FROM QUANTITY TO QUALITY IN INTERNATIONAL MOBILITY AND NETWORKS

– INTERNATIONAL OUTLOOK OF DANISH RESEARCH, PART I

THE THINK TANK
DEA
ADVANCING KNOWLEDGE

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CONTENT

MAIN FINDINGS AND RECOMMENDATIONS

Internationalization is inextricably linked with a successful research career. For most academic researchers, engaging in international activities is not an option, but a given. The scientific community is global, and establishing a successful academic career requires collaborating with respected researchers wherever in the world they may be, publishing in internationally recognized scientific journals, and attending key international conferences within the field. Moreover, for many researchers supranational funding from organizations like the European Union (EU) and from national funding bodies in other countries can be attractive sources of research funding.

This report focuses on international mobility and networking activities in Danish universities, which have traditionally been regarded as matters for the individual researcher. The increasing scope, intensity and formalization of international activities have, however, progressively made them matters for university management as well as government authorities. International collaboration on research and publication has increased significantly in past decades, and in return such collaboration has become a key assessment criterion in universities' recruitment for faculty positions. At the same time, researchers as well as universities are forced to adapt to a growing influence of international institutions such as the EU and its Europe 2020 strategy for economic growth.

The aim of this report is to discuss to what extent, and how, university management and government bodies can bolster – primarily outbound – international mobility and networking by individual researchers or research groups at the Danish universities. This includes identifying possibilities for, as well as barriers to, increasing the quality of international mobility and networks. The report also provides qualitative insight into the activities and challenges related to international mobility and collaboration by academic researchers.

The report is the first in a series of three reports on internationalization in Danish university research, understood as the total set of activities undertaken to support the international outlook, and ultimately the quality, of research at Danish universities. The reports present the results of a study undertaken by The Think Tank DEA, and partly funded by the Danish Agency for Science, Technology and Innovation. While this first report zooms in on *International mobility and networks*, subsequent reports in the series will focus on *International research funding* and *International recruitment*.

All three reports draw on insights gathered

through sixty interviews with researchers, managers on departmental and faculty level, and administrative staff at Danish universities as well as abroad. Interviews were also conducted with managers and board members of Danish public and private research foundations.

While the EU has for example exerted great influence through the framework programs on research and technological development on the mobility of researchers at Danish universities, and their collaboration with especially European researchers, what matters to the researchers in this study is the collaboration itself and not the financial instrument making it possible. In other words, the EU was only mentioned by interview respondents when discussing international research funding, which will be addressed in DEA's second report on the international outlook of Danish research (DEA 2016b). The broader influence of the EU on the internationalization of Danish research will be addressed further in *A brief history of the internationalization of Danish research – A literature review* (DEA 2016a).

A necessary prerequisite for successful internationalization of Danish universities is having strong research environments present in Denmark in the first place. In other reports, DEA focuses on how best to support the quality and impact of Danish research in general. In this series of reports, however, focus is given to activities related directly to the internationalization of Danish university research.

From quantity to quality in international mobility and networking

It has been a goal in Danish universities that more domestic PhD students and postdoctoral researchers should spend part of their PhD period abroad. The aim of this goal has been to expose young researchers to research practices and quality standards in international research environments, and support them in building international networks within their field. Interviews and statistical data both indicate that this goal has been achieved, as increasing numbers of PhD students and postdoctoral researchers go abroad for shorter stays. As such, it is not surprising that DEA's study finds evidence of a growing focus among many university managers and even faculty members on ensuring not just the *quantity* but also the *quality* of these international stays.

Facilitating lasting, strategic international networks

The increasing scope and formalization of international mobility and networks have prompted university management and government authorities to consider what role they can and should play in supporting these activities. As the scope of international activities increases, so do their costs. Because internationalization is driven largely by individuals, it is relevant for management and government bodies to consider how resources invested in international activities can firstly benefit not just the individual but the research community at large, and secondly stimulate lasting activities and effects. University managers interviewed for the study also highlighted their role in accommodating an increasing national expectation of universities to attract international funding for faculty positions and research projects.

A traditional approach to supporting international networking is to provide funding for a single researcher to participate in conferences or a research stay abroad. A more strategic approach

– seeking to maximize the number of researchers who benefit from the funding provided and to stimulate more lasting effects on mobility and networks – is to provide funding for top researchers from leading research environments to spend time in Denmark, interacting with both junior and senior researchers. This provides more Danish researchers with privileged access to leading international profiles. An example of this approach can be found in the Danish Research Unit on Industrial Dynamics (DRUID), which over a period of two decades has evolved from a small, local network with international guests to a world-leading brand and conference in innovation studies.

Another approach to supporting the development of lasting international research networks are framework agreements with particular universities or research environments abroad. Such agreements are entered into either by individual faculties or universities, or on a national level mainly by the Danish Agency of Science, Technology and Innovation. Agreements may take the form of a memorandum of understanding signed to indicate goodwill and a symbolic commitment to another university; they may also involve a certain amount of open positions, possible research stays and/or funding for joint activities.

Overall, interviews indicate that these types of agreements have limited visibility and are infrequently put into practice by Danish researchers. Many respondents were unaware of institutional collaboration agreements and even skeptical about their value offhand. Several respondents mentioned that many memoranda of understanding are simply regarded as symbolic of goodwill at the university on national level, rather than as a sign of actual interest in collaboration by international academics. Generally speaking, framework agreements with institutions and environments in industrialized countries are not widely used by researchers to plan international stays or develop new research collaborations. Interviews suggest that this is because researchers are highly selective about the international researchers and research environments they collaborate with, and already have or can gain access to the right people without the aid of an institutional framework agreement. They will also often be able to fund this contact through project grants or existing funding for travel expenses.

However, a few respondents also stressed that for some researchers, framework agreements can be particularly useful in opening the door to research environments and possible collaborators in emerging economies. This is for instance more prominent where Danish researchers have few or no existing contacts, and where higher power distance means that agreements negotiated by top-level university management or national authorities can be an effective way of paving the road for initial contact.

DEA's study points to a need for university managers to prioritize working with fewer framework agreements with greater relevance as well as visibility for the researchers at the Danish universities. Interviews suggest that successful institutional collaboration requires active involvement of relevant, established researchers, hand-picked to contribute to the establishment of the agreement. This helps ensure that ties are established with the right environments and the right people. Involvement of established researchers is also crucial for efforts to identify and support concrete opportunities for collaboration. Moreover, interviews stressed the

need to improve how widely and how effectively framework agreements are communicated to the wider group of relevant researchers in Danish institutions.

Active career management for junior researchers

The findings of the study underline that there is no universal instrument for promoting stronger international networks across research fields and individual careers for junior researchers during their PhDs, postdoctoral researchers, or even assistant professorships. This points to the need for management members on departmental levels to engage more actively in discussing career perspectives with younger researchers.

Firstly, PhD advisors, principal investigators, and management on a departmental level should actively debate the purpose of international mobility and network activities with the individual researcher. For many young academic researchers, taking a "tour of duty" abroad is now a given, but there is often too little focus spent on selecting the right destination, ensuring that the researcher has opportunity to interact with key local faculty, and timing and preparing the stay to maximize its likely impact on the young researcher's study and career. Increasing this focus requires better guidance from heads of department, PhD supervisors and principal investigators. It is also important to avoid "one size fits all" approaches to promoting internationalization among PhD students; a mandatory six month "tour of duty" may not be ideal for everyone. In some cases, the best path to strong, international research networks may for instance consist of a series of shorter stays focusing on deep relations with one specific university department (e.g. working closely with a key opinion leader in the scientific community), or with several research institutions (e.g. in the experimental sciences, where young researchers need to build competences and networks in different research infrastructures).

Secondly, university management on departmental and faculty level also have a role to play in diminishing the risk of taking up employment at foreign research institutions. According to respondents, some university departments tailor job postings to in-house candidates (despite being legally bound to hire through open, competitive job postings), in which case local networks become crucial for candidates in assuring faculty positions. Needless to say, such a job market does not particularly encourage researchers in Denmark to leave their network for an opportunity with a foreign research institution, should they have an ambition of returning to a university in Denmark later on in their career.

Thirdly, motivating postdoctoral researchers and faculty members for longer stays and employment abroad should ideally begin during undergraduate and graduate studies. Studies have shown that encouraging students to spend part of their studies abroad prepares them for more international mobility during a subsequent research career. A long term strategy for departmental and faculty management could be to further develop models of dual- and double degree programs or similarly tailored programs, where Master's students are exposed to leading foreign research environments during their studies. This has for example been a point of departure for the pre-graduate scholarships offered by the Danish Council for Independent Research | Medical Sciences as well as Lundbeckfonden Clinical Research Fellowship Program (LFCRF),

which both aim at getting young research talents to spend an extended period of time abroad, targeting them during their Master's studies. In addition, LFCRF focuses on maximizing the output of the fellowships, among other things by handpicking the fellows, embedding them in leading research groups, helping them to design concrete research projects before the fellowship commences, and by providing close mentoring from both their home and host institution during the fellowship period.

Finally, DEA recommends investigating the extent of mobility among young Danish researchers, an issue often referred to in the public debate on junior researchers. Interviews revealed that there is a widespread perception that young Danish researchers are not sufficiently internationally mobile, yet there is little if any evidence to support this impression. In fact, international data indicates that young Danish researchers are among the most internationally mobile researchers in Europe when it comes to shorter research stays abroad, both during and in the decade following their PhDs. What is still unclear, however, is the degree to which Danish researchers engage in job to job mobility, taking up research positions for longer time in other countries. Further insight on the extent of mobility among young Danish researchers is needed before conclusions or recommendations can be drawn.

Revitalizing research talent

Several respondents highlighted international mobility and networking activities not only as means for young researchers to establish a research career, but also as significant for revitalizing their research throughout an academic university career.

Respondents also referred to the so-called "Matthew effect" in the research system, whereby successful researchers tend to attract a disproportionate share of funding and awards compared to more unknown researchers. According to respondents, this effect introduces a skewness in the research system, particularly when, as in Denmark, a university research career is highly dependent on external funding, and the success rates for applications to public and private research funding bodies in Denmark as well as the EU is relatively low. This creates the risk that a group of highly talented researchers – i.e. the first and second "runner-ups" – falls just short of securing adequate funding for their research or international activities. However, this group of researchers remains a promising and valuable asset for a department. Respondents also indicated that researchers' careers may stagnate or experience decline, for instance due to family related or other personal issues, upon which revitalizing one's career can be crucial yet difficult.

DEA's study underlines the need for both departmental as well as faculty level managers to ensure that the greater pool of talented researchers in all stages of their career have possibilities of revitalizing their occupation by recognizing that a successful career is rarely productive and successful at all times. For instance, management could encourage and support more systematic uses of career-boosting activities like sabbaticals. For the general population of academic researchers, it is important that faculty and department-level management give priority to offering small amounts of funding to cover expenses connected with international networking. This is particularly important during times of budget constraints, where these funds –

according to respondents – tend to be vulnerable. According to respondents, such small funds play a significant role in creating and maintaining international networks, potentially leading to collaboration with leading foreign research environments as well as international funding, and increasing the likelihood of getting published in international scientific journals.

DEA also suggests that the Ministry for Higher Education and Science works towards reintroducing the tax reduction as part of Ligningsloven § 33 A, which used to apply to university researchers employed at Danish universities going abroad for visiting professorships for a minimum of six months. Without this reduction, it becomes even more difficult for researchers to finance going abroad, especially if this includes financing an accompanying partner or family member(s). Although the Danish Ministry of Taxation is formally responsible for such a reintroduction of *Ligningsloven § 33 A*, DEA would not expect it to pursue it.

In addition, DEA also suggests there is a need for awarding funding on a first come, first served basis each year for supporting day care expenses and increased living expenses related to going abroad on research visits. This type of award should not be based on an academic assessment, but rather on an assessment of the candidate's financial need; this need is closely related with both the destination for the research stay and personal circumstances, and it should be noted that some research grants for stays abroad already come with financial aid for bringing family members. These suggestions are based on input from several interview respondents, who underlined the importance of adequate funding for international activities. This includes funding for short international stays, conference participation and similar, but appears to be particularly vital for researchers who wish to travel for longer periods of time with their families. Several respondents pointed out that going abroad with a partner or family on just one salary is a financial challenge for postdoctoral researchers as well as faculty. This is especially true when considering destinations like New York or London, where education and living expenses are significantly higher than in Denmark: one respondent highlighted paying as much as 18,000 DKK per month for having two children in a day-care institution in London. However, while such an initiative would accommodate a well-known structural and financial challenge for furthering the international mobility of researchers, it is less clear who would have the interest in or the responsibility for providing the funding for it.

WHY IS INTERNATIONALIZATION INHERENT TO UNIVERSITY RESEARCH?

Across researchers, there is a pretty tight correlation between the quality of their research and the degree to which they participate in the international research environments. Of course it is not a perfect correlation, especially because some Danish research environments need to have a national focus. But beyond such exemptions, good researchers are also internationally active, while not so good researchers have a more local perspective. I mean, if your research does not meet the international standards, why would you want to expose yourself abroad?

– Peter Lotz, Head of Department, Vice Dean of PhD Education, Associate Professor, Department of Innovation and Organizational Economics, Copenhagen Business School

Academia and internationalization go hand in hand, as is highlighted by nearly all respondents in DEA's study. Internationalization should not be seen as a goal in itself, but rather as a means to strengthen the quality of research at Danish universities by ensuring access to highly qualified academic talent and international research funding, by reaching critical mass in research areas with small national environments, and by ensuring that agendas and methods in Danish research are state of the art.

For most researchers, pursuing a career in academia necessitates being internationally oriented for several reasons. Firstly, Denmark produces about one percent of global academic research, for which reason the quality of Danish research logically depends on the ability of Danish researchers to tap into global scientific communities.[1] Secondly, bibliometric studies have shown that publications based on international co-authorship are cited more frequently than publications where all authors are affiliated to institutions in one country (Nomaler, Frenken, and Heimeriks 2013). This may indicate that international research collaboration enables higher quality or more original research, or that accomplished researchers (who tend to receive more citations) are more likely to be attractive as international collaboration partners with access to quality international academic networks. Regardless of the underlying explanation, the studies underline that internationalization and high impact research are positively associated. Thirdly, for experimental sciences, the necessary access to cutting edge research infrastructure

1. Danish expenditure on research and development accounts for less than 0.5 pct. of the world's total expenditure on research and development, when looking at gross domestic expenditure on research and development (GERD) adjusted for purchasing power parity (UNESCO 2016). Additionally, the Danish share of the total volume of scientific publications world-wide amounts to one pct. (Danish Centre for Studies in Research & Research Policy, Department of Political Science, Aarhus University).

compels both individuals and teams of researchers to travel to highly specialized large scale research facilities and laboratories across the globe. And fourthly, international research mobility is also widely believed to be positively associated with better access to research funding (IDEA Consult 2013).

The nature of scientific research has always been characterized by its international outlook, whether talking about research mobility, research and publication collaboration, or other forms of knowledge sharing (Taylor 2004). What has changed since the 1980s, however, is the intensity and scope of internationalization of research (Huang, Finkelstein, and Rostan 2014; Dewey and Duff 2009).

Today, there are also emerging patterns of internationalization becoming increasingly formalized and deeply rooted in the activities of universities (Gornitzka, Gulbrandsen, and Trondal 2003). Firstly, there is a growing national adaption to, and influence of, international institutions such as the European Union and its Lisbon Strategy, as well as a subsequent Europe 2020 strategy for economic growth.[2] Secondly, the Lisbon and Europe 2020 strategies both point to an international tendency towards a greater dominance of economic rationales in public support for research. This rationale is particularly prominent in the EU Framework Program for Research and Innovation, which is both a significant source of research funding and a means of emphasizing research as a means to responding to great societal challenges. Thirdly, internationalization seems increasingly formalized by the significance of international research collaboration, which universities ascribe to a successful academic career, and in the continued efforts of Danish universities towards offering academic positions, which are competitive on a global scale.

Studies indicate that individual researchers are behind the majority of the international collaborations among universities (Universities UK 2008), even though there is a lack of insight into the activities and challenges related to international mobility and collaboration by academic researchers (Dewey and Duff 2009). Moreover, little is known about the role of university management in strategically stimulating, supporting, or even directing international activities.

In the following section, this report will discuss what role university researchers and managers on departmental as well as faculty level, along with authorities, play in strengthening international networks of Danish university researchers through international mobility and networking activities.

2. See more in (DEA 2016a).

HOW CAN INTERNATIONAL MOBILITY AND NETWORKING AMONG DANISH RESEARCHERS BE STRENGTHENED? MOVING FROM QUANTITY TO QUALITY

International mobility and network activities are, first and foremost, tools for creating, developing and maintaining strong networks with leading researchers and research environments, regardless of where in the world they may be. Visiting internationally leading research environments and groups also provides researchers with insight into the scientific standards and work effort required to undertake cutting-edge research. This is especially relevant for younger researchers, for whom immersion in different cultural and research practices can be a potential eye-opener and a means of building the foundation for a successful academic career.

Strong international ties require strong research environments. Thus, an underlying condition for successful internationalization is having strong research environments in Denmark in the first place. While interview respondents highlight the crucial part played by internationalization in increasing the quality of Danish university research, ambitions for stronger international research networks also requires a more general debate on the conditions for universities to perform excellent research. DEA is continuously engaged in the broader debate on supporting quality in Danish research. In this study, however, the focus has explicitly been on activities relating more directly to the internationalization of Danish university research.

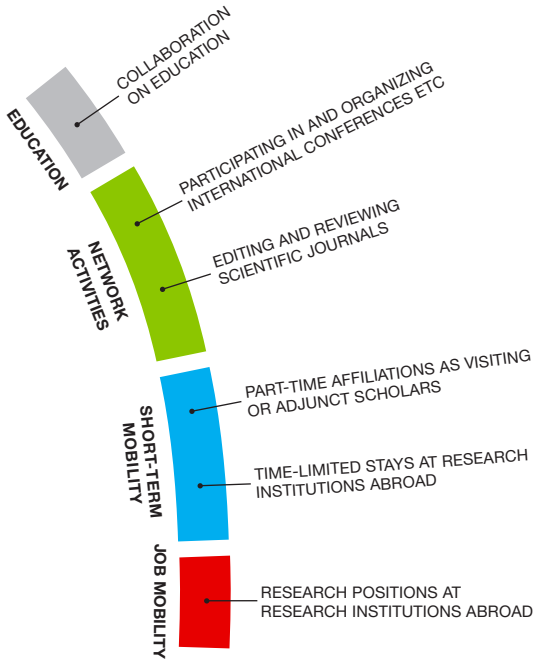
Several interviews, as well as the general literature, point to an increasing focus on internationalization in university departments. On one hand, international activities are driven by individual researchers and research groups. On the other hand, interviews indicated that departments with a high degree of internationalization often also have department heads or influential research leaders who are dedicated to internationalization, for example activities in connection with the recruitment of new faculty members. Furthermore, university, faculty or department level management may seek to support, strengthen and even direct the international activities of faculty members as part of their overall efforts to raise the quality of research. This has led managers to focus on encouraging researchers to go abroad on research stays, and attracting external funding from international sources.

Previously, key goals for internationalization in academic research departments and faculties have been to stimulate PhD students and postdoctoral researchers to go abroad for shorter research stays and, more generally, to support researchers at all stages of their career in engaging

The spectrum of international mobility and network activities

We can distinguish between several types of international research mobility and network activities, involving different degrees of formalization and commitment for the participating researchers. At one end of the spectrum, researchers can engage in network activities such as participating and organizing in international conferences and symposia, editing scientific journal articles etc. Internationalization also includes short-term mobility, i.e. time-limited stays at research institutions abroad, typically ranging from a few weeks to a year in length, or part-time affiliations e.g. as visiting or adjunct scholars. At the other end of the spectrum, internationalization can take the form of job mobility, where researchers are hired in time-limited or permanent research positions at research institutions abroad.

Internationalization of university education has not been within the scope of this study. Nevertheless, where respondents pointed to the potential effects of educational collaboration on international research networks these examples have been included in the report.



actively with the international scientific community within their field. Interviews suggest that this approach has been relatively successful. Statistical data highlights that Danish researchers are, on average, among the most highly cited in the world (DEA 2014) and engage extensively in international co-publication (Gunnarsson 2010). Moreover, Danish PhD students and post-doctoral researchers are among the most mobile in Europe, when it comes to shorter research stays abroad during and after their PhD (IDEA Consult 2013), a fact which is often overlooked in the policy debates on Danish research.

As a result, there appears to have been a shift in the focus of internationalization efforts towards encouraging researchers to become a more active part of the international research community. One respondent described this shift as a new "generation" of internationalization:

> *In Denmark, there is a current challenge in moving university research from a second to a third generation of internationalization. The first generation was about international exchange of students. The second was about getting Danish researchers abroad to challenge themselves and participate in*

foreign research environments, international conferences, etc. This has also largely been achieved. The third generation of internationalization is about establishing research teams that are distinctly international in outlook, for example in their ability to attract funding from international research foundations. This is where more of our research environments should be headed, and this is one of the great challenges for internationalization of research.

– Lars Bo Kaspersen, Professor,
Head of Department, Department of Political Science,
Faculty of Social Sciences, University of Copenhagen

Generally speaking, interview respondents confirm that internationalization challenges today are not about stimulating more researchers to engage in short-term mobility, although the high number of researchers from Danish universities engaging in international mobility is still important. Rather, it is to ensure that a high volume of international stays, networking, and collaboration activities has a sufficient level of quality and beneficial impacts on the participating researchers' careers. Many respondents highlighted the significance of recruiting foreign and Danish researchers with strong international networks in order to strengthen the international outlook of Danish universities, a point which will be addressed in the study's third report on International Recruitment.

Several respondents expressed a belief that the expectation for PhD students to spend a semester in a different research environment, preferably abroad, combined with a massive increase in the number of PhD students that are trained and supervised at Danish universities, has meant that many students do not gain what they should from academic study. Without proper guidance, PhD students risk spending time in less than optimal foreign research environments, or not having a clear idea of what they are trying to achieve with their stay, at worst ending up with little or poor interaction with the research environment abroad.

Furthermore, several respondents expressed a need for strengthening the quality of international ties between Danish researchers and key international researchers and research environments. They advocated more Danish researchers engaging in long-term stays as well as employment at research institutions abroad, allowing them to embed themselves more firmly in leading research environments.

In short, our interviews indicate that there is a growing focus among many university managers and even faculty members on ensuring quality rather than merely quantity in international activities. However, respondents were less clear on how this could be achieved. In the following, we discuss how the roles and responsibilities of university management at the faculty and departmental level, as well as government authorities, can ensure that international mobility and networking activities make a greater contribution to cutting edge research environments at Danish universities.

INTERNATIONAL NETWORKS BENEFITTING MORE THAN THE INDIVIDUAL RESEARCHER

Seeking strong, international research networks through mobility and network activities is an integral part of developing an individual researcher's profile as well as his or her career. Traditionally, this task has fallen upon the individual researcher, who knows the relevant people within his or her field, and who strives towards scientific excellence as the basis for becoming an attractive collaborator. Networks are personal and their strength based on mutual, professional, academic interest from all collaborative parties. A widespread practice of support is the mentoring responsibility of the permanent faculty to guide and support junior researchers, including PhD students. Often, the foundation stone of the young researcher's initial international network is laid by permanently employed faculty introducing them to their personal network, for example as part of a stay abroad as a PhD or postdoctoral student. The other way around this helps permanent research staff maintain their international network as well.

But today, internationalization has become gradually more formalized, and is deeply rooted in the activities of universities. Universities are increasingly expected to invest time and financial resources in benefitting from the possibilities available through international research programs such as Horizon 2020. University managers interviewed for the study also highlighted their role in accommodating an increasing, national expectation of universities attracting international funding for faculty positions as well as research projects. In addition, international research as well as publication collaboration seems to have become a competitive and consequently career qualifying resource across almost all disciplines, judging from the CVs of the researchers, who are hired for faculty positions at the universities today. Internationalization is no longer merely a concern for the individual researcher and his or her mentor, but an institutional concern involving both department faculty as well as university level managers, and – in the case of Danish universities – government authorities.

As the scope of international activities increases, so do their costs. Because internationalization is driven largely by individuals, it is relevant for management and government bodies to consider how resources invested in international activities can firstly benefit not just the individual but the research community at large, and secondly create lasting activities and effects.

This leads us to question what role should managers and authorities play in strengthening the internationalization of researchers at the Danish universities, if most international collaboration is handled by individuals? All interviews stress the importance of allowing for research networks to be driven by researchers themselves. As one of the managers interviewed for the study explains, about 95 percent of external research funds flowing into the manager's organization are raised entirely by individual researchers, and thus very few external funds are contingent on the strategic course charted by the management.

An important role played by university management and government authorities is facilitating networks that benefit more than the

individual researcher. As the case of DRUID illustrates, funding given to networks of researchers rather than to individuals can have a wide and long-term impact on the internationalization and the quality of Danish research. Mark Lorenzen, Professor at Copenhagen Business School and Director of DRUID, argues that giving individual researchers funding to promote internationalization often ends up reinforcing existing international activities and networks rather than creating new ones. While that can undoubtedly be valuable, Lorenzen explains, funding individual researchers is not likely to create much in the way of additional international activity. On this basis, DRUID was created in order to establish new contacts and build new, inclusive networks between Danish researchers and the very best international researchers in the field, something which is very hard to achieve as an individual researcher.

DEA has come across various examples of management and government authorities facilitating more strategic, long-term, international networks, seeking to maximize the number of researchers who benefit from the funding provided. The table below summarizes the purposes, possibilities, and challenges of different types of research management as well as ministerial strategies for research collaboration, though these types are not mutually exclusive.

The types of networking strategies are discussed individually in this chapter.

Table 1. *Research management and authorities' strategies for facilitating long-term, international networks*

Purpose	Possibilities	Challenges
Collaboration between research environments	Management expanding international networks of a research environment by targeting network activities at a specific group of researchers at a research institution abroad with the aim of stimulating future research collaboration	Lack of management ambitions for the international outlook of the research environment. Lack of smaller network funds for inviting international researchers
Institutional research collaboration	Creating stronger ties between departments or faculties furthering both research and educational collaboration	Agreements negotiated on top-management level with insufficient communication with or involvement of department managers or researchers
Educational collaboration	Carefully planned student exchange with relevant research environments abroad possibly creating the foundation for future research collaboration	Lack of faculty resources for developing new educational programs such as dual- or double degree programs
Establishing and securing access to research infrastructure	Attracting foreign research talent and facilitating cutting-edge research projects	Costly to invest in leading infrastructure as well as securing access to infrastructure abroad
Collaboration with universities in emerging economies	Access to international research funding as well as collaboration with strong yet internationally "overlooked" research environments	Identifying strong research environments and accessing local networks as well as funding for collaboration

Danish Research Unit on Industrial Dynamics (DRUID)

The Danish Research Unit on Industrial Dynamics, or DRUID, is a multidisciplinary research network within the field of innovation and the dynamics of structural, institutional and geographic change. DRUID was established in 1995 as an extramural collaboration between researchers at the Copenhagen Business School (CBS), Aalborg University and the University of Southern Denmark. Its aim was to strengthen the participating institutions' research and international brand by building strong ties to the international community of scholars of innovation and structural, institutional and geographic change.

DRUID is an example of how funding given to networks of researchers rather than to individual researchers can have a wide and long-term impact on the internationalization of research. The case describes a bottom-up driven initiative that was made possible by funding from research councils and government authorities; however, management support and funding from the participating universities was crucial in establishing a sound foundation for DRUID's long-term activities and expansion.

DRUID's annual conference has become one of the largest and most high-profile worldwide conferences in its field. The network aims to expose PhD students to the international research community early on in their training. In addition to hosting the annual PhD conference, DRUID works closely with doctoral training programs in both Europe and the US that provide young researchers opportunities for highly specialized training and international networking.

DRUID started as a joint workshop and conference infrastructure between research groups from CBS and Aalborg University, established with funding from the Danish Social Science Research Council and the Danish Ministry of Industry. By the mid-2000s, it became clear that continuing the expansion of DRUID's activities and the ongoing increase in their quality and depth required less ad hoc, more sustained funding. In 2005, as DRUID was entering into its second decade, AAU and CBS agreed to co-finance DRUID.

"During the first ten years, we were completely dependent on public funding", explains Mark Lorenzen, professor at Copenhagen Business School and Director of DRUID. Ironically, DRUID's international success and the increasingly global scope of their activities made it difficult for them to find public funding in Denmark. Today, DRUID is to a high extent self-financed: approximately thirty percent of the annual budget of around two million Danish Kroner is provided by the parent universities to the network; the remaining funding stems from participants in DRUID conferences. In addition, DRUID has begun partnering with leading international universities that act as sponsors and hosts for DRUID conferences.

According to Mark Lorenzen, one of the keys to DRUID's success is that it was designed by the scientists who drive it and guided by ambitious long-term goals. "As a researcher," Lorenzen explains, "you have to prioritize how you spend your time. For you to get involved in something like DRUID, you have to be able to see that the time and energy you invest will pay off, not just here and now, but for several years to come."

Lorenzen also argues that the public money awarded to DRUID in its early days was well spent "precisely because it was given to a collective of researchers. Giving individual researchers funding to promote internationalization often ends up reinforcing existing international activities and networks rather than creating new ones. This can be valuable, but it is not likely to create a lot of additionality. DRUID was created precisely in order to establish new contacts and build new, inclusive networks between Danish researchers and the very best international researchers in the field. This is not something you can do as an individual; it takes a sustained effort by a close-knit team of people."

Lorenzen also addresses the issue of how research groups and communities should internationalize. He explains: "There are two ways you can go international. You can send Danish researchers abroad, or you can get

international researchers to Denmark. And this has been the DRUID strategy from Day one: not to fund individualists who jet off to New York, but to build an international infrastructure and network centered around Denmark."

When asked about what advice he would give to other groups of researchers looking to build an international network of their own, Lorenzen offers the following advice:

- **Bring the mountain to Muhammad.** An effective, low-cost strategy for internationalization is to bring leading international researchers to Denmark, in an intimate setting like workshops or smaller conferences, where many Danish researchers can benefit from the interaction. To cite Lorenzen directly, "It was really a simple concept. In the beginning, all the funding went straight into sponsoring visits from carefully selected international researchers. We approached them directly, and invited them to come for a few days to visit us, eat good food, meet with our faculty, and talk to our students. And then it grew from there. This gives our PhD students a solid platform for building an international network, which is often more effective than sending them off to an international conference on their own. Once the door is open and they know who is interesting to work with, they have no problem getting there themselves."

- **Quality is king / Start small.** "The absolutely most important factor in the success of this kind of effort is maintaining an insanely high level of quality. In that respect, starting out small can be an advantage. Don't start out with a massive conference for the sake of exposure. Even small, invitation-only meetings with ten people can be enough to begin to create momentum. If the network and its activities are sustainable and good enough, they will have the opportunity to grow organically at a later stage, but this should not be the starting point."

- **Keep it simple.** DRUID has often considered expanding into other activities, for example joint research programs or research dissemination. "But we never get around to it, because DRUID has been so successful that we don't need it. The measure of success is not to build an ever-expanding portfolio of activities. But to be successful in what you set out to do."

Sources: The DRUID website, www.druid.dk, and a personal interview with professor Mark Lorenzen.

Collaboration between research environments

Strategic network activities between university research environments were highlighted in several interviews as deep partnerships, where researchers at a Danish university were matched with researchers at a foreign research environment, often resulting in collaboration on actual research projects exchanging ideas, skills and equipment. Deep partnerships between research environments is an obvious tool for research managers on a departmental or center level at universities to target international activities towards particular research groups across two different universities.

An example of a model of deep partnership was highlighted in one of the interviews in this study. Each year, the management of the Interdisciplinary Nanoscience Center (iNANO) at Aarhus University targets a new, leading research organization outside of Denmark, with which iNANO wishes to create stronger ties.

In practice, the iNANO Center invites and pays for a visit of eight to ten researchers from the foreign research organization to come to Denmark for two days, where overlap of research interests and ideas are discussed along with possibilities for collaboration. This concrete yet ambitious network strategy brands the Danish university center worldwide and continuously expands its network, which often leads to an invitation for visiting the research organization abroad.

Besides the obvious research collaborations, the strategy of the organization has also been to establish educational contracts for master students from iNANO to go abroad and visit the foreign research institution – preferably their laboratories – as part of their education.

The example of iNANO is one of active management, where eight to ten out of iNANO's forty employed group leaders are handpicked to engage with the researchers from the foreign research institution. Previously, iNANO has applied for external funding for the networking activities, but last year management decided to fund the initiative through the center's budget.

Institutional research collaboration

Several respondents point to framework agreements – also known as memoranda of understanding – as a means for facilitating collaboration between institutions such as entire universities, faculties or departments. The framework agreements refer to institutional agreements between a Danish university and a foreign research institution, and to agreements with a foreign research institution on hosting Danish PhD students, postdoctoral researchers, and visiting professorships. In many cases, however, these agreements attract little if any interest from the researchers. All in all, DEA's study points to a general problem with involving researchers in such agreements, or even communicating the possibilities of the agreements to the individual researchers.

Framework agreements for collaboration with high-profile universities provide the institutions with branding value, and saves individual researchers the trouble of having their research collaboration with said institutions approved by the university management at departmental or faculty level. Collaborative agreements between researchers often need formal approval from university managers in the form of their signature. And with this signature lies a significant responsibility in demanding agreements that are requested by, and benefit more than, just individual

researchers at the faculty or department.

Finally, on a university level, strategic partnership alliances with top-rated universities can also act as a seal of approval, when Danish researchers look for international partners for applications, for example Horizon 2020.

Overall, however, interviews indicate that these types of agreements have limited visibility and see very limited use by Danish researchers. Many respondents were unaware of institutional collaboration agreements on faculty and university level and even skeptical about their value offhand. DEA's interviews indicate that there is a communicational challenge in making framework agreements visible and attractive to relevant university researchers. Furthermore, the interviews point to a challenge of designing the agreements of collaboration around actual needs of researchers with an interest in collaborating.

Several respondents mentioned that many memoranda of understanding are mere symbols of intended collaboration rather than actual intentions of engaging scholars from Danish and foreign universities. These symbols of collaboration can be of significant branding value to some universities, in which case a Danish university or faculty can be on the point of insulting the foreign university by declining to sign such an understanding.

In addition, interview respondents pointed out several examples of institutional collaboration agreements on university level where researchers or departmental managers had never been consulted about their potential interest in collaborating with the foreign university, and about what was necessary to realize collaborative activities.

During the interviews DEA came across examples of institutional collaboration agreements (memoranda of understanding) with prestigious universities in industrialized countries initiated by Danish government authorities, both by university top management and private research foundations in Denmark respectively, which received little if any attention by university researchers. Interviews suggest this is because researchers are highly selective about the international researchers and research environments they wish to collaborate with, and that they already have or can gain access to the right people without the aid of an institutional framework agreement. They will also often be able to fund this contact through project grants or existing funding for travel expenses.

DEA's study suggests there is a need for university managers to prioritize working with fewer framework agreements with greater relevance as well as visibility for the researchers at the Danish universities. The interviews provided examples of institutional agreements on research collaboration, which included an early dialogue between research environments. This dialogue involved relevant departmental managers and researchers discussing where as well as how collaboration could take place, and what researchers from both institutions needed in order to initiate research collaboration. Many researchers and managers on departmental level in the interviews were skeptical of prefixed memoranda of understanding with no clear sign of interest in collaboration from researchers from the foreign university. Where institutional collaboration seemed to work, it did so because management put an effort into communicating the possibilities of the agreement, or better yet designed the agreement around researchers' needs for realizing collaboration.

In some cases, the successful management strategies hand-picked relevant researchers from each institution to initiate the dialogue. These experiences are relevant for all types of institutional agreements on research collaboration whether initiated by university management, authorities, or by private foundations.

Educational collaboration as a lever for research collaboration

Even when isolating the debate on internationalization in higher education to the topic of research – as DEA's study has done – education cannot be overlooked completely. Research and education are the two most important tasks of the university, and whether addressing international mobility or strategic partnerships with foreign universities, education plays a significant role for the internationalization of research.

Educational collaboration covers exchange of both Bachelor as well as Master's level and PhD students.

International collaboration on education was emphasized in several interviews as a potential long-term lever for research collaboration. The educational collaboration (ranging from formal dual or double-degree programs, where candidates take part of their courses at a specific department abroad, to less formal exchanges of candidate students placed at a foreign research lab) may start with education, but some students grow into becoming researchers. Therefore, the educational collaboration has the potential for researchers across the two institutions becoming familiar with each other's work and along the way seeing possibilities for collaboration. Lundbeckfonden Clinical Research Fellowship Program targets young research talents already during their Master's studies based on the idea that an early success can make a big difference for the students' future research careers (see the case description on page 29).

Some respondents stressed that developing more ambitious models of dual or double-degree programs requires faculty resources that are not prioritized in current times of budget cutbacks.

As for doctoral education with foreign universities, this was highlighted by respondents in several interviews as a more direct tool for linking Danish research groups with foreign research environments, often leading to long-term collaboration. In the interviews these agreements appeared as seeds for future research collaboration planted by both university management and government authorities, and in some cases initiated by PhD students themselves.

Establishing and securing access to research infrastructure

Collaboration around infrastructure is very common in the hard sciences, where the possession of cutting-edge test-facilities helps attract research talent, and the lack of it requires researchers to travel abroad to wherever facilities allow them to do their experiments. From a top-down perspective, negotiations on the location of infrastructure can be extensive, requiring active participation of researchers and high-level university managers as well as governmental representatives. This is the case when securing access to international collaborations like CERN, ESO, and ESS.

Establishing research infrastructure is often costly, and securing access to international infrastructure can be elaborate. International

agreements are negotiated by the Ministry of Higher Education and Science, which in turn depends on researchers for backing for signing the agreement.

Collaboration with foreign companies and universities in emerging economies

Researchers interviewed for this study are still predominantly focused on networks with researchers from either the United States or Europe when looking to strengthening their international ties. These networks are driven primarily by the individual researchers at Danish universities, who are well aware of the names of top researchers in the States and Europe, and who often find the access to those networks either individually or through their colleagues. Based on the interviews in DEA's study, the role of research managers and authorities in Denmark seems limited in terms of facilitating stronger international ties to Danish university researchers, besides providing smaller mobility and network funds for the individual researcher.

Research managers and authorities nevertheless have a more prominent role to play in cultivating international networks between researchers in Denmark and industrial partners, as well as research institutions in emerging economies. Not many respondents had a clear idea of the quality of research environments in countries like India or Brazil, just as many respondents asked for a way of being introduced to networks with relevant companies funding research.

It can therefore be helpful to have the Danish Innovation Centers facilitating meetings or other network activities used for identifying research institutions with the potential for collaboration in Brazil, India, South Korea and China. Also, in those countries official government representation helps bring down hierarchical barriers or simply vouch for the solidity of a possible collaboration with a fairly unknown Danish university department. Furthermore, local insight into the political playing field in countries such as China is also important.

One of the challenges of institutional research collaboration is that it is difficult to fund collaboration around research projects. This typically requires national research foundations from different countries with an interest in financing cross-border collaboration. While this may not be a significant barrier when applying for collaboration with European countries or the United States, Danish public and private research foundations may not be as liable to fund research collaboration with researchers from countries such as Brazil and India, where research environments are less known. A few respondents suggested that collaborative agreements with such countries are rarely formed with a view to increasing research quality in Danish universities on the short term, but because they may be of strategic interest in time. This topic, however, has not been a specific focus for DEA's broader study on the internationalization of university research, and would require further investigation before drawing final conclusions.

INTERNATIONAL NETWORKS CRUCIAL AT AN EARLY CAREER STAGE

Strong international networks are crucial for the young researcher. It is a matter of getting off to a good start, of creating professional relations that will nurture a research career. International networks not only strengthen the possibility for high quality in research through working with and learning from the best researchers, as well as making use of the best facilities in the world. International networks are also of paramount importance to publishing in leading scientific journals and attracting international research funding.

Several interviews highlight that publishing in leading international scientific journals is not only about doing excellent research work. It is important to be a familiar face at conferences and symposia, giving presentations and presenting papers, all of which increases the likelihood of getting published. More specifically, being active at conferences firstly means being more familiar with the relevant academic debates, which the researcher should respond to in a publication; secondly, being a familiar face in the research environment and possibly a more likely candidate when the editor decides, which papers should be submitted for peer review; thirdly, having a better chance of knowing the editors and what they personally look for in submitted papers for the journal; fourthly, learning about specific foci or special issues in forthcoming issues of the journal.

In short, familiarity and visibility increases one's chances of getting published, especially when trying to publish new or controversial ideas. Being active in the international research environment may not be a defining factor in getting published, but it might tip the scales in favor of success. As one respondent argued, it is important to have good colleagues around the world:

> *Research stays abroad are important for learning new ways of pursuing research, but also for your visibility in the international academic community. Researchers, who are well-known for excellent research, are more likely to be invited to participate in international symposia and conferences, and they may know the editors, who send journal submissions for peer review and make the final publication decisions. Researchers are often asked to provide suggestions for reviewers for papers submitted to journals; it is therefore important to have good colleagues around the world from your field of research. Getting your work published is easier if you are a known face in the international network, obviously provided that your research is of high quality. Ways of achieving visibility include taking on various administrative duties, or taking a "tour of duty" on the boards of the professional organizations and societies. The most ambitious researchers organize symposia and conferences for both Danish and international audiences.*
>
> **– Ole Nørregaard Jensen,**
> Professor, Head of Department, Department of Biochemistry and Molecular Biology, Faculty of Science, University of Southern Denmark

Respondents also stress the fact that professional networks with research colleagues are relatively easy to maintain but can be hard to create in the beginning. Once you establish a strong international network, those people are likely to stay within your network, and they will very likely be the academics you end up collaborating with

when applying for international research funding. This is the case when actively gathering a research consortium, but is also not uncommon to be contacted by your network and asked to join a research application from national research foundations in the home country of your network.

No "one size fits all" – a solution for stronger international networks.

The international competition for faculty positions is an unavoidable part of a university research career in Denmark. The younger generation of researchers at Danish universities has experienced a significant increase in the percentage of positions filled by researchers coming from foreign universities or research institutions. Thus, twenty nine percent of assistant professorships were filled by researchers employed at foreign institutions in the period of 2011-2013, compared to merely eight percent in 1998-2000 (The Danish Council for Research and Innovation Policy 2015). This increase most likely also covers a rise in the mobility of Danish researchers returning to Denmark after employment abroad, but it only adds to the point.

But the nature and purpose of internationalization varies across disciplines as well as career ladders and personal events, such as researchers having children and taking up mortgages for buying new homes. There is no universal instrument for promoting stronger international networks. University management as well as government strategies for supporting and facilitating stronger ties between researchers at Danish universities and abroad should be tailored to each specific research area, and viewed in a life course perspective accounting for the diverse needs and challenges of mobility events throughout a researcher's career and personal life.

The nature and purpose of internationalization varies across disciplines

Respondents stress the fact that the significance of different types of mobility is not the same across scientific disciplines.

Researchers from the hard sciences mostly work and publish in groups, which highlights the importance of doing research and publishing with leading research groups outside of Denmark that may have better or merely different competencies than research groups in Denmark. In some fields within the hard sciences such as mathematics, as well as parts of the humanities, researchers typically do research and publish individually and thus are not dependent on other researchers for doing research to the same extent as in subjects such as bio-engineering.

Researchers from experimental sciences depend on cutting-edge research infrastructure in order to perform tests and carry out state of the art research, which compels them to travel to places where such infrastructure is available. This is typically not the case within the soft sciences, where researchers in principle only need a computer and internet access to perform their work. And even within the hard sciences, there are fields of research such as computational engineering, where anywhere in the world with a fast computer would suffice as a workplace.

International mobility can also be necessary in order to acquire special research techniques, which other research units have specialized in. This mobility can also be a matter of getting familiar with and being accepted by key research figures within one's field, particularly in cases where these figures may act as gatekeepers to a fairly small, specialized international research environment.

In areas such as medical research in Denmark, the PhD can serve as a stepping stone for doctors to become medical specialists in Denmark, in which case research stays abroad do not necessarily enhance career prospects in Denmark.

Diverse career ladders and personal trajectories require different paths to international networks

Respondents point out that international mobility for PhD students is primarily a question of building academic networks, broadening students' academic horizons (i.e. exposing them to other ways of doing things), and accessing infrastructure and specialized competences etc. However, in many countries PhD students are treated more like students and less as part of the faculty team, meaning that many end up in large groups of PhD students without much mentorship from permanently employed faculty. Furthermore, there may also be a difference between going abroad in the early, more explorative stage during the PhD, where learning new skills or acquiring new perspectives on research in general can be useful, and going abroad later on during the PhD, where a stay abroad more likely will be in need of a more specific benefit such as accessing data, infrastructure or feedback on concrete elements of the dissertation.

By contrast, postdoctoral researchers are typically integrated into the scientific staff, working closely with permanent members from the faculty team. As a postdoc, research stays abroad resemble temporary employment on specific research projects, and could be used to broaden the international network to include other relevant research environments than acquired during the PhD.

Young researchers do not get permanent employment without strong international networks. But as a professor or an associate professor, those networks still need to be maintained through international network activities such as participating in conferences. Furthermore, to permanent research staff, taking sabbaticals abroad could enable time for doing better research by escaping the familiar routines and obligations at the university (see the chapter below: "Revitalization of research talent is vital throughout an academic career").

Too much focus on the inherent value of a research stay abroad could also mean overlooking the necessary question of how the researcher should benefit from the stay. One principal investigator suggested that several of the researcher's PhD students were too aware of the structural expectation for research stays in the general academic career system to consider exactly that question. And, as other respondents highlighted, even the most talented researchers may not perform equally excellently over the course of a professional career due to personal occurrences such as having children, dealing with family illness, etc. Sustaining the foundations for excellence in Danish research environments also means supporting diversity among scholars as well as the layer of promising, talented researchers taking into account their personal trajectories.

DEA concludes on the basis of the interviews that there is a need for career counseling for junior researchers, which moves away from fixed ideas of international mobility.

PhD supervisors, principal investigators, and heads of department should actively and explicitly discuss relevant international activities at the PhD

and postdoctoral level as well as at the level of permanent faculty. Longer research stays abroad increase the likelihood of – but is no guarantee for – acquiring stronger international research networks, and of actually collaborating and publishing with the foreign research environment in question.

The need for active career management for junior researchers

> *Internationalization at the PhD level is a good idea, but because the PhD in Denmark is so short, I believe in most cases the cost outweighs the benefit. The goal of the PhD process is to become deep in your subject. Three years is often not enough time to do that. Internationalization by this mechanism is fine for some, not good for others, but in no case is it more important than becoming deep.*
>
> **– Charles M. Marcus,**
> Villum Kann Rasmussen Professor, Niels Bohr Institute, Faculty of Science, University of Copenhagen

Studies have shown that a large share of academic researchers maintain collaborative links with their home countries when going abroad for longer stays or employment abroad (Fernández-Zubieta, Geuna, and Lawson 2015). This value of international brain circulation seems prevalent in DEA's interviews. Many researchers as well as department level managers in the interviews express a demand for junior researchers to be willing to spend more of their career at foreign research institutions. The interview respondents hope that Danish researchers going for doctoral education, visiting professorships or other longer term employment abroad will provide research environments at their home universities with stronger international networks.

There is a need for PhD advisors, principal investigators, and management on a departmental level to take a more active part in career management for junior researchers. Some respondents highlighted that for many young academic researchers, taking a "tour of duty" abroad is now a given, but often too little focus is spent on asking how such a research stay abroad can benefit research and the prospects of a research career. Many respondents also expressed a concern that Danish postdoctoral researchers rarely consider a career abroad as an attractive or even necessary option for securing a career as a university researcher.

Firstly, PhD advisors, principal investigators, and management on a departmental level should actively debate the purpose of international mobility and network activities with the individual researcher, rather than merely the length of the stay. As with the research matter, too little focus is often spent on selecting the right destination, ensuring that the researcher has opportunity to interact with key local faculty, and timing and preparing the stay to maximize its likely impact on the young researcher's research and career. Some respondents expressed a concern that both junior researchers as well as management on departmental level failed to properly address the purpose and expectations of going abroad, rather than simply regarding international job mobility as an imperative career direction. Without proper supervision, junior researchers might end up spending time at foreign research institutions without sufficiently clear expectations of what to gain from a stay or work abroad, how to gain from it, and what it takes for international mobility to benefit their career later on. Increasing this focus requires better guidance from heads of departments, PhD supervisors,

and principal investigators. A mandatory six-month "tour of duty" may not be ideal for all PhD students. In some cases, the best path to strong, international research networks may for instance consist of a series of shorter stays focusing on deep relations with one specific university department (e.g. working closely with a key opinion leader in the scientific community) or with several research institutions (e.g. in the experimental sciences, where young researchers need to build competencies and networks in different research infrastructures). In research fields such as computer science, conferences proceedings, where a collection of academic papers is published in the context of an academic conference, are common channels for research publication. In this case active participation in international conferences plays a much more crucial role for researchers than in research fields with experimental science requiring longer visits abroad, where research infrastructure enables proper experiments, or in research fields where the primary publication channel is still scientific journals.

Secondly, university management on departmental and faculty level also have a role to play in diminishing the risk of taking up employment at foreign research institutions. According to respondents, some university departments tailor job postings to in-house candidates despite being legally bound to hire through open, competitive job postings, in which case local networks becoming crucial for candidates in assuring faculty positions. Needless to say, such a job market does not particularly encourage researchers in Denmark to leave their network for an opportunity at a foreign research institution, should they have an ambition of returning to a university in Denmark later on in their career.

Thirdly, another long-term strategy for management at department and faculty level to motivate junior researchers for long-term doctoral studies or postdoctoral employment at foreign universities could be earlier on to introduce them to the research opportunities available at leading universities abroad. Studies have shown that exposing students to international mobility during university studies makes them more likely to become internationally mobile as researchers (Børing et al. 2015). Currently, the share of Danish university students studying abroad during their education is similar to the average share of students in the EU (The Agency for Universities and Internationalisation 2013). This mobility typically takes place within the ERASMUS exchange program, covering stays abroad of three to twelve months in duration. More ambitiously, Danish university departments could increase their use of more strategic, dual and double degree programs or similarly tailored programs, for instance those in which graduate studies are planned with a mandatory exchange with carefully selected and academically relevant institutes abroad. Exposing Bachelor and Master's students to foreign, academically relevant and leading research environments early on would be a long term investment in future international research networks. These programs should be carefully targeted towards the most talented students with the potential to pursue a research career. This has been the point of departure for the pre-graduate scholarships from the Danish Council for Independent Research | Medical Sciences (FSS) providing qualified students with funding to undertake pre-graduate research. It is also part of programs like Lundbeckfonden Clinical Research Fellowship Program, which aims at getting young research talents to spend an extended period of time abroad, already targeting them during their Master's studies.

Lundbeckfonden Clinical Research Fellowship Program

This case provides an example of a dedicated effort to get young research talents to spend an extended period of time abroad, targeting them already during their Master's studies. Lundbeckfonden Clinical Research Fellowship (LFCRF) Program provides the necessary infrastructure for young medical students to get a jump-start on their clinical research career by supporting them in undertaking a challenging, independent research study and building an academic network at leading research institutions in the San Francisco Bay Area.

Every year, the LFCRF Program brings up to six Danish medical students to the San Francisco Bay Area for ten months, to receive hands-on training in clinical research. The program is a partnership between Lundbeckfonden and Innovation Centre Denmark, and is based in Silicon Valley at Innovation Centre Denmark. Selected students will be provided with international experience, comprehensive clinical research training, and a highly supportive infrastructure (housing, insurance, visa, banking etc.) enabling students to accomplish their research and career goals. Students are offered a fellowship stipend of $30,000, and expenses related to travel and health insurance will be covered.

During their stay, each fellow must complete one or more closely mentored clinical research projects at one of the participating Bay Area Institutions: University of California at San Francisco (UCSF), Stanford University, and California Pacific Medical Center (CPMC, an affiliate of Sutter Health) and its research institute. These projects are supervised by two mentors – one from a Danish university and one from the host university. The fellows also receive small-group teaching in the responsible conduct of research, clinical study design, biostatistics, epidemiology, research presentation, and manuscript writing. All fellows are required to submit at least one first-author manuscript to a peer-reviewed journal. In addition to the formal lecture program, Fellowship Program Director Karin Lottrup Petersen, MD, meets twice monthly with individual students to review goals and progress. Fellows also meet with internationally recognized senior clinical researchers for small-group career mentoring.

The aim of the program is to stimulate highly talented Danish medical students to go abroad, and to support them in doing so effectively. Petersen stresses the importance of a carefully designed and managed approach to getting students to venture abroad. "There are several programs," she explains, "that provide funding for students to spend some time at an international institution. But without the right project, the right preparation, and the right mentoring, the stay is off to a bad start. Also, many visiting students end up more or less in isolation during their stay, not really tapping into the local research environment. One of the advantages of our program is that we have a fantastic network of mentors in the participating institutions; moreover, over the years, these people have built strong ties to affiliated mentors in the Danish clinical research community. These ties lay the foundation for a strong fellowship program."

In fact, in addition to the mentoring of individual students, the program aims to create enduring international teaching and research collaborations between participating institutions, taking advantage of the relative strengths of each: Renowned for extensive patient registries, cohorts, and population-based studies, the participating Danish institutions are ideal partners to help advance the cutting-edge, broad portfolio of research and clinical expertise at the three Bay Area medical centers.

Thorough preparation of the project and the supportive infrastructure that the program provides enables fellows to "hit the ground running" and immediately focus on their research project. Ongoing mentoring ensures that problems emerging during the fellowship year (student effort, mentor involvement, study design/feasibility issues) are identified and corrected early on.

The number of fellows is kept at around five per year to allow for the program to deliver sufficient, personal guidance to each and every fellow. The Fellowship Program has produced a number of successful alumni, many of whom have gone on to pursue a career in clinical research.

According to Petersen, the involvement of Innovation Centre Denmark has been crucial in establishing a neutral ground from which to involve each of the US partner institutions. Had the collaboration been anchored in one of the three institutions, this would have been likely to reduce the other two institutions' sense of ownership and commitment to the program.

Sources: Lundbeckfonden Clinical Research Fellowship Program, www.lfcrf.org, and a personal interview with Program Director Karin Lottrup Petersen.

Little evidence of young Danish researchers lacking international mobility

Respondents from a broad range of disciplines have relayed an impression that Danish young researchers are less mobile than could be desired. However, there seems to be little – if any – evidence to back this up. In fact, international data indicate that young, Danish researchers are among the most internationally mobile researchers in Europe, when it comes to shorter research stays abroad during as well as the ten years following their PhD (IDEA Consult 2013).

What is still unclear, however, is the degree to which Danish researchers engage in job to job mobility, taking up research positions for longer time in other countries (Fernández-Zubieta, Geuna, and Lawson 2015). This is a topic which has received little attention in the literature.

Nonetheless, there is a general impression that young Danish researchers are reluctant to move to jobs in other institutions, a subject which deserves attention. For instance, this was highlighted in an international peer review panel evaluation of a program (NABIIT) under the former Danish Council for Strategic Research (The Danish Council for Strategic Research 2012). It is possible that the problem exists but is concentrated in some fields, departments or research groups. It appears to be compounded by the fact that Danish PhD students tend to be older and therefore more likely to have families with small children and working partners or spouses (DEA 2014).

Without evidence, no action should be taken towards increasing the mobility of young researchers. As stated earlier, we should be more concerned with ensuring quality rather than merely quantity in international activities. However, the general consensus among many academic researchers and university managers points to the need for more insight. DEA recommends investigating the extent of lacking mobility among young Danish researchers.

REVITALIZATION OF RESEARCH TALENT IS VITAL THROUGHOUT AN ACADEMIC CAREER

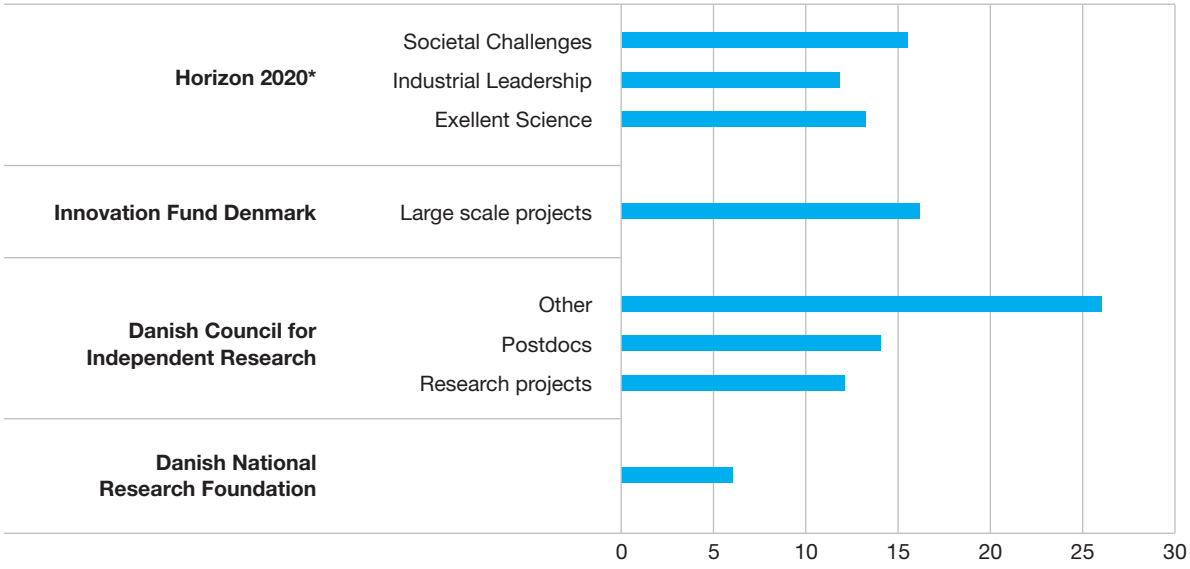
Several respondents highlighted international mobility and networking activities not only as means for junior researchers to establish a research career early on, but also as activities that are significant for revitalizing one's research throughout an academic university career. Nevertheless, respondents experienced a bias in the way opportunities were presented to researchers at the universities.

Researchers interviewed for the study highlighted the Matthew effect (Merton 1968) in the Danish research system, whereby talented, successful researchers tend to attract a disproportionate share of funding and awards compared to more unknown researchers. According to respondents, this effect introduces a skewness in the research system, particularly when, as in Denmark, a research career is highly dependent on external funding,[3] and the success rates for applications for public and private research funding bodies is relatively low. This creates the risk that a group of highly talented researchers – i.e. the first and second "runner-ups" – falls just short of securing adequate funding for their research or international activities, for example. However, this group of researchers may still be very productive and valuable for a department in relation to research, teaching and other tasks. Respondents also indicated that researchers' careers may stagnate or experience decline due to family related or other personal issues, upon which revitalizing one's career can be crucial yet difficult.

Currently, the competition for existing funding resources has resulted in diminishing success rates for applications for research funding from both the EU as well as the Danish research foundations, which are currently at a level where many talented researchers are unable to secure funding. As the table below illustrates, the average success rates for research programs across the public research foundations in Denmark is somewhere in between twelve and sixteen percent, disregarding InnoBooster and Talent, which are not targeted research projects. As several evaluations and studies have pointed out, success rates at around twenty percent and below will cause even the most prominent scientists to have difficulty maintaining funding for their laboratories, and young scientists seeking their first grant may become so overwhelmed that individuals of great promise will be driven from the field (Danish Agency for Science Technology and Innovation 2014; Research Councils UK 2006; Cushman et al. 2015; Hippel and Hippel 2015; Corbyn 2011; Howard and Laird 2013).

3. Denmark is the country in the OECD with the second largest share of external funding for university research coming from private funding bodies (Ministry of Higher Education and Science 2015).

Figure 1. *Average success rates across research councils and funding agencies, pct., 2014*



Source: (Danish Agency for Science Technology and Innovation 2015)
*2015 data

Conditions for sabbaticals may exclude the runner-up

Most interviews stress the importance of sabbaticals for permanent research staff, of shorter or longer research stays as visiting professors abroad allowing a break from teaching and administrative duties. Taking time as a visiting professor allows for immersion in one's research as well as inspiration from new research environments, which is not the case in the daily, hectic and often predictable university career. Some interviews point out that sabbaticals in this way can directly contribute to increasing the researcher's productivity.

Sabbaticals – the interviewees argue – are not institutionalized at the universities, but mostly financed through external project funding that frees the researcher from other duties. Since sabbaticals mean time away from teaching and other obligations, they often lead to increased time to do research and consequently better research output, which again strengthens the possibility for success when applying for more external funding from research councils granting research funds on the basis of peer-review evaluation.

There is a risk that the current way of financing sabbaticals excludes highly talented researchers, where the first and second "runner-ups" falls just short of securing external funding for buying them out from teaching, which reinforces their career as teachers but not necessarily as researchers.

DEA's study underlines the need for both departmental as well as faculty level managers to

ensure that the greater pool of talented researchers in all stages of their career have possibilities of revitalizing their career, recognizing that a successful career is rarely productive and successful at all times. For instance, management could encourage and support more systematic use of career-boosting activities like sabbaticals. For the general population of academic researchers, it is important that faculty and department-level management give priority to offering small amounts of funding to cover expenses connected with international networking. This is particularly important during times of budget constraints, where these funds – according to respondents – tend to be vulnerable. According to respondents, such small funds play a significant role in creating and maintaining international networks, potentially leading to collaboration with leading foreign research environments as well as international funding and increasing the likelihood of getting published in international scientific journals.

DEA also suggests that the Ministry for Higher Education and Science works towards reintroducing the tax reduction as part of *Lignings loven § 33 A*, which used to apply for university researchers employed at Danish universities going abroad for visiting professorships for a minimum of six months. Without this reduction, it becomes even more difficult for researchers to finance going abroad, especially if this includes financing an accompanying partner or family. Although the Danish Ministry of Taxation is formally responsible for such a reintroduction of *Lignings loven § 33 A*, DEA would not expect it to pursue it.

Smaller mobility funds go a long way – not least in times of budget restraints

Some interviews suggest that smaller departmental funds for international network activities are especially vulnerable in times of university budget cutbacks – both in past and present times – where many heads of departments as well as faculty and university management will go to great lengths in order to avoid dismissals.

Nevertheless, even smaller network funds are crucial to ensure research mobility for junior as well as permanent faculty. Having funds for professional visits, shorter research stays, participation in conferences etc. is a matter of maintaining the international network, which generates research collaborative activities, applications for external funding, and increases chances to publish in the internationally leading, scientific journals. Making do without such funds for a year or two may seem like a minor price to pay for avoiding dismissals, but it can have lasting, negative effects on international activities, especially for younger researchers with short term employment and limited external funding for mobility purposes.

Regarding short term international mobility, some researchers in this study emphasize, how strong international research networks were very much obtained through extensive and active participation in international conferences and through shorter stays focusing on deep relations with one specific university department or on broader networks with several research institutions. Furthermore, several respondents highlighted that participation in international conferences, symposia or short visits to foreign colleagues at research institutions abroad are crucial for enabling established researchers to maintain strong ties to foreign research environments, which may lead to both research collaboration and international research funding further down the road. Finally, maintaining familiarity with and visibility in

international networks could mean the difference between success and failure when attempting to publish in international scientific journals (see the chapter on "International networks crucial at an early career stage").

Regarding long term international mobility, several respondents highlight that PhD students and postdoctoral researchers in Denmark are relatively older than their colleagues in other countries and thus more likely to be of an age, where many start having children, buying property, and generally becoming less willing to take on longer research stays abroad. This is a structural challenge and a circumstance facing all potential international mobile workers and not just researchers in particular (Børing et al. 2015). More importantly, it is a financial challenge going abroad on one income, while depending on a double career income for paying for living expenses as well as day care for children abroad, which in countries such as the United States is, according to interviewees, very costly compared to Denmark. Nevertheless, earning a place among the faculty – especially within the technical and natural sciences – usually requires a CV displaying visits at leading research institutions abroad during both PhD and postdoctoral periods, which during the latter is expected to be for a minimum of one to two years.

Respondents therefore argued for better financial support for researchers going abroad with children. One respondent explains that they ended up paying 18,000 DKK per month in London for having their two children in a day care institution. Although the relation is by no means causal, funding seems to have a positive influence on younger researchers' inclination to go abroad for longer periods of time. Thus, previous evaluations of Danish government instruments for researchers early on in their career have shown that there is a correlation between receiving funding for research projects and going abroad (Danish Agency for Science Technology and Innovation 2010).

Based on the interviews, DEA also suggests there is a need for funding awarded on a first-come, first served basis each year for supporting day care expenses and increased living expenses related to going abroad on research visits. This type of award should not be based on an academic assessment but rather on an assessment of the candidate's financial need, since this need is closely related with both the destination for the research stay as well as personal circumstances, and since some research grants for research stays abroad already come with financial aid for bringing family members. This includes funding for short international stays, conference participation and the like, but appears particularly vital for researchers who wish to travel for longer periods of time with their families. However, while such an initiative would accommodate a well-known structural and financial challenge for furthering the international mobility of researchers, it is less clear who would have the interest in or the responsibility for providing the funding for it.

ABOUT THE STUDY

The study is based on sixty interviews with researchers, managers on departmental and faculty level, and administrative staff at Danish universities as well as abroad. Interviews were also conducted with managers and board members of Danish public and private research foundations. Forty-three were conducted as semi-structured interviews of approximately one hour each. Seventeen were conducted as focus group interviews in Copenhagen and Aarhus.

Researchers and university managers were identified using desk research of their relevant experiences as well as snowball sampling following an initial email request for relevant interview respondents to faculty level managers at all Danish universities. DEA has strived to select researchers and managers reflecting diversity in gender, academic fields, and positions from assistant professors to professors across the Danish universities. Interviewees have also been selected on the basis of relevant experience with international mobility and network activities, international recruitment, and attracting international funding. Furthermore, DEA has interviewed researchers with both foreign as well as Danish nationalities.

In addition, the study draws on background interviews as well as findings from a survey of literature on internationalization of academic research. The key findings from this study are described in a separate publication.

Interviews were conducted during a period from October 2015 to June 2016. Respondents are listed below by university affiliation and in alphabetic order by given name. Their title refers to their designation at the time of the interview. Interviews marked with an asterisk were carried out as focus group interviews.

Interview respondents from Copenhagen Business School:

- Alan Irwin, Professor, Department of Organization, Copenhagen Business School
- *Duncan Wigan, Associate Professor, Department of Business and Politics, Copenhagen Business School
- *Kristian Miltersen, Professor, Department of Finance, Copenhagen Business School
- Mark Lorenzen, Professor with special responsibilities, Department of Innovation and Organizational Economics, Copenhagen Business School
- Peter Lotz, Head of Department, Vice Dean of PhD Education, Associate Professor, Department of Innovation and Organizational Economics, Copenhagen Business School

Interview respondents from Roskilde University:

- Gorm Rye Olsen, Professor, Department of Social Sciences and Business, Roskilde University
- *Sune Haugbølle, Associate Professor, Department of Social Sciences and Business, Roskilde University

Interview respondents from Technical University of Denmark:

- *Anke Hagen, Professor, Department of Energy Conversion and Storage, Technical University of Denmark
- Idelfonso Tafur Monroy, Professor, Department of Photonics Engineering, Technical University of Denmark
- *Ivana Konvalinka, Assistant Professor, Department of Applied Mathematics and Computer Science, Technical University of Denmark
- Peter E. Andersen, Senior Researcher, Department of Photonics Engineering, Technical University of Denmark
- Peter Hauge Madsen, Head of Department, Department of Wind Energy, Technical University of Denmark
- Rasmus Larsen, Head of Department, Professor, Department of Applied Mathematics and Computer Science, Technical University of Denmark

Interview respondents from University of Copenhagen:

- *Alicia Lundby, Associate Professor, Proteomics – Center for Protein Research, Faculty of Health and Medical Sciences, University of Copenhagen
- *Anders Juul, Professor, Department of Growth and Reproduction & EDMaRC, Rigshospitalet, Faculty of Health and Medical Sciences, University of Copenhagen
- *Anders Søgaard, Professor with special responsibilities, Centre for Language Technology, Faculty of Humanities, University of Copenhagen
- Ayo Wahlberg, Professor with special responsibilities, Department of Anthropology, Faculty of Social Sciences, University of Copenhagen
- *Carsten Smith-Hall, Professor, Department of Food and Resource Economics (IFRO), Faculty of Science, University of Copenhagen
- Charles Marcus, Villum Kann Rasmussen Professor, Niels Bohr Institute, Faculty of Science, University of Copenhagen
- Helle Krunke, Director, Professor, Centre for Comparative and European Constitutional Studies, Faculty of Law, University of Copenhagen
- Ian D. Hickson, Director of Center for Chromosome Stability, Professor, The Department of Cellular and Molecular Medicine, Faculty of Health and Medical Sciences, University of Copenhagen
- Kim Brinckmann, Director, Research & Innovation, University of Copenhagen
- Lars Bo Kaspersen, Head of Department, Professor, Department of Political Science, Faculty of Social Sciences, University of Copenhagen
- Morten Pejrup, Associate Dean for Research, Professor, Faculty of Science, University of Copenhagen
- Per Sanggild, Professor, Department of Veterinary Clinical and Animal Sciences, Faculty of Health and Medical Sciences, University of Copenhagen
- Robert Krarup Feidenhans'l, Head of Department, Professor, Niels Bohr Institute,

Faculty of Science, University of Copenhagen

Interview respondents from University of Southern Denmark:

- Jesper Wengel, Professor, Department of Physics, Chemistry and Pharmacy, Faculty of Science, University of Southern Denmark
- *Karen Andersen Ranberg, Associate Professor, Department of Public Health, Faculty of Health Sciences, University of Southern Denmark
- Ole Nørregaard Jensen, Head of Department, Professor, Department of Biochemistry and Molecular Biology, Faculty of Science, University of Southern Denmark
- Susanne Mandrup, Professor, Department of Biochemistry and Molecular Biology, Faculty of Science, University of Southern Denmark
- Åsa Fex Svenningsen, Associate Professor, Department of Molecular Medicine, Faculty of Health Sciences, University of Southern Denmark

Interview respondents from Aalborg University:

- Frede Blaabjerg, Professor, Department of Energy Technology, The Faculty of Engineering and Science, Aalborg University
- *Marco Maschietti, Associate Professor, Department of Chemistry and Bioscience, The Faculty of Engineering and Science, Aalborg University
- Søren Pihlkjær Hjortshøj, Head of Section at Aalborg University Hospital, Head of Department, MD, Department of Clinical Medicine, The Faculty of Medicine, Aalborg University

Interview respondents from Aarhus University:

- Anders Frederiksen, Head of Department, Professor, Department of Business Development and Technology, Aarhus BSS, Aarhus University
- *Armin W. Geertz, Professor, School of Culture and Society – Department of the Study of Religion, Arts, Aarhus University
- Bjarke Paarup, Head of School, Associate Professor, School of Culture and Society, Arts, Aarhus University
- *Jacob Sherson, Associate Professor, Department of Physics and Astronomy, Science and Technology, Aarhus University
- John Westensee, Vice Director, AU Research Support and External Relations, Aarhus University
- Johnny Laursen, Dean, Arts, Aarhus University
- Jørgen Kjems, Director, Professor, Interdisciplinary Nanoscience Center (iNANO), Science and technology, Aarhus University
- Kristjar Skajaa, Head of Department, Department of Clinical Medicine, Health, Aarhus University
- Lars Arge, Professor, Department of Computer Science, Science and Technology, Aarhus University
- Lars Birkedal, Head of Department, Professor, Department of Computer Science, Science and technology, Aarhus University
- *Lars Ditlev Mørck Ottosen, Head of section, Associate Professor, Department of Engineering – Biological and Chemical Engineering, Science and Technology, Aarhus University
- *Martijn Heck, Associate Professor, Department of Engineering – Photonics, Science and Technology, Aarhus University

- *Niels Peter Revsbech, Professor, Department of Bioscience – Microbiology, Science and Technology, Aarhus University
- Peter Dalsgaard, Associate Professor, School of Communication and Culture – Information Science, Arts, Aarhus University
- Peter Kristensen, Associate Professor, Department of Engineering – Molecular Engineering, Science and Technology, Aarhus University
- *Rubina Raja, Professor, School of Culture and Society – Archaeology, Arts, Aarhus University

Interview respondents from Danish public and private research foundations:

- Karin Lottrup Petersen, Program Director, MD, Lundbeckfonden Clinical Research Fellowship Program, Innovation Center Denmark
- Peter Høngaard Andersen, CEO, Innovation Fund Denmark
- Anne-Marie Engel, Director of Research, Lundbeckfonden
- Birgitte Nauntofte, CEO, Novo Nordisk Foundation
- Peter Munk Christiansen, Chair, The Danish Council for Independent Research
- Liselotte Højgaard, Chair, The Danish National Research Foundation
- Thomas Sinkjær, Director of Science, Villum Fonden

Interview respondents from universities abroad:

- Fiona M. Doyle, Dean of the Graduate Division, Professor, University of California, Berkeley
- Ludde Edgren, Head of office, Grants and Innovation Office, University of Gothenburg
- Eva Björndal, Team Leader, Post-Contract Office, Karolinska Institutet

List of people interviewed for background:

- Hanne Foss Hansen, Professor, Department of Political Science, Faculty of Social Sciences, University of Copenhagen
- Kaare Aagaard, Senior Researcher, Department of Political Science – Danish Centre for Studies in Research and Research Policy, Aarhus BSS, Aarhus University
- Lise Degn, Assistant Professor, Danish School of Education, Faculty of Arts, Aarhus University
- Lise Thorup-Pedersen, Deputy Director, Rectors Secretariat, Aarhus University
- Mikkel Bülow Skovborg, Innovation Attaché, Innovation Centre Denmark Silicon Valley
- Nina Espegård Hassel, Innovation Attaché, Innovation Centre Denmark Shanghai
- Olaf Svenningsen, Executive Officer, PhD, Southern Denmark Research Support, Faculty of Health Sciences, University of Southern Denmark
- Trine Buhl Monty, Senior Executive Consultant, SCIENCE Faculty Office, Research and Innovation, Faculty of Sciences, University of Copenhagen

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ABOUT DEA

DEA is an independent, non-profit think tank based in Copenhagen, Denmark.

Our mission is to promote intelligent and effective investments in research, education, and innovation that contribute to higher growth and productivity.

DEA strives to fulfill this mission by providing high-quality research, analyses and policy advice, and by engaging in constructive dialogue with the political system and key public and private stakeholders. DEA also collaborates with relevant public and private companies to ensure that policy development is informed by needs and insight from industry.

WHAT WE DO

DEA aims to be a credible and impartial source of insight into research, education and innovation policy. To that end, we:

- Undertake state-of-the-art research and analyses both in-house and in collaboration with leading researchers, consultants and policymakers in Denmark and abroad.
- Organize conferences, seminars, and workshops to stimulate informed, constructive debate and networking among key public and private stakeholders.
- Participate in the public debate regarding science, education, and innovation through e.g. blogs, articles and other contributions in the media.
- Undertake selected commissioned research and consultancy projects, provided that such projects are in line with our professional and ethical standards.
- Give invited talks in Denmark and abroad.

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A BRIEF HISTORY OF THE INTERNATIONALIZATION OF DANISH RESEARCH

– A LITERATURE REVIEW

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A brief history of the internationalization of Danish research – A literature review is partially financed by the Danish Agency for Science, Technology and Innovation.

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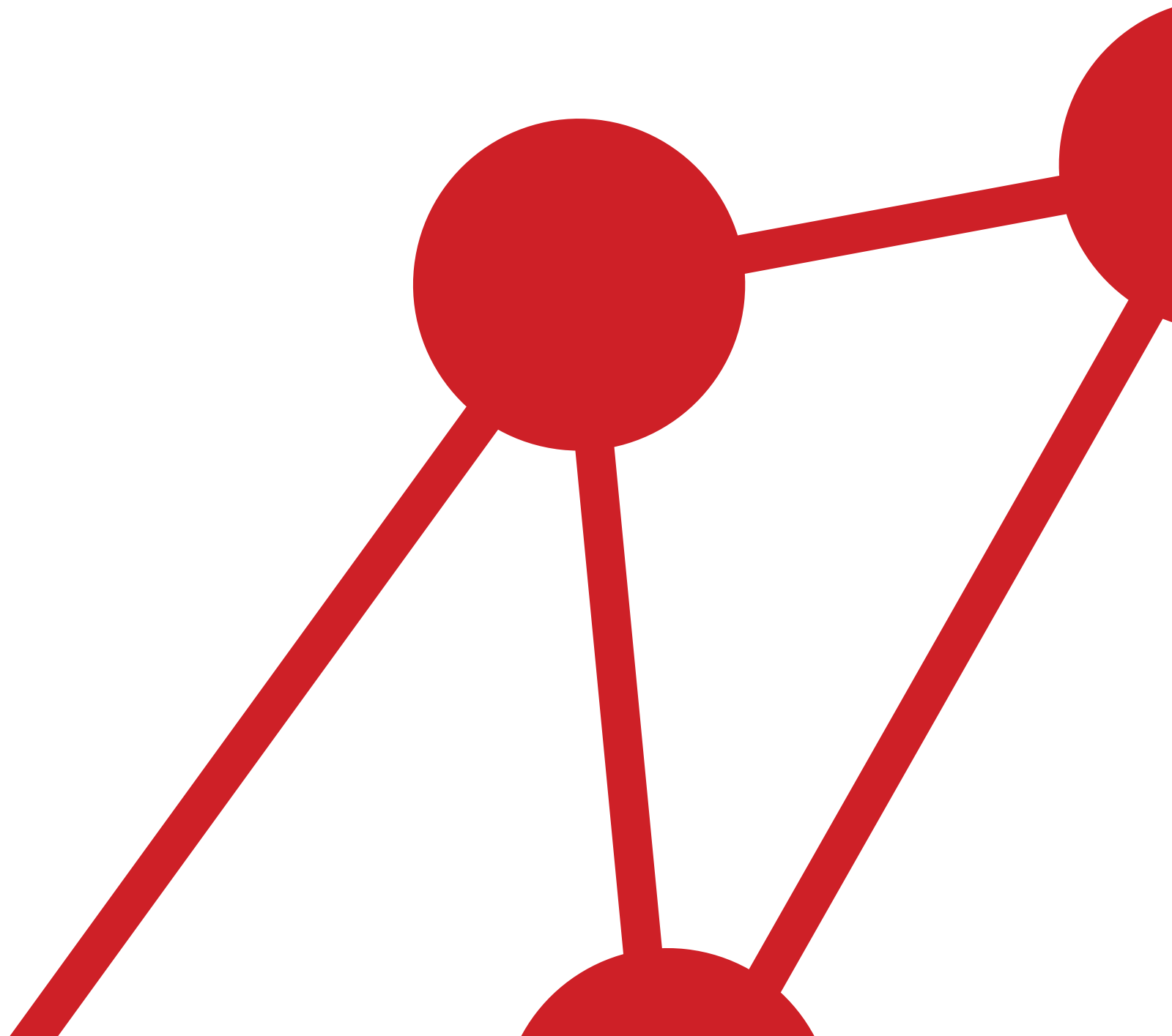

A BRIEF HISTORY OF INTERNATIONALIZATION OF RESEARCH

The nature of scientific research has always been characterized by international outlook, whether talking about research mobility, research and publication collaboration, or other forms of knowledge sharing (Taylor 2004). What has changed since the 1980's, however, is the intensity and scope of internationalization of research (Huang, Finkelstein, and Rostan 2014; Dewey and Duff 2009). In particular, international collaboration on research publication has increased significantly during recent decades (Stek and van Geenhuizen 2016; Abramo, D'Angelo, and Solazzi 2011; Orwat et al. 2015; Cantner and Rake 2014; Kato and Ando 2013).

Today there are also emerging patterns of internationalization becoming increasingly formalized, and deeply rooted in the activities of universities (Gornitzka, Gulbrandsen, and Trondal 2003). Universities as well as governments are pursuing strategies of internationalization, such as stimulating the international mobility of its researchers, and attempting to secure publication in leading international journals (Rostan, Huang, and Finkelstein 2014). Furthermore, universities as well as governments in Europe have increasingly adapted to (and consequently been influenced by) international institutions such as the European Union (EU) and its Lisbon Strategy, as well as subsequent Europe 2020 strategy for economic growth (Kalpazidou Schmidt 2012; Trondal 2003).

This literature review looks at internationalization of university research, a process understood as an exchange of activities in research of various kinds among universities and institutions in different countries (Huang 2014). Today, this implies several things: human exchange and personal mobility of researchers across borders; establishing standards for research careers (such as academic titles) as well as transnational research programs; and research project activities, including the organization of international conferences and joint research.

The first part of this review provides a brief overview of the role which internationalization plays for research in general and university research in particular. The second part of the review provides a brief overview of the internationalization of Danish research policy with a specific focus on the development of the institutional landscape and the influence of the EU.

THE DRIVING FORCES BEHIND INTERNATIONALIZATION OF RESEARCH

The economic and social influence of globalization is a significant driving force behind the internationalization of university research. This is best understood by distinguishing between different rationales, stakeholders, and motivations.

Societal rationales

Huang provides a rather thorough historical perspective on the internationalization of the academic profession, which he divides into four phases, starting with the twelfth century inauguration of European universities (Huang 2014).

In the first phase, incorporating the period between the thirteenth and eighteenth centuries, no nation-state existed, rendering the word international meaningless. Nevertheless, university faculties and scholars moved mainly between different regions and areas of Europe, finding common ground in the language of Latin, motivated mainly by an ambition of expanding Christian culture and values and spreading medieval culture.

The second phase emerged in Europe during the nineteenth century and is typically associated with the creation of a uniform national culture and national higher education systems. The mobility of faculty and scholars still played a dominant role during this phase, but was gradually supplemented by new forms such as the introduction of foreign-language taught programs in home institutions.

By the end of the eighteenth century, the centers of learning had shifted from France to Germany, and again at the end of World War II with a shift to the United States.

Concerning the third phase, occurring in the period between 1947 to 1991, Huang writes:

> *[T]he internationalization of the academic profession occurred in the background of the Cold War (1947–1991). Largely affected by political and ideological factors, internationalization of the academic profession was also considered as one of the effective instruments to facilitate economic development and to build up a national modern academic system and higher education system in many countries, especially in developing countries.*

On an individual level, governments during this period supported the mobility of faculty or academic experts across borders with public funding through schemes such as the Fulbright program, which since the 1940's has sponsored the exchange of researchers between firstly the US and Europe, and then the world more collectively.

The fourth phase is one of international competition characterized by several factors: an increasing number of student enrolments at the level of tertiary education; an increasing expectation of universities to be publicly accountable, including their ability to generate revenues from external sources; and an increasing encouragement as well as support for universities to enhance their quality in research and education with the aim of becoming world-class universities. As Huang writes: "compared with what had happened prior to the early 1990's, the ongoing internationalization of the academic profession is much more strongly driven by both economic and academic factors in a more competitive environment and at a global level."

Regarding Europe, the economic rationale behind the internationalization of research has been, and still is, a cornerstone of EU framework programs for research and technological developments. With this economic rationale the focus on internationalization of research has shifted away from cultural as well as political factors. Instead, there is a focus on the internationalization of higher education institutions as a means of accommodating the need for a more modern and global labor force; on joint international research and development projects to be competitive in the new technologies; and on marketing higher education internationally – viewing higher education as an export commodity (de Wit 1999).

The economic rationale behind internationalization of research is furthermore based on an ambition to improve economic as well as knowledge based competitiveness both nationally and regionally. Politically, there is also a rationale behind the internationalization of research focusing on tackling global issues of national interest (such as climate change and poverty) as well as an aim to expanding diplomatic relations and furthering international security (Universities UK 2008; European Commission 2009). For the EU, the political rationale behind European programs for cooperation and exchange in research, technology, and education has also been to stimulate the development of a European citizenship (de Wit 1999).

Motivation from a university perspective

According to Kalpazidou Schmidt, universities have become more international in conjunction with several factors: developing a closer collaboration between research environments across nations, an increasing collaboration between researchers, a rising in the mobility of researchers, and the result of more higher education students choosing short or long term stays at universities abroad (Kalpazidou Schmidt 2012). Furthermore, universities have also been driven to become more international by their need for supplementing their budget with external research funding from abroad (Kalpazidou Schmidt 2012).

From a university perspective, the primary drivers of internationalization are expanding the horizon of, improving the quality of, and increasing the critical mass in research, by linking national financial as well as human resources and knowledge with resources and knowledge abroad. This is a matter for universities of attempting to attract the greatest international talents to domestic universities. From the perspective of research environments, joint research activities are a means to solving scientific problems. In smaller research- and development intensive countries, international collaboration is a means to building greater, national research capacity (European Commission 2009).

Generally, international university research collaboration can be separated in two groups. On the one hand, there are a relatively limited number of strategic collaborations on an institutional level. On the other hand, there are the much more widespread number of international collaborations between and driven by individual researchers. A study among management at British universities concluded that while top-level management is active in developing strategic partnerships on an institutional level, management has a more facilitating role in individual partnerships between researchers (Universities UK 2008).

Motivation for the researcher

For most researchers in Denmark, pursuing a career in academia necessitates being internationally oriented for several reasons. Firstly, Denmark produces about one percent of global academic research, for which reason the quality of Danish research logically depends on the ability of Danish researchers to tap into global scientific communities[1].

1 Danish expenditure on research and development accounts for less than 0.5 pct. of the world's total expenditure on research and development, when looking at gross domestic expenditure on research and development (GERD) adjusted for purchasing power parity (UNESCO 2016). Additionally, the Danish share of the total volume of scientific publications world-wide amounts to one pct. (Danish Centre for Studies in Research & Research Policy, Department of Political Science, Aarhus University).

Secondly, bibliometric studies have shown that publications based on international co-authorship are cited more frequently than publications where all authors are affiliated to institutions in one country (Nomaler, Frenken, and Heimeriks 2013). This may indicate that international research collaboration enables higher-quality or more original research, for instance, or that accomplished researchers (who tend to receive more citations) are more likely to be attractive as international collaboration partners with access to quality international academic networks. Regardless of any underlying explanation, however, the studies emphasize that internationalization and high-impact research are positively associated. In addition to this, the literature also suggests that internationalization is positively associated with academic productivity in the form of articles published in academic books or journals, research reports written for funded projects, and papers presented at scholarly conferences (Rostan, Huang, and Finkelstein 2014).

Thirdly, concerning experimental sciences, the necessary access to cutting-edge research infrastructure compels both individuals and teams of researchers to travel to highly specialized large scale research facilities and laboratories across the globe.

And fourthly, international research mobility is widely believed to be positively associated with better access to research funding (IDEA Consult 2013).

The literature suggests there are differences across disciplines and fields regarding individual international collaboration practices in research. One study points out a divide between the cluster of natural and medical sciences, where collaborating with international colleagues is more common, and the cluster formed by the social sciences, business, law, and humanities, where international research collaboration is less frequent (Rostan, Ceravolo, and Metcalfe 2014). According to a study of the Norwegian research system, there are different drivers of – or rather propensities to – internationalization across different research fields as well as environments. Thus, the individual researcher's

motivation for a more international outlook in their research is affected by the researcher's language of communication, degree of specialization, and the academic culture surrounding his or her research environment. In addition, access to research funding (as well as linguistic, cultural, and political barriers) plays a role in shaping the researcher's inclination to collaborate internationally. In this regard, researchers in smaller countries have a higher propensity to collaborate internationally – primarily with colleagues from neighboring countries – than researchers in larger countries (Aksnes, Frølich, and Slipersæter 2008).

Renewed internationalization and national needs

Parallel to the renewed strong internationalization of knowledge production and dissemination in the past few decades, the goals of research, innovation, and higher education have perhaps become even more rooted in government policies of national growth, improvements and competitiveness (Gornitzka, Gulbrandsen, and Trondal 2003). According to Gornitzka, Gulbrandsen, and Trondal, this paradox manifests itself through different tensions:

Internationalization through co-operation versus competition. On the one hand, internationalization is to a large extent motivated by the idea of co-operation and knowledge sharing. At the same time there is an increasing competition between universities on recruiting the best students and researchers. Both on an institutional and a national level, internationalization is considered – to a large extent – as a tool for strengthening competitiveness.

Convergence versus divergence. Across different countries, national strategies for internationalization can be difficult to separate from one another. While internationalization in different countries is driven by the need for differentiation from other nations in terms of accessing new knowledge and input from abroad, countries – both in their universities and governments – typically pursue the same types of collaborations with the same type of prestigious research institutions abroad.

Substitution versus synergy. There is a challenge in creating funding schemes and mechanisms that can support the undertaking of research that might not otherwise have been possible. Rather than substituting funding for research, which would have been invested in any case, research funding is often intended to support something in addition to, and differently from, that which extant research funding would have supported. This is a challenge in terms of the EU framework programs for research and technological development, where member states increasingly expect to get back what they invest in the research programs via their national contribution to the EU.

INTERNATIONAL MOBILITY

A significant aspect of the academic and policy literature is the acknowledgement of benefits of 'brain circulation' and the positive returns of sending researchers to institutions abroad. From this perspective, a research stay abroad is not considered a migration process with clear winners and losers (brain gain and brain drain); rather, it is considered a reciprocal process, allowing individuals and countries or regions to benefit from current collaborations and future returns (brain circulation). Thus, survey studies highlight that a large share of academic researchers maintain collaborative links with their home countries when going abroad. Nevertheless, little work has been done on job-to-job mobility, where researchers take up academic employment in other countries (Fernández-Zubieta, Geuna, and Lawson 2015).

Studies have established empirically that international mobility improves researchers' careers in the sense that it increases diversification of their research knowledge and experience in addition to having positive impact on researchers' productivity. Mobility is also widely believed to be positively associated with better access to research funding (IDEA Consult 2013).

On a national-structural level, motivational factors for researchers engaging in international mobility are primarily institutions scarcity of funding and

unattractive career-possibilities in the national research system compared to the possibilities abroad. Several European countries have developed repatriation programs aiming to motivate researchers and scientists to return to their home country, mainly through financial incentives and employment opportunities. However, impact studies show that there is little success with schemes intended to lure researchers back to their home countries. On an institutional level, international mobility is increasingly becoming part of the research career system, valued positively as a criterion for employment (IDEA Consult 2013).

On a personal level, researchers are motivated to emigrate primarily for research-related reasons, such as working on interesting research topics, the quality of the receiving institution, and career prospects, whereas salary plays a minimal role. Studies also suggest that personal or family reasons are the most important factor when explaining a return home. Furthermore, the research quality of the sending and receiving departments matter for the effect of the mobility, as mobility downward into a lower-quality department can decrease the mobile researcher's academic performance (Fernández-Zubieta, Geuna, and Lawson 2015).

Børing et al. suggest that exposing students to international mobility during the period of their university studies makes them more likely to become internationally mobile as researchers (Børing et al. 2015). However, several studies have identified numerous barriers to later researcher mobility. In the main, these constitute the following:

> *[U]nattractive employment conditions; the lack of competition-based internationally open recruitment; the lack of recognition of mobility in recruitment and career development; a lack of trans-national portability of grants/funding; a lack of adequate training and skills development for researchers; lack of funding for mobility; salary; quality and cost of accommodation; personal relationships; child care arrangements; immigration rules; and the nature of contracts. These factors were defined as the result of policy and scholarly debates at EU level and were investigated using a survey administered in eight European countries, which yielded 3,365 valid responses (IDEA Consult 2013).*

THE EUROPEANIZATION OF INTERNATIONAL RESEARCH

For most universities in Europe, the EU framework programs for research and technological development have become the primary source of international research funding (Aksnes, Frølich, and Slipersæter 2008). The EU framework programs are not only seen as a means of funding research, but as financial instruments aimed at securing Europe's global competitiveness by driving economic growth and creating jobs (European Commission 2016).

One can even talk about a Europeanization of the research policy and an internationalization within Europe. One the one hand, this Europeanization has grown with the supranational policy on EU-level, for instance with the establishment of the European Research Area (ERA) and the EU framework programs for research and technological development. On the other hand, Europeanization has been further strengthened by the convergence of national governments to EU policy on research and higher education (Gornitzka, Gulbrandsen, and Trondal 2003).

The EU framework programs for research and technological development has in a very direct way contributed to the Europeanization of university research by financing international collaboration with main emphasis being given to European collaborators. When European research policy was consequently criticized for being insufficiently international outside of these boundaries, the EU decided to open the ERA to research collaboration with the US, Canada, Australia, Latin America, Asia, and Africa (Kalpazidou Schmidt 2012).

The most significant driver of the internationalization of research still seems to be independent academic contact across borders, which is cultivated and pursued by individual researchers. In other words, external funding for research collaboration and formal framework agreements on research as well as higher education collaboration do not account for all of the increasing intensity of internationalization, which can be seen as occurring from the 1980's onwards. Despite the fact that the EU has had a very direct influence on research collaboration across Europe, (and from 2008 and onwards beyond Europe) the increase in scientific publications with authors from several different countries is far greater in the same period than the increase in international funding of research collaborations. The links between policy, funding and collaboration are loosely coupled, and the growth in international collaboration is a much broader, general phenomenon caused by a complex set of factors. With Norway as an example, the EU framework programs for research and technological development appear as the only political internationalization initiative that has had a direct effect on the internationalization of research and development (Aksnes, Frølich, and Slipersæter 2008).

NEW TRENDS IN INTERNATIONALIZATION OF RESEARCH

Internationalization has changed the way in which research and development has been structured throughout the last fifteen to twenty years. International research networks have become more extensive as a consequence of increasing globalization, new forms of communication, and cheap air fares. The internet has increased the accessibility of knowledge and changed the ways in which researchers collect and process information. Researchers pursue competent collaborative partners within their area of expertise, and geographical distances are no longer significant barriers. Additionally, governments and international organizations are increasingly willing to fund international research collaboration (Aksnes, Frølich, and Slipersæter 2008).

These trends, however, do not affect all researchers and university departments the same way. Internationalization has not developed as one common trend, but should be understood in the context of the thematic orientations of the departments and the larger institutions of which they are a part, which in turn have their own traditions and motives for seeking international funding and collaboration. Referring to internationalization in general terms and without context only obscures important variations and should thus be avoided (Slipersæter and Aksnes 2008).

INTERNATIONALIZATION IN DANISH RESEARCH POLICY SINCE 2000

Internationalization is not a new phenomenon in the Danish research environment, where trans-border collaboration has been the cornerstone of research for centuries. Since the 1980's, internationalization has become a rather common word within Danish research policy. It has developed from being a peripheral part of activities at the universities to becoming the crux of their institutional as well as national research strategies, and consequently a policy area with great public attention (Kalpazidou Schmidt 2012, 14).

In 1991, the national parliament of Denmark founded The Danish National Research Foundation as an independent organization with the aim of supporting excellent research at an international level (Retsinformation 1991).

The historical development of initiatives to support internationalization in Danish research policy since 2000 has been carefully described in Kalpazidou Schmidt 2012. Below follows some of the main recommendations and initiatives highlighted in this historical overview:

In 2000, The Danish Research Council recommended that university job postings for professors and associate professor positions were advertised internationally and aimed at a broader target group of applicants in order to increase competition for faculty positions. Furthermore, the council recommended that Danish universities make more use of internationally composed assessment committees and recommended more ambitious goals for attracting foreign PhD-students.

In 2001, The Danish Research Commission recommended the development of a national strategy for international researcher mobility, as well as bringing the share of PhD students coming from abroad to a minimum of twenty-five percent. According to Kalpazidou Schmidt, these recommendations resulted in the university development contracts with the Danish Ministry for Science focusing on strengthening international collaboration, increasing mobility, and attracting foreign researchers.

In 2004, The Danish Act on Research Counselling became effective, among other things aiming to strengthen the foundation for the internationalization of Danish research by establishing The Danish Council for Research Policy, The Danish Council for Strategic Research, and The Danish Council for Independent Research. While the last two were established as funding organizations, The Danish Council for Research Policy was founded in order to counsel the minister of science on Danish and international matters of use to Denmark (Retsinformation 2003).

In 2006, the government for the first time put internationalization high on the agenda with the Danish Globalization Strategy, "Progress, Innovation and Cohesion". The underlying motivation of this strategy was to advance Danish economic growth and competitiveness. Internationalization of research was one focus area, including the possibility for Danish research councils to finance international research collaboration. Subsequently, initiatives were launched to double the number of PhD-students, improve the ability of Danish universities to attract foreign researchers, and increase the participation of Danish universities and companies in the EU framework programs for research and technological development. The initiatives partly followed an ongoing criticism of Danish universities' ability to increase the number of foreign PhD-students. This criticism was raised by the OECD – among others – in 2005, who also recommended that Denmark significantly increased the number of Danish students abroad.

The main argument behind the merger of the universities and other research institutions in 2007 was to strengthen Danish research environments internationally. Through the development contracts, the Danish universities subsequently committed themselves to benchmarks for the supply

of educations offered in English, the exchange of academic personnel with research institutions abroad, and the recruitment of foreign researchers. Kalpazidou Schmidt concludes that "while these initiatives [focusing on quantitative benchmarks] have had a positive influence on the resources for Danish science, they have in other ways shown inadequate, and should e.g. be aimed at, how one strengthens the collaboration with foreign research environments."

Since 2006, the Danish government has established representation in Bruxelles as well as a number of Danish Innovation Centers in Silicon Valley (2006), Shanghai (2007), Munich (2008), São Paulo (2013), New Delhi (2013), and Seoul (2013), all aiming at strengthening the internationalization of Danish research institutions and the access to knowledge exchange for Danish companies. Furthermore, Danish research councils have been provided with the possibility of allocating up to twenty percent of their funding to international fora such as – but not exclusively – EU initiatives like ERA-Nets, where the grant authority is given to independent committees. Previous counting has shown that approximately two percent of the funding in the years 2007-2008 were allocated to such purposes.

Adding to Kalpazidou Schmidt, the national parliament of Denmark passed the basis funding reform in 2009, whereupon twenty-five percent of the funding for universities would be distributed in accordance with the universities' research publishing (bibliometrics). This basis of distribution encourages a particular publication behavior since scientific journals are ranked according to a number of indicators, including their international visibility. The most prestigious international journals thus result in receiving the most points, and the basis funding reform imbeds internationalization as a key research activity in the research environments (Schneider and Aagaard 2012).

Selected reforms and initiatives with relevance for internationalization of Danish research policy since 1990

1991	Establishment of The Danish National Research Foundation
2000	Establishment of The Danish Research Commission
2004	The Danish Act on Research Counselling (establishment of The Danish Council for Research Policy, The Danish Council for Strategic Research, and The Danish Council for Independent Research)
2006	The Danish Globalization Strategy
2007	The university mergers
2009	The basis funding reform
2014	Innovation Fund Denmark
2014	Establishment of The Danish Council for Research and Innovation Policy

Source: The selected reforms and initiatives are inspired by (Aagaard and Mejlgaard 2012) and extended for the period following 2009.

The Innovation Fund Denmark was established in 2014 as a consolidation of the Danish Council for Strategic Research, the Danish Council for Technology and Innovation, and the Danish National Advanced Technology Foundation. The purpose of the Fund is to fund advances in science and technology (including advanced technology) in order to boost research and facilitate innovative solutions for the benefit of growth and employment in Denmark, and funding development of knowledge and technology – including high technology – leading to stronger research and innovative solutions benefitting the economic growth and employment in Denmark (Retsinformation 2014). The Fund is provided with the possibility of allocating up to twenty percent of their funding to international fora, where the grant authority is given to independent committees.

The Danish Council for Research and Innovation Policy (DFiR) was established in 2014 and charged with the responsibility of providing policy makers with independent and expert advice on research, technological development, and innovation at a system level in an international context.

THE EUROPEANIZATION OF UNIVERSITY RESEARCH IN DENMARK

From the 1960's onwards, the OECD (and later on the EU) have influenced perceptions of challenges and solutions in Danish research policy. Especially since the late 1990's, the EU has been a significant factor in diffusing the idea that research should be favored in the national budgets in return for an expectation of research making contributions to economic growth and social development in society (Aagaard and Mejlgaard 2012).

In 1999 Denmark signed The Bologna Declaration, whereby European nations committed themselves to uniformize the structure and merits of the educational systems, (bachelor/master/PhD) in order to establish a cohesive European knowledge region (European Union 1999). In 2002, Denmark adopted the Barcelona objectives, whereby member states committed themselves to raise investment in research and development to three percent of GDP by 2010. These objectives were part of the EU goal to become, by 2010, "the most competitive and dynamic knowledge-based economy in the world", what has become known as the Lisbon strategy (European Union 2002). In 2007, Denmark ratified the Lisbon Treaty, which among other things was aimed at strengthening the European research infrastructure, including the possibilities for the mobility of researchers. The ambition was that excellent research and research infrastructure would transform the EU into the world's most competitive and dynamic knowledge based economy (Official Journal of the European Union 2007).

The Bologna Declaration and the Lisbon Strategy have stimulated internationalization of research in Denmark by supporting and encouraging international mobility and recruitment of researchers and students, as well as introducing a rationale in research policy across Europe highlighting the significance of quality in research and education, and improving the international profile of universities in Europe (Kalpazidou Schmidt 2012).

The instruments for pursuing the objectives of the Lisbon Strategy have been the framework programs for research and technological development. The Seventh Framework Program for Research and Technological Development had a budget of more than fifty billion Euros. Today the program has been replaced by Horizon 2020 with a budget of roughly seventy-five billion Euros (Ministry for Higher Education and Science 2016). The Lisbon Strategy was replaced in 2010 by a new strategy for economic growth and job creation, Europe 2020 (European Commission 2010).

The significance of EU-funding for Danish researchers is unquestionable today, where the funding to Danish universities amounts to ten percent of all external funding[2]. In the first two years of the present EU framework program for science and innovation, Horizon 2020, Danish researchers,

2 Based on external funding in 2014 (Statistics Denmark 2014).

companies, and organizations have managed to attract 2,65 billion DKK in grants (Ministry of Higher Education and Science 2016). In comparison, this makes the financial influence of the EU program comparable to a fourth research program on par with The Danish Council for Independent Research (1,36 billion in grants in 2014), Innovation Fund Denmark (1,62 billion in grants in 2014), and the Danish National Research Foundation (0,69 billion in grants in 2014) (Danish Agency for Science Technology and Innovation 2015). The Danish share of the funding from Horizon 2020 at present is higher than it has been in the framework programs for the past fourteen years (Ministry of Higher Education and Science 2016).

The EU framework program for research and innovation also seems to be a point of orientation for the Danish identification of promising areas for strategic investments in research and innovation. Thus, there are thematic overlappings between Danish strategic research funding, and the thematic focus in Horizon 2020's program for Societal challenges on prioritizing funding for research aimed at addressing challenges of particular relevance to society. The connection with the thematic areas in Horizon 2020 is mentioned explicitly both in the RESEARCH2020 catalogue, which forms the knowledge basis and foundation for decision making concerning the Danish Parliament's distribution of funds for strategic investments in future research (Ministry of Science, Innovation and Higher Education 2012), and in the INNO+ Catalogue, which identifies promising focus areas for strategic investments in innovation (Ministry of Science, Innovation and Higher Education 2013).

Selected research policy initiatives in the EU since 1999

1991	The Bologna Declaration
2002	The Barcelona objectives
2002	The Sixth Framework Program for Research and Technological Development
2006	The Seventh Framework Program for Research and Technological Development
2007	The Lisbon Treaty
2010	Europe 2020
2014	Horizon 2020

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