FROM RESEARCH TO INNOVATION

– ON FIRMS' USE OF PUBLIC R&D PROGRAMMES

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This is a summary of a report published (in Danish) by the The Think Tank DEA and The Confederation of Danish Industry in April 2014. The aim of the report is to examine why Danish firms participate in publicly funded R&D programmes. More specifically, the report sheds light on firms' motivations to participate and on how they select which projects and programs to participate in. Finally, it discusses a series of factors that influence firms' propensity to make a significant commitment to, and take an active role in, these projects and programs. The conclusions and recommendations of the report are primarily targeted at the Danish Innovation Foundation and other public R&D programmes.

INTRODUCTION

Every year, the Danish government invests approximately 2.4 billion DKK in public programmes that support collaborations on research, development and innovation (RDI) between the business sector and publicly funded research institutions. This significant investment comes with significant political pressure to demonstrate that these programmes lead to increased innovation, exports and job creation. Achieving these effects, however, requires that businesses play the right role in these programmes, and that projects are designed in such a way as to effectively support product development and innovation in private companies.

In this report, the Think Tank DEA and The Confederation of Danish Industry focus on industry-oriented research and innovation programmes in Denmark, and we examine these programmes from the perspective of the participating companies. The analysis shows that publicly co-funded projects can make a big difference for companies of any size, especially in their ability to explore new technological paths and develop innovative new products and processes. There is, however, great variety in the extent to which the companies involve themselves in different projects – and in the pay-off that they derive from their participation.

> ***"Who wants to admit that a big project turned out* not *to be a success?" (Poul Toft Frederiksen, Grundfos)***

There are relatively few public discussions of what can go wrong in publicly funded R&D collaborations. Understandably, participants in such projects rarely take it upon themselves to point out problems that they may have played a role in creating, and which may cast an unfavourable light upon the involved participants or the funding body. There is thus a need for greater insight into why and when businesses choose to participate in publicly funded RDI collaborations, and into the factors that determine how much the businesses choose to invest in these collaborations. Such insight is necessary in order to create the best possible conditions for Danish industry and academia, so that cutting edge research can be more efficiently translated into new products, jobs and exports.

The analysis focuses on RDI programmes under The Council for Strategic Research, The Council for Technology and Innovation, The National Advanced Technology Foundation, and the Development and Demonstration programmes. A number of these programmes have, as of April 2014, been gathered under the new Danish Innovation Foundation, which has been tasked with increasing research and innovation activity in the Danish business sector.

DATA AND METHODS

This report includes the results of **desk research** on relevant analyses, evaluations and research. Moreover, we have carried out a **survey** among approximately 1,500 businesses that had recently participated in at least one publicly co-funded RDI projects. The survey study was carried out over a one-month period from January to February 2014. 402 respondents participated in the survey. Of these, 281 respondents were aware that their business had participated in at one or more publicly co-funded RDI projects within the last five years.

The analysis also draws on a series of personal or phone **interviews with 28 companies**. Finally, the contents and conclusions of the analysis were shaped by a number of **meetings with key personnel from relevant RDI funders, authorities and interest organizations**.

WHAT MOTIVATES BUSINESSES TO PARTICIPATE IN PUBLICLY FUNDED RDI PROJECTS?

Strengthening their innovation options. The main reason why companies participate in publicly funded RDI projects is that they wish to strengthen their opportunities for developing innovation. Large businesses are slightly more focused than small and medium sized enterprises (SMEs) on getting access to knowledge and technology that may lead to innovation and competitive advantage in the *long term*. In contrast, SMEs are more focused on gaining knowledge, methods or technology that may be translated into new products and increased sales in the *short term*. This is not surprising, as small businesses often operate with limited R&D budgets and are more under pressure to show the results of their investments in R&D.

No expectations of market-ready products. Even though companies participate in publicly funded RDI projects to get inputs to their innovation process, most companies do not expect to that these projects will lead directly to market-ready products. Rather, companies see innovation as something that happens *within* in the company – after the project. The results of an RDI collaboration often follow an unpredictable and uncertain road before they are translated into innovation, and companies do not expect to see a prototype or an end-product before at least one and sometimes as much as fifteen years after the project has ended. According to firms, a good result of a project does not have to be a product prototype, but might just as well be new knowledge, a workable component, a new method or even just the opportunity to test a technology or an idea. In other words: firms are not looking for low-hanging fruits in these collaborations.

The opportunity to carry out larger, more ambitious projects. Most companies, even the largest and most RDI-intensive, have limited resources for R&D. Moreover, the lion's share of their resources is typically allocated to short-term development projects that are close to the market. Another key reason why companies choose to participate in publicly funded RDI projects is therefore that it gives them the opportunity to carry out more, larger and more ambitious projects than they are able to undertake on their own. The public gearing of firms' investments allows companies can invest in more long-term and uncertain projects, from which revolutionary breakthroughs can potentially emerge.

> ***"Publicly co-funded projects have been an important factor in our long-term research. Sometimes they have been the very pillar of my research. The publicly co-funded projects are the ones you cannot just shut down if you suddenly have to reorganize, because they are long-term investments with external funding." (Søren Bech, Bang & Olufsen)***

Recruitment and signal value. Companies also identify a number of other, if less significant motivators for participating in publicly funded R&D collaborations, including (a) being able to establish stronger collaborations with university researchers, (b) keeping their company updated on developments on the research front, (c) motivating staff with an academic background, (d) getting access to students or researchers with a view to recruitment, (e) supporting the development of relevant research and education environments in their field, and (f) strengthening the company's reputation as an RDI-intensive, innovative business.

HOW DO COMPANIES CHOOSE THEIR PROGRAMMES AND PROJECTS?

Companies use the whole range of programmes, from basic research programmes to demonstration projects, though different companies use different programmes. Several factors influence which programmes companies choose to enter into, e.g. the maturity of the technology, how research-intensive the industry is, and the individual company's needs, interests and previous experiences with public programmes.

Different expectations for different programmes. Generally, companies deem that they have good insight into the focus areas and funding criteria of the programmes that are relevant to them. They also adapt their expectations of the content and results of the projects to the particular requirements and instruments of each programme. For instance, companies associate strategic research projects, SPIR (Strategic Platforms for Innovation and Research), and the Industrial Ph.D. programme with good opportunities for supporting relevant basic research and long-term innovation, while for instance the Development and Demonstration programmes, The Advanced Technology Foundation, the Innovation Voucher Scheme and Innovation Consortia are associated with supporting innovation projects with a more short-term commercial value.

From ad hoc approaches to clear, strategic goals. There is a great variety in the extent to which companies' participation in public-private RDI collaborations are determined by strategic goals and supported by the top-level management. Some companies choose projects using a highly selective, strategic approach, while others employ an ad hoc approach where the top-level management has not set any clear guidelines for how to select which projects to participate in or for the extent of the company's commitment. The risk of an ad hoc approach can be that collaborations with university researchers are not given sufficient priority.

Larger firms have however, by their own assessment, become more selective and strategic in their choice of projects during the last five years. For many companies, the economic recession has resulted in an increased focus on the costs of R&D projects and expected returns on investments.

SMEs are generally very selective, probably because of their limited resources. Many SMEs stress that they only enter into RDI collaborations that hold a substantial expected commercial potential.

Large partnerships foster coordination, while focused projects promote product development. Generally, companies distinguish between two groups of instruments: *large partnerships* and *focused projects*. Both are important to companies' ability to create innovation, but they support different parts of the process of translating research results into commercial innovations.

Large partnerships, platforms, networks or consortia include a larger number of partners. Also, they often include specific requirements from the funding body as to which kind of participants are to be included and sometimes to the nature of the activities as well. According to the interviewed companies, platforms can be a good starting point for, for instance, explorative R&D projects, or if there is a need to bring actors together in a way that the companies themselves are not able to do. For example, it may be relevant to gather competing firms or various actors within the same value chain. Likewise, large partnerships can according to firms be a useful tool for working with the development of legislation and standards that promote innovation.

However, several firms also point out that when you receive a large grant (as large partnerships often do), you are also very aware of the fact that you are expected to "deliver". This may motivate project participants to play it safe rather than taking risks with an innovative project. Moreover, the interviewed companies were generally of the opinion that large partnerships are *not* useful for concrete technology or development projects. This is, firstly, because the larger number of players and possible requirements or expectations to include certain types of partners increases the complexity and the coordination costs of the collaboration. It becomes difficult if not impossible to design optimal partnerships for solving problems and generating specific outputs. Secondly, the larger number of

participants makes it harder to enter into a clear and satisfying agreement regarding the flow of information from the project and ownership of the intellectual property rights (IP) that may emerge from the project.

> ***"Some people think that if you gather a lot of different organisations and establish a secretariat, then you automatically have a collaboration. But in our experience, that is not true … In large projects, any change becomes laborious. It is one big compromise: First in order to satisfy the terms of the call, then for the partners to reach agreement, and finally to satisfy the requirements of the funder. It is very inefficient." (Jesper Sand Damtoft, Aalborg Portland)***

Focused projects are another category of instruments that typically have more defined and specific goals and fewer participants. Such projects seek, for instance, to generate specific knowledge, solve recognised problems or to test promising materials or technologies. Their goals are usually some form of concrete contribution to an innovation process. The benefit of focused projects is that the individual company has more control over the setup of the project team and the contents of the collaboration. In smaller groups of participants, it is also easier to reach an agreement on the distribution of IP rights.

According to the companies interviewed, in focused projects, it is particularly important to minimize expectations or obligations to include specific kinds of participants or activities. Such terms may lead to the inclusion of partners that are neither "natural" to the project nor highly committed, either because of the formal requirements or because the partners seek to maximize their chances of obtaining funding. The result can be an "artificial" or even "schizophrenic" project with insufficient focus or momentum – which in turn is likely to reduce the company's interest and commitment in the collaboration.

Of course, there is no clear distinction between the two categories of instruments; rather, they can be described as archetypes at opposite ends of a spectrum of innovation-promoting instruments. Generally, the interviewed companies stated that the larger the partnership, the smaller the probability of bringing concrete product/development-oriented activities into the collaboration.

WHEN DO COMPANIES MAKE A SIGNIFICANT COMMITMENT TO A PROJECT?

Company participation is no guarantee of company involvement. There are several examples of projects where, for any number of reasons, company participants do not play the role described in the project application. This is problematic, if the main goal of these instruments is to promote innovation and growth in the private sector. This section therefore presents a number of factors likely to strengthen firm commitment.

Early involvement strengthens commitment. If companies have influence in the application phase, where the project is designed, this heightens the chance of identifying relevant, qualified partners, agreeing on a clear and efficient division of tasks, and establishing a good working relationship between the partners from the beginning. It also increases the likelihood that the project will be relevant to the company.

Many companies have been in a situation where they felt like an "alibi partner" in a project initiated by public researchers and which the company has not helped shape, where the chief aim was to attract funding for public research. To many companies, this kind of collaboration is not particularly attractive. Several large companies moreover stressed that they are today less willing than before to enter into projects that they have not had a hand in shaping.

Trust is essential. Trust between partners is essential if the project participants are to bring knowledge and technology to a shared project. They have to feel secure that the other participants will not steal ideas, and that they will play their parts and honour the agreements. Many companies have experienced the feeling of being "held hostage" in a project that they could not influence in the way they had expected.

In order to establish or maintain a trusting collaboration, it is important for companies that there is both an effective fine-tuning of expectations at the beginning of a project and efficient project management along the way; both of these project qualities are, by companies' own account, often lacking. Several respondents emphasize the approach of The Advanced Technology Foundation as a good model for how public sponsors can promote effective matching of expectations at the outset of a collaboration.

Some companies want to be in the driver's seat – others don't. While most companies emphasize the importance of being able to influence the project from the beginning, the extent to which companies wish to play an *active* role in the management of a project varies significantly. The company's interest in being in the driver's seat naturally depends on the nature of the project. Several SMEs state, for instance, that they are open to managing more focused development projects, while they would rather leave the management of larger partnerships and long-term research projects to others. Some companies completely opt out of actively steering projects, because they do not feel that the benefits that accrue from leading a project outweigh the costs of coordinating project participants and managing the collaboration. Others opt out simply because they cannot find the time or energy to manage the project.

"The jungle of rules" is a hindrance. Many companies participate in more than one project, both in Denmark and abroad (primarily within the EU). Different procedures and rules for applications and follow-up documentation, both nationally and internationally, make it difficult and costly to participate in several projects at the same time. Moreover, companies sometimes see the official requirements for documentation and follow-up as unnecessarily cumbersome. This sentiment is – unsurprisingly – more prevalent among SMEs.

A clear strategy and a realistic obligation affect commitment. The company's commitment to a project is very much dependent on whether the project is a high priority for the company. Sometimes, the company is simply not very interested in a project, for instance if the outcome is highly uncertain, or if the management of the company does not consider the project to be central to its strategy. A company's commitment to a project is usually strengthened if the company has a clear strategy for how to further develop the results of the project, and for how the results are expected to influence its other R&D activities. It is also important to ensure that the company's co-funding of the project (as reported to the funding body) reflects its actual, expected commitment; the "in kind" co-funding provided by firms is not always a good indicator of the company's actual investment in the collaboration, which creates unrealistic expectations of the company's role.

Focus on momentum and flexibility. Most companies stress the importance of flexibility in publicly funded projects, and of a mutual understanding that it might be necessary to change the goals or activities of the project, including possibly the allocation of funding to partners and activities, in dialogue with the funder. This is relevant for instance if adequate feasibility tests have not been carried out prior to the project, or if changes in the competitive situation or the general technological development require adjustment of project goals and activities. In order for companies to be able to justify a significant (financial) commitment, a project must have a clear, expected output that justifies this investment.

> ***"A good model is to start 'small' before you establish a large project. The company does not go 'all in' before it is clear whether there is something to be gained. When the potential has been demonstrated, then you can enter into the next agreement. What is the critical experiment that needs to be made in order to test and demonstrate the potential? That is something the company can often help to determine." (Klaus Bøgesø, Lundbeck)***

It may be that the preliminary results of the project have been disappointing, for instance if a specific material has turned out to be unfit for commercial use. In these instances, the interviewed companies generally feel that the project ought to be shut down or refocused, so that the resources may be redirected towards ventures that have a significant commercial potential. If this does not happen, participants are left with projects that linger on without a clear shared goal, which means that the resources are poorly spent, and that the company's commitment is dramatically reduced.

RECOMMENDATIONS

These recommendations are primarily directed at the instruments that, as of April 1, 2014, have become part of Danish Innovation Foundation, but they are also relevant for other, private sector oriented RDI programmes.

It should be noted that the recommendations are based solely on this analysis, which has primarily uncovered the views of companies that are already users, and often experienced users, of the public RDI funding system.

1. **Innovation requires both large partnerships and focused projects.** The new Danish Innovation Foundation has been tasked with trimming the existing programmes in order to stimulate more innovation. This analysis stresses that it is important to maintain a broad spectrum of programmes that accommodate different needs. Some companies need programmes that can help them bring industry players together, while others prefer closer, focused collaborations with fewer partners, and still others seek out programmes that support long-term research. It is also important to distinguish between *large partnerships*, typically with a broader spectrum of partners and goals, and programmes that further the development of *focused projects* with few partners and specific goals.
   The analysis shows that companies see large partnerships primarily as a means to further dialogue and coordination among a larger group of actors, whereas they prefer focused projects when they wish to work with concrete development projects or specific technological or scientific problems. This raises the question of how The Danish Innovation Foundation is going to make use of the new instrument Societal Innovation Partnerships to stimulate innovation. The results of this analysis suggest that the Societal Innovation Partnerships could be seen as a platform for uniting actors, facilitating knowledge-sharing and dialogue, supporting change in regulations and standards etc. – but that concrete development projects require smaller project teams, where companies have a high degree of influence on the choice of partners and goals and are better able to protect their IP. This might be achieved by using the Societal Innovation Partnerships as platforms for developing ideas for concrete development projects that could then be “spun off” using private funding og funding from public RDI programmes under or outside The Danish Innovation Foundation.

2. **Need for coordination between programmes, including those that are under different authorities.** The new Danish Innovation Foundation includes many of the existing innovation programmes, but not all of them. It is therefore important that the foundation prioritizes coordination with programmes offered by other authorities (e.g. the Development and Demonstration Programmes) that might play a part in the further development of activities supported by The Danish Innovation Foundation. There is a need for more knowledge on whether the programmes within and across the RDI-funding bodies actually complement each other or whether they fund the same or completely distinct activities. Moreover, there is a potential for a strengthened collaboration between the programmes, for instance in connection with joint calls and the simplification and harmonization of application and follow-up procedures.

3. **Experience contributes to successful collaboration.** Successful collaborations between companies and universities take time, and both parties achieve more trusting, more rewarding and often more ambitious collaborations over time as they learn from their experiences. Even though it is desirable to support the development of new collaborative relations, it might therefore also be appropriate to support collaborators who meet repeatedly – preferably in a context that gradually raises the ambitions of their collaborations.

4. **Increased commitment on the part of the companies requires influence and an early fine-tuning of expectations.** An early and substantial involvement of companies in the shaping of a project is essential if the project is to feel relevant to the business partners. This will make the companies more interested in investing time and resources in the project. It is moreover crucial to ensure a very concrete, explicit upfront discussion of what the parties can truly bring to the collaboration, what they expect from each other, and what they expect the results of the project to be. Sometimes, important details are left unspoken, which may lead to projects with unrealistic goals or work plans, or where participants have incompatible expectations. It is also important

to clarify the extent to which company participants wish to take part in the daily management of the project. Sometimes the company wishes to play a decisive role (for instance, if the project aims to uncover answers to a specific problem), whereas other times the company might prefer to take the backseat (for instance, if it is looking for insight into a promising, but unripe technology).
Several companies would like it to be more acceptable for them to participate in a "light" model in some projects, for instance by contributing only ten percent of the total budget. Often, companies get the impression that the more co-funding they provide, the greater their chances of obtaining funding. Substantial co-funding from the company is however only desirable if it reflects a genuine interest and investment in the specific project. If one or more project participants – companies or research institutions – lack the drive or the experience to ensure an open and concrete fine-tuning of expectations as to the content and goals of the collaboration, The Danish Innovation Foundation should consider how to help lay a solid foundation for the projects it funds, as seen for instance in The Advanced Technology Foundation's approach to project design and selection.

5. **Irrelevant criteria and requirements can reduce companies' commitment.** Politicians and policymakers might have reasonable political agendas for promoting certain kinds of collaborations or behaviour in the activities they support. However, one should be careful not to undermine the focus of the project by setting expectations or requirements that are overly specific (such as number or types of players), as this may lead applicants to engage in "box ticking", trying to meet as many application criteria as possible in order to increase their chances of getting funding. This can result in poorly designed and less focused projects, which ultimately affects the companies' and other participants' commitment in a negative way. The analysis also stresses that it is important not to place too much emphasis on the percentage of funding that companies and other parties bring to the project. As stated earlier, a large degree of co-funding does not guarantee the foundation for a mutually binding and committed collaboration. The co-funding may stem from resources allocated to related activities in the company or at the university, rather than to the specific project. It is therefore important that the funding body makes a qualified assessment of whether the co-funding provided by the parties reflects their actual, expected role and commitment in the collboration.

6. **Effective project management and follow-up is essential for a good project.** Companies interviewed do not expect all publicly funded RDI projects to be successful, precisely because such projects should, by their very nature, be pioneering, innovative projects. A valuable outcome may therefore be a product prototype, a new technology, new insight – or even just the knowledge that an idea, technology or method is *not* feasible or commercially viable, allowing the company to focus its attention on more promising R&D paths.
The Danish Innovation Foundation and other RDI programmes must therefore adopt a broad understanding of innovation that recognizes that a good end product might be anything from a prototype to useful knowledge. Effective project management and follow-up by the funding body will maximize the chance of achieving a commercially useful result. This means that The Danish Innovation Foundation should call for specific, realistic goals and milestones along the way in the projects that it funds. It also means that the foundation, by means of ongoing follow-up (for instance by calling for semiannual reports supplemented by a qualified assessment of the progress made in the project), ought to be able to take hard decisions – such as asking for a change of course in the project or withdrawing the support for it, if circumstances have changed significantly, for instance as a consequence of the technological or market development or new strategic priorities in the company.
The Danish Innovation Foundation might for instance choose to initially support multiple projects in the same field or under the same these, and then only to support the most successful projects in a second round of funding. The foundation could also consider requiring large projects to hire a professional and experienced project manager with proper incentives and the mandate to steer, cut or extend the project in order to achieve the best possible result. Last but not least, the foundation might consider supplying follow-up funding with which to explore promising new directions in successful, completed projects, e.g. for a one or two year period; in the absence of such follow-up funding, the project otherwise might lose momentum – for instance if key employees change jobs because of the lack of resources, or if they are allocated to other projects.

7. **Flexibility is key.** It is important to ensure flexibility in the planning of a project. For example, the project participants and the funding body need to agree that it might become necessary to deviate from the goals and

planned activities of the project, e.g. because of the preliminary results or a change of circumstances. This can reduce the risk that companies – as they sometimes do – feel "taken hostage" in a project that spans several years but quickly turns out to be irrelevant. It also increases the likelihood that the research institutions obtain a committed collaborator that delivers to the project.
Moreover, it is relevant to consider how much of the project should be allocated to Ph.D. scholarships, as Ph.D. students are a relatively inexperienced and inflexible human resource, which, according to several companies, is better suited for long-term, exploratory projects than for projects that are closer to a product or to the market (which therefore often require ongoing adjustment of goals and activities). In the latter case, it may therefore be beneficial to assign a larger part of the budget to financing of post.docs. or other, more experienced researchers.
It increases the probability that a company can make a significant, actual investment in a project if it can increase its investment along the way, based on a realistic assessment of the project's commercial potential and chance of success. Thus, The Danish Innovation Foundation might therefore consider whether some projects ought to begin with a short, focused pilot project in which essential elements of the project are tested as early as possible, without undermining the participating research institutions' chances of planning a long-term, coherent endeavour. For example, it might be necessary to test whether academic research results can be replicated in a scale or under circumstances that are necessary in the private sector. In other words, the aim is to test whether fundamental preconditions for the success of the project are in place, *before* the participants and the funding body commit to a large-scale investment. In such situations, one possibility is to fund projects in two phases, e.g. first a short pilot projects and then a full-scale project.

8. **Companies also carry part of the responsibility for ensuring productive collaborations.** There are major differences in the extent to which companies think of external collaborations as strategically important. It makes a big difference for a company's commitment whether or not a collaboration is prioritized by top management and firmly anchored with senior staff in the company. The Danish Innovation Foundation might therefore stress that company participants should provide an experienced, senior project manager to the project, if the company expects to play a significant and active role. Active participation, especially when it comes to large projects, ought also to be motivated by a clear strategy for what the company expects to achieve and how it expects to further develop and apply the results of the project. Likewise, it is important that company participants allocate resources, throughout and after the project, to build up in-house absorptive capacity, provide inputs to the direction of the project, and to determine how to continue work once the project has been completed. This may for example require hiring or allocating experienced staff to the project, both during and subsequent to the collaboration, and setting clear goals for the company's efforts to further work with project results.