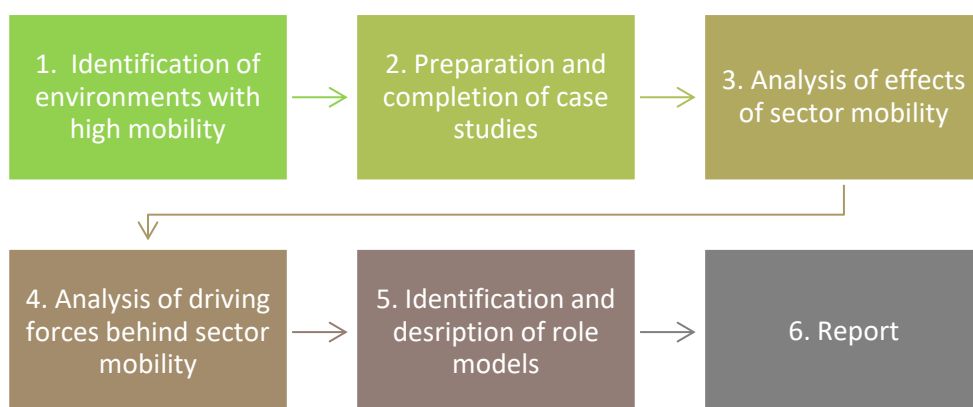
Chapter 3

Approach

3.1 INTRODUCTION

The analysis of sector mobility was carried out between July 2016 and October 2016. It consisted of six consecutive phases, as illustrated in the figure below.

Figure 3.1. Activities



Source: IRIS Group

The content and procedure of the six phases are outlined in the sections below.

3.2 IDENTIFICATION OF ENVIRONMENTS WITH HIGH LEVELS OF MOBILITY

3.2.1 Germany and Switzerland

The first step was to identify environments with high levels of sector mobility in order to carry out the case studies.

The universities representing the international case studies were selected in advance by the Danish Council for Research and Innovation Policy, cf. chapter 2. Consequently, the task was not to identify universities and clusters with an extraordinary high level of sector mobility in a European context (or national context in Germany and Switzerland). Rather it was to identify environments with the highest degree of sector mobility in the selected institutions – in terms of both incoming and outgoing mobility.

Based on desk research and telephone interviews with people in the central administrations of the universities and managers at faculty and institute level, we identify the following environments as those with the highest degree of sector mobility at EPFL, ETH Zürich, and KIT.

Table 3.1. Selected environments for case studies in Germany and Switzerland

University	Environments with high sector mobility	Connected sector/cluster
ETH Zürich	Energy related research environments at three different faculties	The energy cluster in Switzerland
EPFL (Lausanne)	Department of Civil Engineering and Environmental Engineering and Department of Computer Sciences	Companies using advanced IT, computing, and system analytical methods in Western Switzerland
Karlsruhe Institute of Technology (KIT)	Karlsruhe Service Research Institute	The ICT cluster in Baden Württemberg

The detailed case studies (see separate case report) describe the three environments in further details.

According to both central and local managers, a common trait of the three environments is the degree of incoming sector mobility, which are at least twice as high as the average of the three universities. Outgoing mobility also exceeds the average at the universities, but it varies significantly between the three environments. A reason is, the environment at KIT was selected due to a high number of shared professorships (which is not prevalent in the two Swiss cases).

As for the cooperating companies, sector mobility also varies a great deal. Yet, in all environments we have successfully identified and interviewed companies involved in a considerable level of mobility.

We strove to identify environments with (extensive) sector mobility at Ludwig-Maximilians-Universität (LMU) in Munich. However, based on a number of interviews with university managers as well as the key biotech cluster organisation we concluded that sector mobility is close to non-existent at all faculties at the university.

The main reason appears to be that LMU is a relatively “traditional” university in terms of research success criteria and career paths. All faculties at LMU have a strong emphasis on research excellence and the ability to publish in leading journals. The recruitment of new researchers reflects this focus, as classical indicators, e.g. publication activity and prior employment at recognised universities, are essential when vacant professor and associate professor positions are announced. Furthermore, the university put emphasis on avoiding conflicts of interests between academia and businesses. The possibility and potential gains of recruiting researchers with industrial background are thus – according to our interviewees at LMU – not part of the mindset at the university.

Moreover, very few researchers from the elite environment of LMU find it natural or interesting to continue their career in private companies. In short, the university does not recruit the type of researchers that find it relevant to work in both sectors.

This is in clear contrast to another university in Munich: The Technical University of Munich (TUM). According to the interviewed business and cluster organisations the TUM has a significant in- and outgoing mobility to companies in the region.

It is worth mentioning, that LMU does display considerable activity at other knowledge bridges. The university engages in several collaborative research projects with private businesses and the university also creates a number of spinouts. This collaboration is borne out of LMU's status as one of the most highly profiled excellent universities of Germany.

Cooperation and technology transfer are not seen as activities that conflict with the overall excellence focus of the university. On the contrary, cooperative projects are a way to increase research funding, while spinouts and licensing agreements are perceived as indicators of excellent research at many LMU-institutes.

In particular, this attracts businesses within life science, e.g. pharmaceutical companies, where engagement at an early stage in ground-breaking excellent science is key for business. In that regard, classical research performance indicators, e.g. publication activity and excellence, carry more weight than industrial experience.

To sum up, at LMU (and probably at many other universities in the Western world) knowledge spill overs and cooperative research are viewed as activities, which produce mutual benefits for the two distinct sectors involved (with rather different competences and employees). And not as activities where value creation can be increased through mobility and more integration of human resources.

3.2.2 Denmark

Parallel with the identification of foreign case studies, we also identified Danish university departments characterised by a high degree of sector mobility compared to other departments at the universities.

In our research, we focus on four universities – University of Copenhagen (UCPH), the Technical University of Denmark (DTU), Aalborg University (AAU) and Copenhagen Business School (CBS).

We chose DTU and AAU because they in different statistics represent the highest level of private sector cooperation and technology transfer in Denmark, when the size of the universities is taken into consideration⁷.

UCPH is the biggest Danish university, while CBS represents social science and humanities, coupled with a close integration of several businesses in the university's research and educational activities.

As in the German and Swiss cases, we identified environments with high sector mobility through preliminary interviews with both central managers and managers at the department level. We were able to identify strong cases at UCPH, AAU, and DTU, while CBS – despite a very extensive

⁷ See for instance IRIS Group (2014); "Vidensamarbejde under lup – evaluering af universiteternes erhvervssamarbejde og teknologioverførsel".

collaboration and knowledge exchange with businesses – does not have singular environments in which sector mobility is high.

Table 3.2 gives an overview of the Danish case studies (further described in the appendices).

Table 3.2. Selected environments for Danish case studies

University	Environments with (relative) high sector mobility	Connected sector/cluster
University of Copenhagen (UCPH)	Department of Pharmacy	Life science in Greater Copenhagen
Technical University of Denmark (DTU)	DTU Wind Energy, DTU Electrical Engineering, DTU Compute	Energy and Healthtech in Greater Copenhagen
Aalborg University (AAU)	Department of Electronic Systems	Electronics in Northern and Western Jutland

At UCPH, Department of Pharmacy seems to be the department with the highest degree of sector mobility including both in- and outgoing mobility, as well as a few shared positions.

AAU stands out as the Danish university with most shared positions and the Department of Electronic System (well known for their close cooperation with B&O) has created most of these positions compared to other AAU-departments.

At DTU both medtech and energy are areas with relative high sector mobility. All three departments in the table have close cooperation with these sectors.

At the Copenhagen Business School (CBS) there are no individual environments displaying high sector mobility. But individual “mobile researchers”, with a primarily managerial background, are present at the Department of Finance and Department of Corporate Governance.

3.3 DESIGN OF THE CASE STUDIES

The case studies were carried out in the late summer and autumn of 2016. They include several in situ interviews at the participating universities, as well as personal interviews with companies in the selected clusters. The number and composition of interviews vary a little across cases, but the cases typically include interviews with;

- 1-2 directors at department or faculty level.
- 3-4 leading researchers (interviewed individually or in focus groups).
- A key person from the central office for innovation and business cooperation.
- 2-3 research based companies from the cluster that have experience regarding sector mobility with the selected university research environments (in most cases we interviewed 1-2 research directors from big companies and a researcher with university background).

- A regional cluster organisation, or another key organisation, engaged in mobility, recruitment, and university-business cooperation in general.

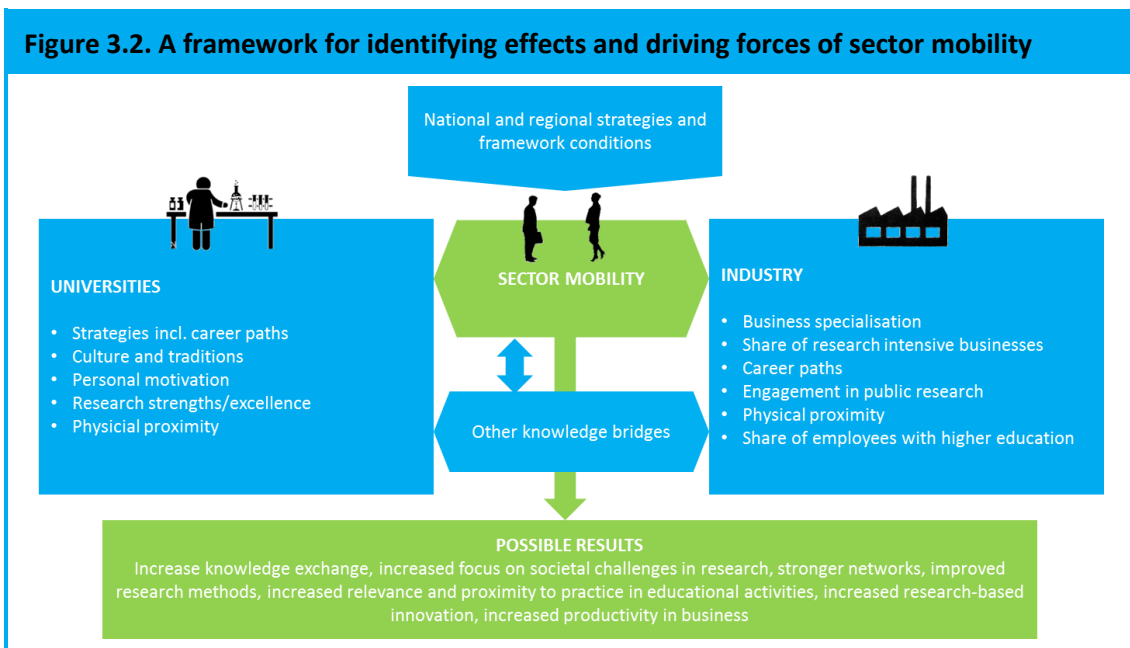
3.4 ANALYSIS OF EFFECTS, DRIVING FORCES AND ROLE MODELS

The main ambition of the analysis is to identify effects of sector mobility and drivers behind sector mobility in the identified cases.

All interviewed managers, researchers, and companies were asked a range of questions about effects at the individual level, department/faculty level and company level during the interviews.

Moreover, the interviewees were questioned about their views on the most important driving forces behind realised sector mobility during the later years. In this regard, we focused on different levels of drivers and their possible interaction.

Based on former analysis of university-industry cooperation and sector mobility, we assume sector mobility can be influenced by a number of interrelated drivers, including national programmes and legislation, university strategies, cultural patterns, the business structure, and other forms of university-industry interaction. Thus, we analyse sector mobility in an innovation system framework, illustrated in figure 3.2.



Source: IRIS Group

Firstly, the figure illustrates that sector mobility is one among a number of knowledge bridges that mutually can influence each other. Prior to the analysis, our hypothesis was that other knowledge bridges such as *spinouts*, *license agreements*, *cooperative research projects* and *co-publications* might stimulate sector mobility. Thus, different kinds of knowledge collaboration are expected to entail a synergetic relation to sector mobility (if the two sectors do not relate

and involve in cooperative projects, movements of people between the sectors will probably be low).

Secondly, the model illustrates that sector mobility may be stimulated by a number of other interrelated factors;

- **Universities:** sector mobility might be affected by goals and ambitions in university strategies, culture and traditions, prioritised research strongholds (and their relevance to regional industry), local rules for leaves and shared professorships and the personal motivation towards mobility among researchers. Moreover, large-scale initiatives to support co-location of academia and business at campus can encompass multiple levels of knowledge transfer.
- **The business sector:** sector mobility might depend on sector specialisation (i.e. regional strongholds that are linked to university strongholds), the extent of research intensive companies, proximity to universities (i.e. innovation parks and open campuses) and the extent to which research based companies engage in public research (like big pharma in Denmark engages in financing of university research).
- **National framework conditions:** sector mobility might be stimulated by national schemes or regulations that allow for flexible recruitment strategies, shared positions, etc.

Thirdly, the lower part of the figure illustrates that the impact of sector mobility can manifest itself in a number of different ways in both academia and companies.

Finally, the figure illustrates that sector mobility might not only be stimulated by other kinds of knowledge bridges. There can also be synergies from sector mobility to for instance joint research projects and spinouts. Sector mobility might stimulate more activities in these areas, as well as increasing value creation in specific projects and spinout companies.

We have analysed effects and drivers through comparative methods, in which;

- Effects and drivers in each case and for each type of informants are listed in a table.
 - With regards to drivers, we used a scale from 1 to 5 (with 1 as poor and 5 as strong) to evaluate the presence of different drivers in each case (see chapter 6).
- Universal effects are defined as effects presence in all or almost all cases.
- Local effects are defined as effects present in one or a few cases.
- Fundamental drivers are defined as drivers scoring 4-5 on the scale, as well as clear qualitative evidence that these drivers underpin (and are prerequisites for) sector mobility.
- Important drivers are defined as drivers scoring high in some/most cases, and with significant evidence that these drivers have spurred sector mobility in the cases in concern.

- Context dependent drivers are defined as drivers that are important in 1-2 cases, but where we conclude that their importance were due to specific local conditions, and thus may not be relevant for most other regions.

Role models

A final ambition of the analysis is to identify specific role models. Illustrative cases (at role model level) might be useful in diffusing knowledge of the potential impact of sector mobility. They are also useful in terms of stimulating interest in sector mobility. Moreover, role models (and their success) might challenge traditional thinking on the typical career paths and individual goals/ambitions among researchers.

Chapter 4

The size and content of sector mobility in the case studies

4.1 INTRODUCTION

This chapter summarises the level and characteristics of sector mobility in each of the seven case studies that we carried out, cf. chapter 3. The mobility patterns and the development in sector mobility in each case are described in more details in the case study appendixes.

Focus is, of course, on in- and outgoing mobility at the university level, as we do not possess estimates of mobility rates at the sector level.

The chapter also gives a brief introduction to the universities and their related sectors in the three non-Danish case regions.

4.2 SWITZERLAND AND GERMANY

EPFL and the industry of computing and system analytics in Western Switzerland

Ecole Polytechnique Federale de Lausanne, EPFL, is one of two federal universities in Switzerland (the other is ETH Zürich).

In the last 4-5 decades, the EPFL has significantly increased its scientific production and international ranking. Today, EPFL is no. 92 at the Shanghai/ARWU ranking, and its latest position at the Leiden list was no. 146. The university has an annual budget of 965m CHF. More than 10,000 students are enrolled at the EPFL, while it employs approximately 340 professors (including associate professors).

Our EPFL-case focuses on two departments characterised by very strong ties and close cooperation with many companies. The companies are not tied to a specific sector, but represent different sectors – with one common trait of using *highly sophisticated computing and system analytics* related to research. The two departments are Department for Civil Engineering and Environmental Engineering and Department for Computer and Communication Sciences.

The companies cooperating with these two departments amount at least 10 percent of the Swiss GDP. Examples include IBM, Cisco, and companies within medtech, manufacturing, environmental service, and transportation.

Incoming mobility at the two departments is very high. 50 percent of the professors (including associate professors) recruited during the last three years were recruited directly from research positions in the industry. This pattern represents a continuation of a tradition that has prevailed at these faculties for decades. Interviewees at the EPFL point out that, sector mobility was even higher a generation ago.

Outgoing mobility is lower – only a few professors leave EPFL to work in the industry but some cases do exist.

In the identified departments mobility is much higher than at the rest of EPFL. At the EPFL in general, sector mobility has declined significantly, partly due to requirements regarding the number of peer-reviewed scientific articles needed to become an assistant or a full professor.

The character of mobility in the two departments is “traditional”, i.e. the researchers leave full-time positions in one sector to full-time positions in the other sectors. Thus, the two departments have not been involved in shared professorships or mobility in terms of temporary part-time positions etc. However, some professors have been involved in spinouts in which they act as advisors or board members. Yet, in recent years no professors have left their jobs to work more than 20 percent of their time in these companies.

ETH Zürich and the energy sector in Switzerland

Eidgenössische Technische Hochschule in Zürich, ETH, is the biggest and most prestigious university in Switzerland. It is the most highly ranked Swiss university – ranging from no. 5 in the QS World rankings, to no. 19 in the Shanghai / ARWU ranking, and no. 62 at one of the Leiden rankings. It has fostered 21 Nobel laureates with Albert Einstein as the most famous.

ETH Zürich has throughout its history been characterised by a close and well-functioning collaboration with industrial partners, in Switzerland as well as globally.

ETH had in 2015 more than 19,000 enrolled students, a total staff of 9,000 people, and 475 professors (hereof 392 full professors). During the last decade, the budget has grown from more than 1,100 m. CHF to 1,712 m. CHF in 2015.

Our case study focuses on energy research and the energy sector, in which sector mobility between academia and companies is significantly higher than in the rest of ETH. Energy-related research is confined to a number of departments. One fifth of ETH Zürich’s professors undertake research that relates to energy in some form. The *Energy Science Center* coordinates energy-related activities and energy-related university-business research projects. It has 60 professors as members.

Based on our interviews, we estimate incoming mobility to the selected departments at ETH Zürich (related to energy) is around 15 percent, which is much higher than at the rest of the university. In total, around 25 percent of all professors at the two departments have an industrial background. Like EPFL, sector mobility is at a high level, but declining.

Outgoing mobility is somewhat lower than this. According to our interviews with managers at ETH, researchers who get through the “needle eye” more or less have a lifetime guarantee of an interesting and well-paid job. Also, when appropriate, they can use the “one day a week”⁸ rule to do external activities.

⁸ Professors are employed in so-called four working days a week positions where they are free to use the last day on other tasks and jobs, e.g. consultancy services.

Like at the EPFL, sectoral shifts of researchers are traditional in character, i.e. they go from full-time to full-time occupations. Presently, there are no shared professorships. Some professors use time on spinouts, but in the latest years there have been fewer spinouts in the energy area compared to the rest of ETH Zürich.

However, there are special professorships created with co-funding from industry. One of these is the chair now occupied by *Ulrike Grossner (UG)*, who is our selected role model at ETH (see case appendix). She worked at ABB as a researcher from 2011-2015, when ABB, together with other partners donated an ETH professor chair in semiconductors to the university. Professor Grossner – an expert in this field – subsequently got the professorship.

Karlsruhe Institute of Technology and the ICT sector in Baden Württemberg

The Karlsruhe Institute of Technology (KIT) is among the most prestigious and advanced technical universities in Germany and one of the largest research facilities in Germany.

It has approximately 25,000 enrolled students and a staff of around 9,200 employees, hereof around 346 full professors. The annual budget is 790 m. EUR.

KIT is a world class technical university that performs strongly on a number of international rankings⁹. The institution is well-known for its world class competencies in areas such as nuclear energy, particle physics, and not least computer science.

On the business side, the ICT sector constitutes one of the strongest sector in the region. Moreover, it is the sector that has the closest cooperation with the KIT. The city is one of the largest and oldest locations of Siemens, while the headquarters of SAP, one of Europe's largest software companies, is located 40 km. outside Karlsruhe.

The actual extent of in- and outgoing mobility with the computer science/ICT sector is significantly higher than in other research areas.

At the moment, the university hosts two ICT-focused “industry on campus” centres that bring together university researchers and researchers/developers from the private sector. The case focuses on the most well-established of these centres: The Karlsruhe Service Research Institute, which is an interdisciplinary research environment that bridges economics and technology and works with the digital transformation of the service domain.

Researchers from IBM, Bosch, and the research organization FZI work closely together with KIT-researchers at the institute. Many of the KIT senior researchers employed at the institute have an industrial background.

Furthermore, sector mobility at the KIT also includes a number of shared professorships and “shared research groups”, co-funded by industry, which will also be covered in the case studies.

⁹ On the Leiden CWTS-ranking, KIT ranks as no. 4 in Europe within physical sciences and engineering.

4.3 DENMARK

University of Copenhagen and the life science sector

The Copenhagen case focuses on Department of Pharmacy and the life science sector in the Greater Copenhagen region.

The Department of Pharmacy is a relatively small department. It has 11 full professors, 28 associate professors, and 12 assistant professors. Of these, six professors, corresponding to 12 percent, have been recruited from the life science sector. The last recruitment of a professor from industry was in 2012. The director of the department himself has an extensive experience as an industrial researcher, before he was appointed to his present position in 2009.

Considering the increase in the recruitment of researchers to the institute, this can be interpreted as a decline in sectoral mobility, but the department still experiences a higher level of sector mobility than other departments at the university.

Outgoing mobility is higher. In the last 3 years, not less than 14 assistant professors have left the department and half of these have left for jobs in the industry, primarily for jobs at Novo Nordisk.

According to Novo Nordisk, this is to some extent incidental. The total number of Novo-researchers working in Denmark with experience as university professors (i.e. level R3 and R4) is not more than 15 in total.

The character of mobility is mostly “traditional”, i.e. it does not involve shared professorship, jointly funded chairs, or temporary positions in spinouts. However, an interesting exception is a shared professorship between the department and *Bioneer* (an enterprise specialised in pharmaceutical and regulatory consulting), which was established last year.

Technical University of Denmark, the healthtech sector and the energy sector

The case about the Technical University of Denmark focuses on three different departments (DTU Wind Energy, DTU Electrical Engineering, and DTU Compute) and their mobility relations to two sectors: energy and medtech (primarily the hearing aid sector).

Sector mobility at the three selected departments differ slightly. At DTU Wind Energy approximately 10 out of 150 professors have an industrial background. At DTU Electrical Engineering the number is 15 out of 51 professors. At DTU Compute the number is 12 out of 91. In total, this corresponds to 13 percent, which is a very high level compared to other Danish departments and universities. These professors with industrial background have been recruited continuously during the years, presumably with a declining tendency.

Outgoing sector mobility of professors is assessed to be on approximately the same level as incoming mobility, i.e. in the neighbourhood of 10 percent.

Like in most of the other cases, the character of mobility is traditional, i.e. not linked to shared professorships, jointly funded chairs, or spinouts.

However, the professorship of our selected DTU role model (see case appendix), *Jan Henrik Ardenkjær-Larsen*, was slightly different from the other recruitments. He had a background as a

researcher in GE Healthcare when he in the beginning of 2015 received a grant from the Danish National Research Foundation. With this grant, he arranged a new professorship at DTU, while keeping a 20 percent position at GE, which was of mutual benefit for all parties.

Aalborg University and the tech sector of Northern Jutland

The Aalborg case focuses on the Department for Electronic Systems and its relation to large Danish industrial corporations (within electronics) located in Northern and Western Jutland. The department has played an important role in the development of the entire university and the historical growth of the strong ICT-sector in Northern Jutland. Today, the department has close collaboration with companies like Bang & Olufsen (B&O), Oticon, Grundfos, and Nokia Solutions and Networks. The department has 18 professors and 57 associate professors.

The department hosts five part-time shared professorships established in cooperation with B&O and Nokia. The model allows senior researcher from the industry to spend 20 percent (or a higher share) of his/her time at the university doing research, educational activities, and business outreach.

Concurrently, the department for Electronic Systems has, in collaboration with B&O, established three “outgoing” professorships, in which senior researchers at the university spend 20-40 percent of their time at B&O. The entire professorships are fully paid by the university, while the projects, that researchers are involved in, are financed by the company.

Copenhagen Business School

At the Copenhagen Business School (CBS), there are generally few researchers, who live up to the definition of sector mobility used in this analysis, and those who do are dispersed all over the university. Thus, we have not compiled an in-depth case study of a specific CBS environment.

The university have no official statistics on the actual extent of mobility (according to our definition), but our sources estimate that the number of sector mobile researchers employed at the university is between 10-15. Concurrently, the university does not have records on outgoing mobility, but the interviewees point out that it is probably higher than ingoing mobility, due to the attractiveness of CBS-researchers in well-paid managerial positions in businesses.

We have interviewed two senior professors with a background in the business sector, and they are both recruited from top management positions rather than research positions.

The two researchers, however, are highly profiled at the university. Professor Henrik-Ramlau Hansen has a long career as both CEO and CFO in major Danish financial companies (Danica Pension and Danske Bank), before he began his career as researcher at the Department of Finance at CBS. He is part of our role model section.

Professor Lars Christian Ohnemus has an extensive managerial experience from large international corporations and holds a number of board positions. Today, he is head of the Center for Corporate Governance at CBS.

It is, however, important to mention, that Copenhagen Business School (CBS) has a very extensive university-business collaboration, and the university employs over 100 external lecturers -

many of whom have a background in business. Furthermore, several researchers engage in business-oriented activities such as board positions in large corporations etc.

It should also be noted, that Copenhagen Business School is an internationally renowned business school and ranks as no. 10 on QS World University Rankings for Business & Management Studies. CBS-graduates and PhDs are in high demand by international corporations such as McKinsey and Co. and Novo Nordisk.

4.4 SUMMARY

The common trait characterising the cases is that mobility between the departments and sectors in focus is significantly higher than in the other parts of their mother universities.

In most cases, mobility is “traditional” in nature. Thus, it is defined as researchers leaving full time positions in one sector to full time positions in the other sector. However, Karlsruhe Institute of Technology and Aalborg University differ from this pattern, as both institutions have a large number of shared positions – especially concentrated at our case departments.

Again, aside from Aalborg University and Karlsruhe Institute of Technology, sector mobility is declining rather than increasing at the case-institution. The main reason appears to be increasing requirements concerning the number of peer reviewed articles, which is crucial in order for researchers to achieve professor positions.

Chapter 5

Effects of sector mobility

5.1 INTRODUCTION

As described in chapter 2, sector mobility is in a number of analyses considered to be a particular effective way of enhancing university-business collaboration. Furthermore, it is perceived to strengthen exchange and transfer of knowledge and technology between academia and businesses¹⁰.

However, while some international analyses have examined the *extent* of sector mobility (cf. chapter 2), no prior analyses have examined the *effects* of sector mobility. As discussed in chapter 3, effects might occur at several levels, including;

- Content, focus, relevance, results and financing of university research.
- Content and organisation of education at both Master's and PhD -level.
- Personal effects in terms of new network, increased employability, and experience of new approaches and new environments.
- Increased networks at the institutional level.
- Research based innovation and knowledge transfer to the private sector.
- Culture, openness, and the ability to combine and create synergy between academic approaches and private sector approaches.

We discussed realised and potential effects of sector mobility with all the approximately 40 interviewed university managers, researchers, and private sector research managers (see appendix 1). The following sections summarise the results, as they distinguish 1) between effects in academia and businesses, and 2) between universal effects and more local effects.

5.2 EFFECTS IN ACADEMIA

The analysis reveals a number of effects for research. Most of them seem general in nature, since they are found in all, or most, of our cases, while other effects are more specific to one or two environments. The positive effects which we found in most of the cases include are listed in box 5.1.

¹⁰ See MORE1 (2010) and MORE2 (2013) for a discussion

Box 5.1. Effects found at the research environments

- More result- and relevance-oriented culture and work practices.
- Advancement in research careers and managerial responsibility, as a result of experiences and competencies gained through sector mobility.
- More industry- and application-oriented research focus and topics.
- Strengthened competencies with regards to attraction of external funding.
- Stronger network and door-openers to collaborative partners in the business sector.
- More relevance and practical orientation of educational activities.
- Role models for students, PhDs, and young researchers motivating (or even helping) them to a career in industry or starting new businesses.

More result- and relevance-oriented culture and work practices

The majority of informants stated that mobile researchers have a positive impact on work culture and that they contribute significantly to changes in work practices in the research environments.

The common conception among the interviewees was that professors with experience from the industry add a more relevance- and result-oriented approach to research, as well as an interdisciplinary culture and work practice to the environment.

Many informants, including research managers, emphasised a sharper ability of mobile researchers to identify and pursue dimensions of a research topic, which could be relevant for industry/society. Thus, they can focus research questions towards practical challenges. Some interviewees, particularly at the Karlsruhe Institute of Technology, furthermore point out that mobile researchers do not see themselves as confined by academic silos. Instead, they focus on the research challenge and draw in the necessary interdisciplinary competencies across and outside the university to solve it.

Furthermore, informants across the cases stress out, that mobile researchers generally employ industrial project management methods such as time-tables, clear deadlines with deliverables, etc. They are also better skilled in identifying and cutting off “dead ends” of a topic, as a mobile researcher from ETH Zürich put it.

The interviewees differ as to whether this happens at the expense of traditional academic rigor. Most of the mobile researchers at EPFL and Karlsruhe Institute of Technology emphasise that they generally focus more on “relevance” than “rigorous, meticulous academic processes”.

Conversely, interviewed researchers at Aalborg University viewed academic research and industrial experience as a plus-sum game, adding quality *through* relevance. They also argued that there are no differences in the bibliometric performance of the two types for researchers.

“We are probably less prone to get lost in detail – we focus on the big picture”

Lars Hovgaard, Novo Nordisk and professor at the University of Copenhagen

Advancement in research careers and managerial responsibility

A number of the interviewees with industrial background acknowledged that their experience (either in terms of full employment in a private company or a shared professorship) have played a role for their career development. In some cases, such experience has even fast-tracked their careers at the universities.

In the Karlsruhe case, researchers have used shared professorships as a stepping stone to receive full professorships, and even positions as head of departments. Similarly, the interviewed full professors with industrial experience have in a number of cases been employed in research management positions, presiding over large research groups or institutes, due to leadership and project management skills attained in industry.

In the Danish cases, there are similar examples of researchers, who were employed in professorships directly after their industrial career, and thereby they were merited for their industrial experience.

While these are examples of personal impacts on mobile researchers they also indicate that mobile researchers contribute to better management skills in academia, and thereby a better ability to set goals, to motivate researchers, and to increase cooperation and knowledge sharing across research groups.

More industry- and application-oriented research focus and topics

Sector mobile researchers do to some extent influence the research focus of the environments by opening new “angles” of a topic or by developing new ideas to research projects focusing on industrial challenges. For example, researchers in shared professorships at Aalborg University have defined new research fields (e.g. research in perceptual models and new wireless standards for internet of things) that have gained high priority by the department (which also has to do with the flow of private funding to these professors).

At ETH Zürich, mobile researchers have actively focused the energy research on issues like the “Energiewende”, i.e. how to replace fossil fuels and nuclear power with renewables by means of their political and industrial understanding of energy research.

Mobile researchers at ETH Zürich and Aalborg University stress that they have a strong impact on the environment’s ability to engage with businesses. They possess the skills to speak “business language” and understand the logics of industry, whereby they constitute important “translators” for the research environments, e.g. in R&D-projects.

Strengthened competencies with regard to attraction of external funding

All interviewees stress the importance of “mobile” researchers in improving the environment’s ability to attract external funding, i.e. from industry, national or especially European funds. For example, one researcher point out that calls for Horizon 2020-funding is heavily influence by industrial interests, why it is a clear strength to have researchers with industrial affiliation or background in the group. This happens in different ways:

- the researchers can help focus applications by making topics, research questions, and methods more in tune with practical industrial needs.

- the researchers can draw on their often extensive industrial network and bring in crucial partners in consortia, which can strengthen the application.

However, it is primarily an advantage in relation to funds allocated to challenge-based research projects. With regards to excellence-funding or basic-research schemes, the interviewees do not emphasise differences between them and other researchers.

“Ultimately, it is industry that determines the content of the EU-calls. The same is the case for the Innovation Fund Denmark. In that context, I think we have a better vantage point for making applications that succeed”

Jakob Stoustrup, Professor, Aalborg University

Stronger network and door-openers to collaborative partners in the business sector

All sector mobile researchers have strong networks - not only in the companies they are/ have been affiliated with, but also with former partners in their network. This constitutes a huge advantage in relation to collaborative R&D-projects, where researchers can fulfil a function as matchmakers between academia and companies.

Indeed, one of the interviewed researchers at Aalborg University (Jakob Stoustrup) acts as a matchmaker for researchers at the faculty, enabled by his extensive industrial background and network to get in touch with SMEs that could benefit from research collaboration. Likewise, at UCPH mobile researchers are important gate-keepers for researchers seeking to get in touch with people at big pharma-corporations.

More relevance in, and practical orientation of, educational activities

Sector mobile researchers generally seem to have a big impact on the educational activities they engage in. Many of the interviewed researchers employ cases, real data, and real-life challenges in their education activities. Furthermore, the case studies reveal that they provide a more direct access to companies than traditional researchers. Master’s- and PhD-students are introduced to employees in the researcher’s network, and are in many instances invited to work together with companies with the potential prospects of a subsequent recruitment.

“We have seminars with students where things are very hands on. The PhDs get to talk to employees at Bayer, use their data, and show Bayer the results that they have found. It is a strong reference for both the students and research vis-à-vis other companies”.

Prof. Dr. Thomas Setzer, KIT, Head of shared research group with Bayer

Role models for students, PhDs, and young researchers

For the same reasons, mobile researchers often constitute inspiring beacons that can be conducive for shifting the mindset of students and young researchers, who see in person the career prospects of going into industry. They also function as a contact point for students, who are seeking internships or student projects at a company. One professor at the Karlsruhe Institute of Technology uses his experience from industry to offer courses, in which students and PhDs train their skills as entrepreneurs based on the commercialisation of real patents from the university (see chapter 7).

Finally, the mobile researchers are all heavily engaged in supervising PhDs. Some mobile researchers point out that they generally have a more structured approach to a PhD-project than their peers, and more often can open collaboration opportunities with companies.

“I have experience that I can use to govern people through their PhD-project. I can provide a structured setting with deliverables, deadlines, reflections on the process and so on. It is typical stuff you do in industry – I try to transfer it to the environment at KIT”.

Prof. Dr. Alexander Mädche, KIT

5.3 EFFECTS IN THE COMPANIES

For the interviewed companies, the primary impact of sector mobility (from academia to businesses or through shared positions) pertain to an easier access to the talent pool and cutting edge research. The identified effects for industry are summarised in the box below.

Box 5.2. Effects found at the company level

- Easier and more direct access to a university talent pool at both Master’s and PhD-level.
- Better and less complicated matchmaking with researchers at the university in question, but also with other universities.
- Increases in other forms of knowledge collaboration/bridges, especially joint R&D-projects and student projects.
- Access to cutting-edge research results crucial for innovation in the company, especially regarding industry 4.0-related research.
- More long-term and stable relations to the research environment, which also makes research-collaboration more long-term and forward thinking.

Effects that are primarily prevalent in one case was;

- Access to knowledge and technology crucial for organisational innovation and management capacity at large German companies (Karlsruhe Institute of Technology)
- Improved image of products/services in the market.

Easier and more direct access to a university talent pool

One of the key effects of incoming sector mobility for the companies, is the opportunity to tap into the talent base of the environments by using mobile researchers as effective entry points. The mobile researchers often have a strong first-hand knowledge of promising talents, e.g. in PhD- and student projects, who could be constitute good matches for the company. Concurrently, the mobile researchers give companies the opportunity to build up a more direct relationship to students at an early stage in their career, thus showing them the prospects in an industrial career in light of their position as role models.

Better and less complicated matchmaking

This “gatekeeper”-function is also important in relation to the ability of mobile researchers to match company challenges or projects with researchers in academia. Mobile researchers have

a strong personal network in “two worlds” and in some cases, they have lowered the entry-barriers for the companies (especially researchers in shared positions). For example, this manifests itself in a more limited use of complicated non-disclosure contracts and more focus on a personalised atmosphere of trust to the collaboration, thereby lowering the transaction costs of research collaboration.

The ability is not only limited to the specific academic research environment that they leave or are a part of. Because of their “special profile”, they are often invited to PhD-assessment boards, industry-academia networks, think tanks, etc. Hence, they have wider knowledge of attractive collaborative partners.

“I know all the employees who work at the department and have a good sense of which research results are “on their way” and which results might be interesting for the pharmaceutical industry. Therefore, I play an important role as contact point for companies who wish to collaborate with the department”.

Harrie Boonen, Director Lundbeck and Honorary Professor at the Department of Drug Design and Pharmacology, University of Copenhagen.

Increase in other forms of knowledge collaboration/bridges

For the same reasons sector mobility furthers other forms of knowledge collaboration. All our cases and interviews with professors and research managers show mobile researchers are important for the creating of well-functioning university-industry teams around joint project. They are strongly engaged in matching company innovation challenges with students and PhDs. Especially Bang & Olufsen utilise shared professorships with Aalborg University directly in relation to innovation-projects;

“When the shared researchers are at B&O everything is open to them and we treat them as full employees, although they are only there 20 percent of their time. They are provided access to entirely new and still secretive technologies. We have experienced an impressive development with these researchers. One of them created a new algorithm useful for our technology. We have increased his B&O time-share to 40 percent”.

Prof. Søren Bech, B&O and Aalborg University

Access to cutting-edge research results

Through mobile researchers the companies gain an easier access to cutting-edge research results. All interviewed company representatives and researchers, who have moved to companies, provide examples of new technologies and innovation that were created from academic research, in which the mobile researchers played an important role. For example, Danish pharmaceutical companies, such as Novo Nordisk and Lundbeck, that work with long-term development of new products. In this regard, the ability to tap into the fundamental research in an early phase is crucial. In this regard, the mobile researchers provide an uncomplicated non-bureaucratic entry point to research results.

More long-term and stabile relations to the research environment

Finally, a mobile researcher might be a way for companies to further strengthen and entrench an already strong relationship to a research environment. Mobile researchers give companies a “permanent” presence or access to the environment, which is conducive to build up trust. This

in turn plays a role for the long-term innovation-outlook in the company and the competitiveness of the company. E.g. in terms of being at the forefront of research in industry 4.0 technologies.

“It is definitely part of our decision to remain in Aalborg, because we get a close collaboration with the department of electronic systems, and because we can get a steady inflow of new people and talents. It is a great tool to think ahead, beyond the next half year”

Prof. Klaus Pedersen, Head of Nokia Bell Labs in Aalborg

Case specific effects

In our interviews with B&O, it was also emphasised that the shared professors with Aalborg University play an important role with regards to improving the image of products to the public. The company have experienced a strong media attention, as a result of the professorships, and thus it has actively promoted its products as “made in collaboration with Aalborg University”.

5.4 FINAL DISCUSSION

Based on the qualitative analysis, we can conclude that sector mobility entails a range of positive effects for research environments and companies alike. For the academic research environments, the main benefits lie in the shift towards a more relevance- and application-oriented culture and work-practice among both researchers and students. Furthermore, mobile researchers facilitate useful industrial networks and partnerships to the university that might have a strong impact on the quality/relevance of research. Finally, these researchers can enhance the ability to attract external funding.

At the business research side, sector mobility constitutes an effective door-opener to talents, other researchers, and research results that can have a profound impact on the innovation processes in companies. Moreover, mobile researchers create more stable relations – especially when mobility takes the form of shared positions. Finally, sector mobility further spurs the extent of collaborative projects, which in turn have a documented positive effect on productivity and growth.¹¹

The positive effects of sector mobility, sketched out above, do not come without caveats. A few interviewed research managers, especially at Copenhagen Business School and Karlsruhe Institute of Technology, as well as informants at the LMU in Munich leave the impression that mobile researchers might not only have positive effects for the level of excellence. They argue that researchers, who have spent time in industry not always have maintained a high publication frequency. Thus, they are in some instances primarily entrusted with educational tasks rather than research. Conversely, researchers at Aalborg University strongly emphasise that mobility constitute a plus-sum game that endows research with quality and relevance.

¹¹ See Copenhagen Business School (2016); “Contribution of academic research to innovation and growth” and IRIS Group (forthcoming); “Analyse af værdien af Aalborg Universitets vidensamarbejde”.

However, one critical condition is that the company itself leaves room for academic activities and, in the case of shared professorships, understands that researchers should hold a research position in the company; this rather than managerial or consultative positions.

Chapter 6

Driving forces behind sector mobility

6.1 INTRODUCTION

As outlined in chapter 3, drivers behind sector mobility might comprise conditions, motivation factors, traditions, etc. at many different levels. We distinguish between:

- national or regional) framework conditions (in terms of schemes, rules, national strategies, etc.).
- university mission and strategies, campus initiatives, practices regarding leaves and shared positions at university level, etc.
- driving forces behind research specialisation and excellence, cultural factors, relations to industry, local goals, recruitment practices, etc. at faculty or department level.
- personal factors of motivation among researchers, i.e. exploitation of research, access to better equipment (in the other sector), working time, salary issues, career planning, etc.
- other knowledge transfer mechanisms as drivers behind sector mobility, i.e. spinouts and cooperative research.
- drivers behind mobility in industry, including R&D-intensity in the sector, connection between strongholds in academia and businesses, access to talent, desire to get easier access to ground-breaking research, etc.

We discussed possible drivers with each informant based on a checklist targeting all types of informants. After the interviews, we listed all types of drivers connected to each case, and carried out a comparative study to identify three types of drivers behind sector mobility (cf. chapter 3): fundamental drivers, important drivers, and context dependent drivers (see section 6.7).

In most cases, it was complicated to identify drivers at more than a couple of the above levels. We interviewed many sector mobile researchers, department and faculty leaders and representatives from enterprises and business/cluster organisations. Behind many of the individual sector shifts, personal reasons were often important.

However, behind these factors of motivation we found common characteristics. Among the most important were drivers at the *department level* (third dot), other knowledge transfer mechanisms (fifth dot) and the *company level* (last dot).

However, few driving forces were identified at the general level (national framework conditions, university strategies and to some extent faculty and department strategy/goals). This indicates the fact, that sectoral mobility – even in the identified good practice examples – is low/modest, and even declining in some of the environments, cf. chapter 3.

6.2 NATIONAL OR REGIONAL DRIVERS

In all cases, we firstly identified national or regional drivers behind sector mobility. Such drivers can be national programmes supporting sector mobility, university legislation, “softer” control through informal discussions between ministries and university managements, etc. It might also be the more indirect effects of other legislation, which can influence mobility as a side effect, e.g. preconditions for government funding of research projects.

Box 6.1 summarises the few identified drivers at this level.

Box 6.1. Drivers identified at national or regional level

- **Government co-funding of joint research projects:** in Germany, the “Exist Programme” co-finances leaves for researchers using time in spinouts.
- **Special career tracks:** in Switzerland, a special “leeway” exists for researchers in private enterprises.
- **Other factors:** possible side effects of strong or increased government funding for joint research projects.

Source: IRIS Group

We find that only few *government programmes* – neither on national, federal or regional level – are established to promote sector mobility directly. In none of our cases do national policies or regulations play a decisive role for the decision of researchers to become sector mobile. The only example is the German programme, EXIST, which can be used to co-fund leaves for researchers using time in spinouts¹².

In Switzerland, it is the general *career track rule* that appointed assistant professors cannot be older than 35 years. However, researcher can waiver from this rule by the number of years they have worked in a private enterprise.

During the later years, an increase in the national level of funding for joint industry-university research projects have increased research cooperation in general - both Switzerland and to some extent in Germany. Some informants emphasise that a side effect of this has been a strengthening of cross-sector research networks. Hence, it is indirectly a driving force behind sector mobility.

¹² The programme aims to increase the number of scientists, who start their own business. It includes for example multi-annual scholarships for potential entrepreneurs among university researchers. “Gruenderstipen-values” goes up EUR 30,000 and is targeted funding of the pre-startup phase, including development of business plans. “Forschungstransfer” fellowships go up to EUR 250,000 and target technology maturation.

6.3 DRIVERS AT THE UNIVERSITY, FACULTY OR DEPARTMENT LEVEL

The box below summarises the drivers behind sector mobility that we identify at the university, faculty and department level.

Box 6.2. Drivers identified at the university, faculty or department level

- **General university strategy and focus on sector mobility:** in a few cases (Karlsruhe and Aalborg) we find this factor to be decisive.
- **Tradition and culture in selected departments:** most of the identified environments have a long-standing tradition and culture for both sector mobility and close industrial cooperation, which clearly influence sector mobility.
- **Specific mobility promotion instruments at university level:** relevant instruments are rules and practices of leaves and shared professorships.
- **Research profile and match with industry needs:** a strong research profile and research excellence increase the perspectives of sector mobility significantly.

Source: IRIS Group

In two of our six cases, Karlsruhe and Aalborg, university management plays a distinctive role in establishing a *general university strategy* emphasising and initiating concrete initiatives and actively encouraging a culture spurring sector mobility. In Karlsruhe, the “shared instruments” for professorships co-funded by industry, were launched by the university leadership while the university merged with the federal Karlsruhe Research Center in 2009. In Aalborg, it was the dean of the Faculty of Science and Technology, who launched the shared professor scheme to deepen the strategic relations of the university vis-à-vis close industrial partners.

In almost all our cases, faculties and departments have *traditions and cultures* with long histories of close cooperation with industry. At the UCPH Department of Pharmacy in Copenhagen, the tradition of close cooperation with, among others, Novo Nordisk, Leo Pharma and Lundbeck is more than half a century old. In 1974, Aalborg University was founded and from its beginning, the university has had close regional veneration and cooperation with regional enterprises in Northern Jutland. Since the 90s, the university has developed a close relationship with the ICT- and electronic industries at a national scale.

An important consequence of the “cultural factor” is that faculty and department leaders tend to reward industrial experience in the recruitment of new researchers. Hence, they value industry experience rather than traditional research performance parameters (e.g. publication activity). According to the interviewed heads of department at Karlsruhe Institute of Technology, the Technical University of Denmark and Copenhagen University, industry experience is reinforced in environments where leaders themselves have been sector mobile during their career.

Long-term relationships between academic and private research entities also indicate the collaborators become more connected, which in turn makes it easier for a researcher to apply for a job in “the other sector”.

Specific mobility promotion instruments at university level also exist. In Karlsruhe, we identified two important instruments. One was to establish special, interdisciplinary “environments” in

which sector mobile researchers have the best conditions to flourish and employ their unique skills, and where business researchers are invited to establish activities directly at campus (Karlsruhe Service Research Institute). The other is so-called “shared research groups”. In shared research groups researchers from industry and university sit together on a daily basis for longer periods of time in order to solve common research problems and challenges.

Another instrument, used at both Karlsruhe and Aalborg University, is the comprehensive and strategic use of joint or shared professorships. Thus, professors are employed and work in an enterprise and at the university simultaneously.

Finally, a *strong research profile* of the individual department is necessary to attract business researchers. Business researchers are attracted by the prospects of contributing to new stimulating research challenges, cf. the next section.

Moreover, it is important that the profile of the department and the research specialisations are in line with research agendas in the private sector. According to several informants, sector mobility is relatively high in many of the cases because the scope and content of research in the two sectors are not distinct from each other. Possibly, this both has something to do with the problem-solving nature of the research at the selected departments, which again is stimulated by old traditions of private sector collaboration. Also, it relates to the character of some of the research areas – IT, energy and life sciences – where the gap between basic and applied research may not be distinctive.

6.4 DRIVERS AMONG RESEARCHERS

Looking at personal drivers among researchers it is relevant to distinguish between career shifts to and from private enterprises. The most important driving forces we identify for researchers changing sector are summarised in box 6.3.

Box 6.3. Drivers among researchers

- **Positive sides of university research:** research freedom and possibility to lead research groups
- **Negative sides of university research:** “red tape” and budget cuts
- **Positive sides of business research:** access to better equipment, higher wages, the possibility to establish or build a new research department
- **Negative sides of business research:** research is too commercial or “short-sighted”
- **Altruistic drivers:** the possibility of “giving something back” by going back to academia

Source: IRIS Group

As the box indicates, both sectors can have advantages and disadvantages, depending on the concrete situation of the individual researcher.

Most of our interviewees enjoy and appreciate the research freedom at universities with respect to both research focus and research methods. Full professors also value the possibility to manage research groups and thereby get the opportunity to reach more important breakthroughs.

Meanwhile, a number of interviewees in Denmark emphasise the disadvantages of being employed in the university sector, as such employment usually revolves around challenges of “red tape. E.g. it is difficult for researchers to procure new or better research equipment because of research budget cuts (during the last four years all public institutions, incl. universities, are cut two percent annually). Also, researchers use increasing amounts of time on funding issues rather than research.

Positive aspects of working in the business sector are, among others, easier access to new or cutting-edge equipment, higher wages and “less bureaucracy”. In some cases, mobility is also spurred by companies establishing a completely new research group/department, which appeals to university researchers. For most the interviewed researchers, wage is not in itself a decisive factor.

The negative side of the business sector is, for several of the interviewed researchers, that research should stay focused on commercial viable prospects. Furthermore, research has a shorter time horizon (often a maximum of 3-5 years) than at universities, where many research projects have longer time horizons.

All these factors are more or less personal in nature. A number of the interviewees also emphasise more altruistic explanations of returning to academia, which focus on prospects of “giving something back” to the university or to next generation of students and researchers.

In general, most of our interviewees appreciate the mutual relationship between the two sectors. Moreover, interviewees underline the importance of ending a downward trend in sector mobility based on reasons mentioned in previous chapters.

Reflections about enterprise results as being “too commercial or short-sighted” were not meant as a critique. These conditions are perceived natural and necessary in enterprises that want to stay competitive in the market. The reflection might be a sign of “schizophrenia”, according to one of our interview persons, who has enjoyed working in both sectors.

“I enjoyed my time with Roche, which was very well-paid. And conditions were really good. But my family was far away and sometimes I missed my freedom to investigate new angles, new questions. And at the university, I love to train the next generation”

- Prof. Thomas Rades, Department of Pharmacy, University of Copenhagen

“In my teaching, I use millions of examples from my past in GE and ABB. And the students really appreciate it. I was very fond of the concrete and issue-driven research in the private sector but I enjoy the university at least as much”

- Prof. Ulrike Grossner, Department of Information Technology and Electrical Engineering,
ETH Zürich

6.5 THE IMPORTANCE OF OTHER KNOWLEDGE TRANSFER MECHANISMS

The presence of other types of knowledge transfer is also an important contributing factor to sector mobility in some cases. In this regard, the most important drivers are explained in box 6.4.

Box 6.4 Drivers related to other knowledge bridges

- **Spinouts:** in most of our cases spinouts have a significant indirect effect on sector mobility, and a large effect on mobility of researchers at lower levels, i.e. PhDs and postdocs.
- **Amount of joint research projects:** the amount of projects matters. Joint projects create personal networks that are often decisive when researchers are recruited to/from the private sector.

Source: IRIS Group

Spinouts are important for many reasons. They demonstrate innovation and may be catalytic for local job creation. Yet, they may also stimulate sector mobility. In many of our cases, universities and departments are highly active in supporting the creation of spinouts.

In Switzerland, professors usually have the freedom to use parts of their time (up till 20 percent) on spinouts and may get leaves to work at them. However, we only found one example of a professor, who quitted his job to work full-time in a start-up. Instead, a number of intervieweed professors work as part time consultants at newly established spinouts or contribute as board members. In some cases, spinouts are further developed by the establishment of incubator environments or innovation facilities. Illustrative examples are the Innovation Park at the campus of EPFL, which contains both start-ups, research or innovation departments of larger enterprises, and Scion DTU close to the Technical University of Denmark.

The amount of joint research and innovation projects also has a significant influence on sector mobility. Most importantly, joint projects create or enhance networks between researchers in the two sectors. They also provide research managers with stronger knowledge of relevant candidates in other sectors.

The Karlsruhe case indicates that the effect on mobility is reinforced when the co-operative projects take place within specific interdisciplinary environments that both hold researchers from academia and industry. Thus, the possibility to use campus as a hub for cooperation and knowledge sharing also appear to spur sector mobility.

6.6 DRIVERS IN THE COMPANIES

The identified drivers at enterprise level vary between countries and sectors. In some of our cases we only find a few mobile researchers, who have worked at universities on a senior level (as professors) compared to a high or a very high number of PhDs in the research-intensive enterprises. We identify the following drivers, cf. box 6.5.

Box 6.5. Drivers identified at the business level

- **R&D-intensive cluster / sector:** necessary to attract researchers from senior positions.
- **Business involvement in university research:** such an involvement spurs business interest in recruiting university researchers and increases the interest of these researchers.
- **Publication culture:** allowing or encouraging researchers to publish makes it easier for researchers to go back to academia. Also publications “brand” the enterprise as research-intensive.
- **Physical proximity:** for many researchers distance is important and proximity matters to networks, informal contacts and actual mobility.
- **Other factors:** university researchers are recruited as “ambassadors” or “network creators”.

Source: IRIS Group

An important prerequisite for ingoing mobility to industry is that the sector is *R&D-intensive*. In most cases, a precondition for hiring senior researchers is that the company has research activity that is both “broad” (measured in people and facilities) and “high” (i.e. produces results and publications of general academic interest).

Business involvement in university research is also important. With such an involvement the company influence research agendas at universities, while this action also allows the agenda of the university to influence research of the company. It makes the company a more attractive work-place for researchers.

Some of the interviewed researchers emphasise the importance of enterprises’ *publication culture* for sector mobility. In many enterprises, researchers have little time to produce articles, which in turn must be approved by the firm’s IP-departments and management. Not all enterprises allow the publication of articles and only a few enterprises encourage it.

In interviewed companies that encourage publications in research journal, the drivers were, among others, to support the research community, to brand the company or to be more attractive to researchers in general – or a combination of these factor. But clearly, an positive attitude can be important to sector mobility. Oppositely, it is difficult for an enterprise researcher to produce the required number of articles to become professor.

A large number of enterprises in the vicinity of the university underline that the “*proximity factor*” stimulates mobility. This effect is both indirect and direct. The indirect effect is that proximity stimulates networking and informal contact. The direct effect is that proximity often makes a job change easier.

However, *other factors* can contribute. Researchers with experience as senior university researchers often have a huge university network allowing enterprises to “tap in” new knowledge and research more efficiently. In some cases, mobile researchers may also be role models for students and they make it easier for the company to attract students to work with projects from the company or to apply for work there.

6.7 CONCLUDING ANALYSIS

In this concluding section we look at all the non-personal drivers (cf. section 6.4). They are listed in the table below, in which we have also assessed the strenght of each individual driver on a scale from 1 to 5. 1 signifies weak and 5 strong presence in each case. In most cases the *strength* of a driver and its influence on mobility is more or less the same. But in a few examples, e.g. spinouts, there may be a difference between strength and influence, since many spinouts only create an *opportunity* for sector mobility. This opportunity is pursued *if* the researcher chose to leave academia temporarily or permanently (which is not always the case).

Table 6.1: Driving forces behind sector mobility in selected departments (1-5 points)

	EPFL	ETH	KIT	AAU	DTU	UCPH
National and regional framework and strategies						
Government programmes to increase sector mobility	1	1	2	1	1	1
Special career tracks	2	2	3	3	3	3
University strategies						
General university strategy and focus on sector mobility	1	2	3	4	3	2
Tradition and culture of sector mobility in selected departments	4	4	4	4	3	4
Flexible leave opportunities	2	2	2	2	2	2
Flexible positions	1	1	4	4	2	2
Research profile and match with industry needs	5	5	5	5	5	5
Other knowledge bridges						
Spinouts	4	2	2	2	5	2
Amount of joint research projects	5	5	4	5	4	4
Business culture						
R&D-intensive cluster / sector	4	4	5	4	4	5
Business involvement in university research	3	3	4	3	3	4
Publication culture	4	4	3	4	3	3
Physical proximity	3	4	2	3	4	4
Successful sector mobility	4	4	4	4	4	4

Naturally, the assessments are subject to a number of qualifications.

In general, the first group of drivers – national or regional strategies – is not very strong in any of our six cases. The assessments of Swiss cases result in "2" because of the existence of the "35-years practice" described above. The "3" in Denmark is based on the relatively soft, arms-length dialogue between Danish universities and the Ministry of Education. Thus, this leaves room for the individual universities to decide their own strategies in this area. The same applies for Germany (Baden Württemberg and Karlsruhe Institute of Technology).

Tradition and culture are on the other hand identified as strong factors in all cases. It is possible to change culture and tradition but university departments are in most cases very conservative. Therefore, such changes are slow and can only be changed if managements continue to maintain and implement consistent long-term strategies.

"Flexible researcher categories" are used strategically in several of our cases. These may cover *shared professorships, industrial professorships, or creative use of researcher categories*. Shared professorships are used in a number of instances at Karlsruhe Institute of Technology, Aalborg University and University of Copenhagen. In most of the cases where shared professorships are not used, individual managers and researchers stress it is a good and viable instrument that could/should be used more.

Finally, the director of DTU Wind Energy at the Technical University of Denmark, Peter Hauge Madsen, explains that titles as "leading engineer", which is not a formal researcher category, can attract good researchers from the industry, who do not meet the publication requirements.

Measured by quality and the international reputation of key university researchers, all universities in this study have a strong research profile. Correspondingly, the university environments were by many businesses emphasised as environments with leading positions in their research fields. Within areas such as life science, energy, and ICT/computing, it is important for business to cooperate with globally leading research environments. Thus, the leading research position of the environments are in fact a prerequisite for the engagement of companies in their "local" university.

As regards "other knowledge bridges", the number of spinouts varies between the cases. In some cases, e.g. EPFL and DTU, spinouts have a significant effect on regional innovation and job creation. Therefore, spinouts are perceived to be very important for knowledge spill-overs. But the effects of spinouts on sector mobility are only indirect in our specific cases. Only in rare instances a successful spinout has led a full professor to quit his/her job to start working full-time in a spinout - even mobility through part time leaves seems to be rare.

Occasionally, professors work as part-time consultants, thus spinouts can further sector mobility and new employment opportunities for junior researchers. It appears sector mobility can be furthered in this area by using opportunities for part time leaves more strategically.

Finally, business culture has important influences on sector mobility, although it is something that is easily influenced by policy. R&D must be of high quality and interdisciplinary in order to be attractive to university researchers. Company involvement in university environment and in joint projects are also a stimulating factors. Many of our informants stress the importance of the

business “publication culture”. Of course, enterprises will not risk having their business secrets disclosed, which should be properly patented before being published. Yet, publications may be beneficial for the whole cluster and the individual companies.

Finally, a relevant question is which drivers that can be categorised as *necessary preconditions* (or fundamentals) for sector mobility, and which drivers that *stimulate* sector mobility.

As illuminated in the table, three factors stand out with assessments of 4 or 5 in all cases. These are 1) research profile and match with industry needs, 2) high amount of joint research projects, and 3) R&D-intensive sector/companies. We do not see this picture as incidental. The interviews and identified cases of mobility strongly support the perspective that these drivers are essential for any degree of sector mobility.

Nevertheless, the additional drivers are also important. They illustrate that there may be different ways to increase sector mobility. Clearly, government programmes or support from university rectors may be helpful, but typically not decisive. In other instances, use of specific instruments (e.g. leaves and use of flexible researcher categories) can increase mobility. Spinouts and innovation parks are important for innovation but may also spur mobility. And some drivers are found in the domain of culture. For this category of drivers, our conclusion is that at least some of them typically are present in order to supplement the above-mentioned fundamentals.

Chapter 7

Role models

7.1 INTRODUCTION

In each case, we have identified 1-2 role models. These are researchers, researches groups, companies or research departments that experience a high degree of sector mobility. Also, these role models represent clear and illustrative examples of effects and synergies between academia and industry that can be achieved through different kinds of sector mobility.

In the sections below, we introduce six role models. More examples can be found in the separate case appendices.

7.2 PROFESSOR GISELA LANZA, INSTITUTE OF PRODUCTION SCIENCE, KIT

“The big advantage as a researcher lies in the experience of two worlds. I became an integrated employee at Daimler and learned the inner workings of a huge corporation without having to deal too much with complex non-disclosure agreements. At Daimler, I helped with the company’s expansion in China and I was a big part of the decision making on what to produce in China and what to produce here”.



Prof. Dr.-Ing Gisela Lanza is Head of the Institute of Production Science at Karlsruhe Institut of Technology. She holds the professorship “Production System and Quality management”, where she works with optimisation of industrial production at a global scale, e.g. supply chain management, factory planning, quality assurance and global production strategies. The research of the institute is highly interdisciplinary and bridges economics with technology.

In 2004, she received her PhD from the University of Karlsruhe. She has received several awards for her research and holds a number of positions, e.g. as Director of the “Global Advanced Manufacturing Institute” in Suzhou in China. She has been a member of the Industry-Science Research Alliance of the Federal Ministry of Education and Research Mobility Work Group and member of the scientific advisory board of the German “Plattform Industrie 4.0”.

Prof. Lanza held the first shared professorship at the KIT institute “Global Production Engineering and Quality”, in collaboration with Daimler AG from 2008 to 2011. During the professorship she worked on improving the global production network and supply chains of the company, e.g. in relation to new growth markets such as China and India. In her work, she supported decision

making at the top level of Daimler with models of global production chains. Prof. Lanza constituted the “pilot”-case for shared instruments and KIT.

The Institute already had a close collaboration with the Daimler AG at the time, where Prof. Lanza got the professorship. The institute had several collaborative R&D-projects with Daimler, and Prof. Lanza had a strong network to the company, including persons in top managerial positions. Her competencies were therefore well known by the company.

Prof. Lanza’s professorship was also a way to enhance her research career. The institute wished to keep Prof. Lanza, but the German principle of “Hausberufungsverbot” usually prevents that junior researchers gets a professorship at the same institution, unless they have experience of working at another institution or in industry. By engaging in a shared professorship, Prof. Lanza could remain at KIT, while strengthening her experience and career by working directly with Daimler.

Originally, the plan was to have a 1 year full-time stay at Daimler before returning to KIT and then spend the last year at Daimler. However, the shared professorship became more mixed in nature. The first year, Prof. Lanza spent 50 percent of her time at KIT, but towards the end she spent relatively more time at the university, to pave the way for a full professorship once the shared instrument expired.

“The big advantage as a researcher lies in the experience of two worlds. I became an integrated employee at Daimler and learned the inner workings of a huge corporation without having to deal too much with complex non-disclosure agreements. At Daimler, I helped with the company’s expansion in China, and I strongly supported the decision making on what to produce in China and what to produce here.”

“A shared professorship should be time-limited. 4-5 years is enough. It can be resource consuming because both parties expect that you are 100% dedicated to them – and in the end, it is difficult to stay between two chairs. After 4-5 years, you should decide whether to go entirely to industry or go back to research.”

7.3 PROFESSOR BERTRAND MERMINOD, DIRECTOR OF EPFL'S GEODETIC ENGINEERING LAB

"I will describe my research as very practical with strong ties to enterprises, as well as to important societal challenges, with Africa as an example. Furthermore, my industrial background has been a prerequisite for our ability to create successful spinouts".



The deans of IC (Computer and Communication Sciences) and ENAC (School of Architecture, Civil and Environmental Engineering) at the EPFL point to Prof. Bertrand Merminod as one of the most important role models at EPFL. He works with environmental engineering at ENAC, but in close cooperation with colleagues at IC. He is director of EPFL's geodetic engineering lab, which comprises researchers from the whole of EPFL. The main research area of the lab is development of algorithms and methods to utilise 'big data' from integrated sensors, satellites and drones with strong links to industrial sectors as informatics, telecom, agriculture and environmental services.

Prof. Merminod graduated as a PhD in engineering at EPFL and worked as a researcher at the University of New South Wales in Australia. He has also worked in a UN organisation in Africa where he developed methods to improve satellite surveillance and mapping. He has worked more than 10 years in research departments in private enterprises, e.g. Thales (radar systems) and Leica (navigation systems) before becoming a full professor at EPFL in 1995.

His industrial background is valuable in the development of new relevant joint research projects and in his teaching and supervision of PhDs, in which he can use practical industrial examples based on own experience.

The research of his team has led to a number of spinouts. The most recent and important is Gamaya, which is a fast-growing company based in the Innovation Park. Gamaya sells software programmes using satellites, drones and other mapping techniques to monitor crops for farmers, traffic congestion in cities and environmental conditions in cities and in rural areas.

The company is only 1 ½ years old but with a monthly growth rate of 10 percent, it has already attracted some millions CHF in venture capital. According to Yosef Akhtman, CEO of Gamaya, more than half of the employees are PhDs from EPFL.

7.4 PROFESSOR THOMAS RADES, DEPARTMENT OF PHARMACY, UNIVERSITY OF COPENHAGEN

“I enjoyed my time with Roche, which was very well-paid. And conditions were really good. But sometimes I missed my freedom to investigate new angles, new questions, etc. And at the university I love to train the next generation”



Thomas Rades (TR), Department of Pharmacy at University of Copenhagen, is both an example of intersectoral mobility as well as international mobility. His career path both includes movement between academia and industry and across national borders (New Zealand, Switzerland, Germany and Denmark).

TR has served as professor at Department of Pharmacy since 2012. He was headhunted (a special procedure for the recruitment of already established professors) from a position as professor at Otago University (OU) in New Zealand by former Dean of Faculty of Pharmaceutical Sciences, Sven Frøkjær, and the current Head of Department, Flemming Madsen. OU is a good university, but it lacks the central location that Copenhagen has. It is near a number of other universities and research centres, which TR is dependent on.

TR has achieved international recognition for his research in physical characterisation of drugs and dosage forms, as well as formulation and delivery of drugs with help from high energy formulations (e.g. amorphous systems) and nano-particles (both polymeric and lipid-based).

Prior to his employment at *OU*, TR was for two years a central researcher at Hoffman La Roche in Switzerland, where he was responsible for the development of new drugs. Originally, TR is educated as a PhD in pharmacy from the University of Braunschweig in Germany.

TR has a long history of publications, research projects, research cooperation, and PhD supervision. He is probably the most renowned international researcher at DP, thus he acts as a role model for colleagues and students. TR describes the research environment at DP as good, characterised by autonomy, and with considerable support from the industry.

TR got familiar with Denmark in 2010 when he stayed in the country in connection with a period of leave.

As a researcher, TR still uses his contacts at Roche, and other pharmaceutical companies, to develop cooperative research projects. He does not perceive the more application-oriented research processes in industry as better than the more idea-driven and long-term research processes at the university - or vice versa. He believes corporate and university research methods complement each other. He also adds that university research is not damaged by demands for reporting as in businesses, hence individual knowledge becomes collective.

In addition to his corporate network, TR inherently contributes to the international collaboration of Department of Pharmacy through his network in New Zealand, Switzerland, and Germany.

7.5 PROFESSOR ULRIKE GROSSNER, ETH ZÜRICH

“In my teaching, I use millions of examples from my past in General Electric and ABB and the students appreciate it. I was very fond of the concrete and issue-driven research in the private sector but enjoy the university at least as much”



Ulrike Grossner (UG), Department of Information Technology and Electrical Engineering at ETH Zürich, was appointed as professor only 1 ½ years ago.

She is a role model for sustaining sector mobility at ETH Zürich. She was appointed as full professor in march 2015, when the university foundation together with ABB Switzerland and other private enterprises established financial support for a new professor chair. UG is a specialist in semiconductors based on wide bandgap materials.

UG has worked 4 years as a principal scientist at ABB Switzerland. Before that she was two years at GE in the U.S and one year as a scientist at the Paul Scherrer Institute in Switzerland. In the beginning of the century she worked as scientist at the University of Oslo. Originally, she has a PhD in physics from the Friedrich-Schiller-University of Jena in Germany. Besides, she has an MBA from the University of Massachusetts Amherst in USA.

UG's research and teaching is influenced heavily by her employment as a researcher in ABB and the Paul Scherrer Institute. In her lectures, she always uses practical examples based on her own industry experience, which is highly appreciated among students. She describes herself as an “impatient” researcher, keen on research and project execution, consequently “baselining” existing research in comparison with new experiments. Industrial use of new research is seen as an important “sanity check”.

She stresses the importance of good collaboration in research teams, as it is a prerequisite for successful results. Also, she underlines the importance of teaching the next generation, which is the reason why she wanted to “go back” to academia. It was a task she missed in the private sector.

7.6 THE KARLSRUHE SERVICE RESEARCH INSTITUTE

“The mix is good: take hard core academic people and combine them with people who have an industrial background. It is all about translating problems. If companies come and tell about the challenge, we can understand it, translate it and bring academic research into it.”



Prof. Dr. Alexander Mädche

In 2008, the Karlsruhe Service Research Institute (KSRI) was founded as a public-private partnership between KIT and IBM in Germany. Today, the partnership also includes the large German corporation Bosch, as well as the Forschungszentrum Informatik (FZI).

The case of the KSRI shows how to further sector mobility by establishing special “unorthodox” industrial focused research environments, which constitute an attractive backdrop for recruiting and retaining researchers with industrial employment experience.

KSRI focusses on interdisciplinary research to support and advance the digital transformation of the service domain, i.e. innovation of services in the context of digital industry 4.0-technologies that are revolutionising the face and potentials of services. E.g. through big data analytics, artificial intelligence and internet of things. Technologies that allow for more tailored, autonomous and smart service concepts, a much more direct link to the end-user, and finally new and vast capabilities for gaining and analysing information about the user, which can be utilised in innovation of new and improved products and services.

The institute itself rests on an “industry-on-campus” model for ingoing sector mobility. The institute is physically located at the South Campus in Karlsruhe. Researchers from both IBM and Bosch work together with KIT-researchers on the digital transformation of services in an interdisciplinary setting. They draw on disciplines such as computer science, management science, engineering and economics. The environment is co-funded by industry and led by senior researchers, many of whom are sector mobile researchers themselves with a background in industry

There are five KIT-researchers with an industrial background and ten researchers employed by industry out of a total of 45 researchers. All examples of sector mobile researchers at the KSRI comes from large research-intensive German cooperation, e.g. SAP, IBM and Bosch.

KSRI transcends faculty boundaries and acts as an autonomous unit within the KIT, partly funded by the KIT and partly by the industrial partners. In terms of organisation, the KSRI is divided in nine topic-specific research groups. Some of these are led by either “mobile” researchers with industrial experience or researchers with concurrent employment at IBM or Bosch. The box illustrates some of the research environments and their leading senior researchers:

Box 7.1. Research groups at the Karlsruhe Service Research Institute

Service Innovation & Management explores conceptual designs and implementation of new forms of services through a direct partnership between KIT and IBM. The group is led by Prof. Dr. Gerhard Satzger, who is Director of Business Performance Services Europe at IBM Deutschland and Honorary Professor at the KIT at the same time. Prof. Dr. Satzger has a long background of shifting between academia and the private sector, as a researcher and manager at IBM Germany.

Information Systems & Service Design which conducts research based on the understanding and design of intelligent, user-centered digital service systems for enterprises and society. The research is highly interdisciplinary and includes design research, as well as behavioural science. The group is led by Prof. Dr. Alexander Mädche. Prof. Mädche has previously been a researcher at the FZI within computer science and informatics. Before becoming a professor at the KIT, he was academic director at the University of Mannheim and has a background as researcher and manager at SAP.

Knowledge Management focuses on semantic knowledge representation (used in artificial intelligence), knowledge management (how to control the flow of knowledge in a large organisation) and the development of digital services. Among the leading researchers is Prof. Dr. York Sure-Vetter that has a career as senior researcher at SAP and as the president of the GESIS Leibniz Institute for the Social Sciences, where he utilised his computer science experience in a social science context.

Moreover, the KSRI serves as a platform for fostering a new talent pool with knowledge of digital service transformation. The institute offers a Master's specialisation in digital service systems, relevant for engineering students looking for a career as a service professional. The programme features in-depth modules, e.g. "digital service system in industry", "service design" and "service computing" that make it possible to tailor a major or minor specialization. Many of the modules draw on existing courses at the KIT.

The mobile researchers actively engage the students in their future careers choices, and they utilise their industrial experience to guide the students' choice of modules. In a newly launched project module, students are furthermore invited to carry out projects payed for by industry, where the income is used for a study trip to Stanford University.

"Traditionally, industry would sponsor a professorship or a project, and until deadline the researcher and company would work relatively separate. That does not create the same direct connection to research results. At the KSRI, people from IBM are working together with researchers at the KIT whereby they get a direct connection to the capabilities of the environment."

Prof. Dr. Gerhard Satzger, Director Business Performance Services Europe at IBM and Honorary Professor at the KIT.

Evaluations of the KSRI have until now documented that the institute has been highly successful in terms of fulfilling the initial goals of IBM to join the partnership. IBM has consecutively prolonged its engagement and is currently committed to the institute until 2018.

7.7 NOKIA BELL LABS AND THE DEPARTMENT OF ELECTRONIC SYSTEMS AALBORG UNIVERSITY

“What really works is that the boundaries between the institute’s research and Bell Labs is fluid. We give PhDs and researchers open access to our equipment and vice versa. That gives maximum benefit for us”.

Professor Klaus Pedersen, Nokia Siemens Networks and part-time professor at Aalborg University



Nokia Siemens Networks has a long history of collaborating with the Department of Electronic Systems at Aalborg University. From the late 90s, Nokia Siemens Networks has sponsored collaborative R&D-projects at the Department and worked with supervision of PhD-students, as well as provided student projects for postgraduate students.

Bell Labs is the central R&D-division at Nokia Siemens Networks. It employs around 1,500 people worldwide and 12 at its Aalborg branch. The branch is located at the science park NOVI, directly on campus and co-located with research environments and start-ups at the university.

At the moment, Bell Labs has two sector mobile professorships affiliated to the Department of Electronic Systems, Professor Preben Mogensen and Professor Klaus Pedersen, who are leaders at Bell Labs in Aalborg at the same time. Their research focus on end-to-end mobile network systems, including disciplines such as radio resource management, multi radio access technology orchestration and solutions for facilitating internet of things (IoT) use cases. Moreover, the researchers work with standardisation and algorithm development for 4G and more recently 5G. In terms of application, the branch work with technologies relevant for the future of mobile networks, self-driving cars, drones and remote surgery – technologies that demand ultra-reliable wireless network.

The relation is very close and generally characterised by a large and open-minded out- and influx of people to and from the research environments. One of the researchers at Bell Labs notes that most other universities in the world have a much clearer division between business and science.

The most important effect emphasised by the leader of Bell Labs is that the professorships works as facilitators for the influx of talents and new ideas, that are crucial for the work of a relatively small R&D-department specialised in disruptive technologies. Through the 20 percent professors Nokia Siemens Networks gains a more direct access to both researchers, PhDs and students. The professors are especially focused on supervision of PhDs, who furthermore get access to equipment and knowledge at Nokia Siemens Networks.

Furthermore, the head of Nokia Siemens Networks emphasises that the professorships enhance the strategic long-term dialogue on research with the Department, which would otherwise be more short-term and focused on the individual project.

From the perspective of the university, the cooperation indicates access to cutting edge modelling and simulation systems, e.g. for mobile networks. Furthermore, Nokia Siemens Networks has a more up-to-date knowledge of the global discussions on new standards and protocols, which the Department can use to guide its research.

It is pointed out by researchers, that the two primary critical conditions for the work model is the close physical distance and the long-standing trust-based relationship between Nokia Siemens Networks and researchers of Aalborg University.

7.8 PROFESSOR HENRIK RAMLAU HANSEN – COPENHAGEN BUSINESS SCHOOL

“I can draw practical experience into the research environment and make other researchers aware of details they were not previously aware of”.

“Working in research and being in a top managerial position has many parallels. It is all about being able to identify new connections between things”.

- Henrik Ramlau-Hansen



The Department of Finance at Copenhagen Business School consists of 30 researchers within finance and 5 researchers in statistics. The Department of Finance conduct research related to financial markets, pensions and insurances, risk management and corporate finance. Furthermore, approximately 24 PhD students is enrolled at the department. The Department of Finance hosts a nationally funded Center of Excellence (the Center for Financial Frictions) and the Pension Research Center that is a joint initiative between Copenhagen Business School and the Danish pension sector.

Henrik Ramlau-Hansen has been working as associate professor at the Department of Finance since July 2016. He has an extensive managerial career from the financial sector behind him. This includes serving as CEO in the Danish pension fund, Danica Pension from 2000 to 2010, and as CFO in the largest Danish financial corporation “Danske Bank” from 2010 to 2016. He was a key player in the bank’s turnaround following the financial crisis. The net income of the bank rose from 1,7bn DKK in 2011 to 17,7bn during his tenure.

Furthermore, Ramlau-Hansen has an academic background in insurance science and pension mathematics. Before his career in the financial sector, he was associate professor at the University of Copenhagen and contributed to the field of insurance science with many internationally recognised publications. For his work, he received the David Halmstad Memorial Prize in 1988 for the best research article within the field.

His current part-time (60 per cent) position as associate professor is predominantly focused on education. Ramlau-Hansen is responsible for a new course in pension mathematics, and he is engaged in pension research of the Department through the Pension Research Center. He points out that his experience of communicating and presenting in large corporations, has a positive impact on his teaching skills today. Furthermore, he fulfils a role as bridge builder in the research environment linking researchers with potential partners in the financial sector. Moreover, he introduces the faculty staff to “blind spots” in their research based on his own extensive practical experience.

The primary driving force for Ramlau-Hansen’s return to academia, was the empowerment to “give something back to society”, and especially being able to influence and inspire the young generation.

APPENDIX: INTERVIEWEES IN THE CASESTUDIES

DTU

Name	Position
Gert Rode	Director, GE Healthcare, Denmark
Jan Henrik Ardenkjær-Larsen	Professor, Department of Electrical Engineering
Jan Eiersted Moltzen	Office Manager, Rector Secretariat, DTU
Kenneth Thomsen	Section Leader, Department of Wind Energy
Kristian Stubkjær	Head of Department, Department of Electrical Engineering
Lars Martiny	Senior Vice President, Haldor Topsøe
Peter Hauge Madsen	Head of Department, Department of Wind Energy
Rasmus Larsen	Head of Department, Department of Applied Mathematics and Computer Science
Rasmus Paulsen	Associate Professor, Department of Applied Mathematics and Computer Science

UCPH

Names	Position
Bente Gammelgaard	Professor and vice Deputy Head, Department of Pharmacy
Flemming Madsen	Head of Department, Department of Pharmacy
Harrie Boonen	Director, Lundbeck
Katrine Luise DiBona	Head of R&D Policies and Trends, Novo
Lars Hovgaard	Principal Scientist, Novo
Sven Frøkjær	Associate Dean, Faculty of Health and Medical Sciences / Professor
Thomas Rades	Professor, Department of Pharmacy
Vivian Lindgaard	Section Manager, HR & Organisation, UCPH

AAU

Name	Position
Børge Lindberg	Head of Department. Department of Electronic Systems
Søren Bech	Director Research at Bang & Olufsen and part-time professor at Aalborg University
Klaus Pedersen	Head of Bell Labs, and part-time professor at Department of Electronic Systems.
Professor Jakob Stoustrup	Professor at Aalborg University (Automation and Control) and former Chief Scientist/Advanced Controls Program Manager at Pacific Northwest National Laboratory. Senior Advisor for the Faculty of Engineering and Science.
Lisbeth Munksgaard	Senior Consultant at Aalborg University
Nina Schjoldager	Nina Schjoldager Senior Consultant. AAU Innovation & Research Support.
Professor Preben Mogensen	Principal Engineer at Nokia Siemens Networks Siemens Networks and part-time professor at Aalborg University

CBS

Name	Position
Søren Hvidkjær	Head of Department, Department of Finance
Henrik Ramlau-Hansen	Associate Professor Department of Finance, Former CFO Danske Bank and CEO Danica Pension.
Lars Christian Ohnemus	Director of Center for Corporate Governance, Extensive managerial experience from a range of companies, including founder of –BPT Asset Management A/S and regional Managing Director in Phillip Morris International for the Baltics.
Nikolaj Burmeister	Head of Secretariat, Dean's Office of Research

ETH

Name	Position
Christian Schaffner	Director, Energy Science Center, ETH

Turhan Demiray	Managing Director, Research Center for Energy Networks, ETH
Matteo Gazzani	Senior scientist, Fac. of Engineering, ETH
Jonas Mühlenthaler	Head of research, Swissgrid
Konrad Hungerbühler	Full professor, Fac. of Science, ETH
Madeleine Luethy	Head of HR services, ETH
Marcus Maibach	CEO, Infrac
Patrick Jenny	Full professor, Fac. of Engineering, ETH
Pedro Crespo Del Granado	Research coordinator, Fac. of Engineering, ETH
Peter Bachhofner	Director, Mercury Urval, Switzerland
Reza Abhari	Full professor, Fac. of Engineering, ETH
Ulrike Grossner	Full professor, Fac. of Engineering, ETH

EPFL

Name	Position
Alain Munafo	Principle researcher, Merck Switzerland
Andreas Mortensen	Vice provost for research, EPFL
Bertrand Merminod	Professor, ENAC, EPFL
Claire Bernard	Head of HR, University of Lausanne
Julien Guex	Deputy CEO, Vaud Chamber of Commerce
Lorenzo Granai	Director, Cisco Switzerland
Lorraine Davis	Director, Swiss National Fund for Research
Nathalie Viraq	Principal scientist, Medtronic Switzerland
Pascal Fua	Professor and part of IC management, EPFL
Pascal Girard	Head researcher, Merck Switzerland
Philippe Ory	Director, EPFL Career Center
Yosef Akhtman	CEO, Gamaya

KIT

Name	Position
York Sure-Vetter	Full Professor at the Institute of Applied Informatics and Formal Description Methods (AIFB) and researcher at KSRI, Former senior researcher at SAP
Alexander Mädche	Head of Information Systems & Service Design, KSRI, and former Vice President at SAP.
Orestis Terzidis	Head of EnTechnon, and former researcher at SAP
Gerhart Setzger	Director of Business Performance Services Europe in IBM and professor KSRI
Thomas Setzer	Head of Shared Research Group Corporate Services and systems with Bayer
Gisela Lanza	Head of the Institute of Production Science, held first shared professorship at KIT (2008-11) in collaboration with Daimler.
Michael Kleinschmidt	Head of KIT research office
Barbara Schmuker	Head of KIT Business Club
Bjorn Hain	Current shared professorship in Intelligent Industrial Robotics with Schunk
Ralf Trunko	Head of Innovations & International Affairs, Cyberforum

LMU

Name	Position
Christoph Zinser	Deputy Head Technology Transfer at LMU Munich
Prof. Horst Domdey	Managing Director of BioM Biotech Cluster Development and Honorary Professor at LMU
Prof. Dr. Oliver Behrend.	Managing Director of the Munich Center for Neurosciences, LMU
Dr. Pascal Schweizer	Managing Director and Chief Financial Officer (CFO), Thermosome (spinout).