Analysis of Innovation Fund Denmark's users and potential target groups
(Report A)

IRISgroup

Content

1. Summary

The Innovation Fund Denmark (IFD) was established in 2014 by a merger of the Strategic Research Council, the High Technology Foundation and the Council for Technology and Innovation. The main purpose of IFD is to invest in early stage projects with the potential to create societal value, growth and employment. Most investments are managed in one or other of four IFD programmes: Grand Solutions, Industrial Researcher, InnoBooster and InnoFounder.

The purpose of this report is to examine the activities of the programmes run under IFD in the period 2015-2017. An additional aim is to assess the impact of the establishment of IFD on the users of research and innovation programmes before and after 2014. The analysis builds on data from the InnovationDenmark database and various registers from Statistics Denmark.

1.1 IFD applications and funding

From 2015-2017, IFD received more than 7,600 applications, of which 1,942 were approved. This corresponds to an average approval rate of 25 per cent. The number of applications has been slightly declining over time. In 2017, IFD received a total of 2,400 applications compared to 2,679 applications in 2015. The decline is driven primarily by a fall in the number of applications to Grand Solutions and InnoFounder, which are also the programmes with the higest shares of rejected applications.

Following the decline in the number of applications, the total amount of applied funds has likewise been declining. In 2017, IFD received applications applying for a total of DKK 5.9 billion, down from DKK 9.2 billion in 2015. The average grant size across the four programmes has been stable, at around DKK 4 million per project from 2015-2017. Grand Solutions is the programme with the largest average grant size of over DKK 13 million per project.

Grand Solutions typically accounts for half the IFD's total budget each year. IFD-funded Grand Solutions projects are notably skewed towards a small sub-group of the 14 strategic research themes set out in the RESEARCH2020 catalogue[1] (*Bio-resources, food and other biological products*, *Future energy technology and systems*, *From basic research to efficient prevention, diagnostics and treatments* and *Digital opportunities and solutions*). This is true both in terms of the number of projects and the share of IFD funding granted.

1.2 Company characteristics of IFD applicants

The largest group of users of the IFD programmes are the private Danish companies. From 2015-2017 almost 2,000 private Danish companies were approved for funding, with 85 per cent being one-time users and the remaining 15 per cent being multiple users. The multiple IFD users are generally larger and older companies with a higher share of highly educated workers.

Most companies applying to IFD, both accepted and rejected, are within *Manufacturing, mining and quarrying, and utility*, *Business services* and *Information and communication*. These two sectors are overrepresented in the IFD applications relative to all Danish companies. The sectorial distribution before and after the

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[1] The RESEARCH2020 catalogue serves as input for politicians and stakeholders in the current discussions and prioritizations of public research funding.

establishement of IFD in 2014 represents a shift towards users belonging to the more knowledge-intensive sectors, especially within *Information and communication*.

Accepted applicant companies are typically both larger and younger than the average Danish private company. While companies with fewer than 10 employees account for 92 per cent of all Danish companies, they only represent 54 per cent of accepted applicants. Likewise, 1 per cent of Danish companies have more than 100 full-time employees, whereas companies with that staffing profile make up 16 per cent of the accepted applicants, of which most participate in Grand Solutions, reflecting the resource requirements of the programme.

Furthermore, 37 per cent of the accepted applicant companies are 0-5 years old, while the corresponding share for all Danish companies is 28 per cent. The fact that accepted applicants tend to be younger is likely to be explained by InnoBooster's focus on young SMEs.

Comparison of the companies' size and age distribution before and after 2014, indicates a shift in the user profile of private companies. Since 2014, the shares of both small and large companies have increased, following the IFD's focus on the InnoBooster and the Grand Solutions/Industrial Researcher programmes (which appeal to small and large companies, respectively). Moreover, after 2014 the IFD users tend to be younger companies, in line with the stronger focus on younger companies in the InnoBooster programme.

Accepted applicant companies are most likely to be geographically located in the Capital Region of Denmark (45 per cent). In comparison, 33 per cent of all Danish companies operate from the Capital Region. The second most popular region is the Central Denmark Region, with 24 per cent of the accepted applicants. Both regions were also the main geographical localities before 2014, although the share in the Capital Region has risen since the establishment of IFD.

Key knowledge indicators also suggest that accepted applicants have better educated workers, are more likely to undertake R&D activities, have a higher intensity, and initiate more product- and process innovation activities. This finding is hardly surprising, since the accepted applicants are a selected group of companies that often apply for funding to finance existing R&D activities or to establish and strengthen new R&D activities.

Finally, accepted applicant companies with 25 employees or fewer typically have lower labour productivity than the average Danish company. By contrast, the successful applicants with more than 50 employees that tend to participate in Grand Solutions and Industrial Researcher typically have higher labour productivity than average, suggesting that these companies have already commercialized their technology and started to generate sales. Accepted IFD applicants with fewer than 50 employees typically grow faster, in terms of number of full-time employees, than the average Danish company, which suggests that they are likely to be in the early stages, focusing on developing their technology, which often requires the hiring of new personnel.

1.3 Higher Educational Institutions' participation in IFD programmes

Another important and substantial player among users of IFD programmes is the higher education sector.[2] Industrial Researcher projects, for example, mostly build on and exploit high-quality research and involve a Danish university partner. Higher education institutions (HEIs) are also central to the Grand Solutions

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[2] This sector includes the eight universities, the three Academies of Art, the eight University Colleges and the eight Business Academies. From 2015-2017 the Business Academies were not approved for IFD funding.

projects, where they often take a leading role in research-intensive projects. In fact, 31 per cent of all IFD funding distributed in 2015-2017 was granted to HEIs involved in projects supported by Grand Solutions.

During the period 2015-2017, HEIs were involved 2,587 times as project applicants, and a total of 772 HEI applications received funding from one of the two IFD programmes, Grand Solutions and Industrial Researcher. Two universities – the Technical University of Denmark and the University of Copenhagen – accounted for more than half of all HEI participation in 2015-2017, while the top four universities made up almost 85 per cent. The participation distribution of HEIs is not driven by noticeable differences in approval rates. The same top universities were also the leading participants in research programmes before the establishment of IFD in 2014.

Focusing on the eight universities, the individual departments are categorized by their faculty affiliation, giving four main research areas – i.e. *Technical/Natural science*, *Health science*, *Social science* and *Humanities*. Not surprisingly, project participation is heavily skewed towards *Technical/Natural science*. In all, 67 per cent of the participants belong to *Technical/Natural science* and receive almost 80 per cent of the total funding allocated to Grand Solutions and Industrial Researcher – although *Technical/Natural science* is allocated (only) 52 per cent of the universities' total R&D expenditure. By contrast, *Health science* and *Humanities* underperform in terms of IFD users and allocated IFD funding compared to their respective shares of total R&D expenditure. The share of users from *Social science* is approximately equal to its share of the universities' total R&D expenditure, but it receives a lower share of the IFD funding allocated among the universities.

2. Introduction

Innovation Fund Denmark (IFD) was established in April 2014.[3] The main objective was to create a single point of access to innovation funding for Danish companies, universities and talents.

On behalf of the Danish government, IFD invests at an early stage in innovative projects with the potential to create growth, employment and solutions to societal challenges. Over the period 2015-2017, more than DKK 4 billion was invested in various projects and individuals. More than 8,000 applications were assessed, and over 2,000 projects were initiated.[4]

The investments are administered primarily through four programmes - each designed for a specific target group:[5]

- **Grand Solutions** is a programme for substantial investments in long-term projects/partnerships between academics and companies with the purpose of creating growth and solutions to societal challenges. Grand Solutions is IFD's most complex programme, with the largest investments and the toughest competition.

- **InnoBooster** targets start-ups, SMEs, and entrepreneurial researchers with a sound business idea and the potential for growth. The programme is designed to offer fast and easy entry to companies with little or no experience with grant applications.

- **Industrial Researchers** are PhD and Postdoc research projects shared between a company and a university. The programme is designed with the company and candidate as the main focus.

- **InnoFounder** is a one-year incubator course offered to new graduates from higher educational institutions with an innovative and scalable business idea. InnoFounder differs from other IFD programmes in offering courses in which participants are followed closely and services are adapted to needs identified during the course.

The four programmes differ in terms of scope, funding, target group and requirements. While a Grand Solutions project includes several partners and should be benchmarked against the best research and innovation projects worldwide, an Industrial Researcher project which only includes two partners should be assessed on the basis of the partners' individual potential for value creation.

The "Agreement on the Danish Innovation Fund - the Foundation for Strategic Research, High Technology and Innovation" of 3 October 2013 requires the IFD to be evaluated in 2018 by an international expert panel. As input to the evaluation, the Danish Agency for Institutions and Educational Grants under the Ministry of Higher Education and Science has asked IRIS Group to conduct an evaluation of IFD's users and potential target groups.

The purpose of the analysis is to map the use of the programmes managed by IFD during the period 2015-2017. The evaluation focuses on private sector companies and Danish higher education institutions (HEIs) that have used at least one of the four largest programmes run by IFD – i.e. Grand Solutions, InnoBooster, Industrial Researcher and InnoFounder. It should be noted that participants in InnoFounder often have not

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[3] 2014 was a transition year in which programmes were (re)designed. Hence, 2014 is not examined in the following chapters.
[4] Innovation Fund Denmark annual reports for the years 2015, 2016 and 2017. The number of applications and projects includes international programmes.
[5] IFD is also involved in international programmes. These, however, are not part of the evaluation.

founded a company at the time of their participation and are therefore not registered with a company ID by IFD. Thus, InnoFounder is examined only in Chapters 2 and 3 of this report.

The analysis proceeds in four steps. First, Chapter 3 presents the four IFD programmes, focusing on how they differ in terms of target group, application process, project management and grant size. Second, the profiles of programme applicants under IFD are analysed and compared to IFD's potential target groups. This part of the analysis is undertaken separately for private companies in Chapter 4 and HEI's in Chapter 5. Third, Chapter 6 maps the distribution of Grand Solutions projects in relation to the 14 political priorities set out in the RESEARCH2020 catalogue. Finally, Chapter 7 compares the distribution of companies and universities that have received funding from IFD in the period 2015-2017 with DAMVAD Analytics' analysis of the IFD target group prior to 2014.[6]

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[6] DAMVAD Analytics (2014): "Danmarks Innovationsfond – Målgruppeanalyse". See: https://ufm.dk/publikationer/2014/malgruppeanalyse-af-danmarks-innovationsfond-1.

3. The programmes managed by IFD since 2015

This chapter focuses on the four main programmes run by IFD during the period 2015-2017, and the data underlying the analysis of the IFD users to be presented.

After a brief introduction to the four IFD programmes, key features of the primary data source on IFD users, the InnovationDenmark database, are presented in Section 3.2. The chapter ends with a description of the project data, focusing, for each programme, on the number of applications, approval rates and average grant size over time.

3.1 Programmes

The Innovation Fund Denmark was established 1 April 2014, by a merger of the Strategic Research Council, the High Technology Foundation and the Council for Technology and Innovation. With the creation of IFD, existing programmes managed by the three research councils were either terminated or continued in a different form, and because of this 2014 was a "transitional year" and hence not suitable for inclusion in the analysis.

Key features of the four IFD programmes are summarized below in Box 3.1.

Box 3.1. Key figures of IFD programmes

Grand Solutions	**InnoBooster**
Duration: 3-4 years	Duration: Up to 3 years
Grant size: DKK 5-30 million (typically)	Grant size: Up to DKK 5 million
Budget in 2018: DKK 685 million	Budget in 2018: DKK 286 million
Main target group: private and public institutions	Main target group: SME's and start-ups
Industrial Researcher	**InnoFounder**
Duration: 1-3 years	Duration: 1 year
Grant size: Approximately DKK 1 million	Grant size: Approximately DKK 215,000
Budget in 2018: DKK 160 million	Budget in 2018: DKK 15 million
Main target group: companies with university collaboration	Main target group: Graduates from higher education institutions

Source: IRIS Group (2018): "The users' experience of the Innovation Fund Denmark".

3.1.1 Grand Solutions

The purpose of Grand Solutions is to invest in high-quality research and innovation projects with the potential to create knowledge, growth and employment in Denmark. Grand Solutions projects are characterized by their high-risk profile and focus on ambitious results in terms of new knowledge and/or new or significantly improved processes, systems, products or solutions to societal challenges. The project must create societal or economic value through the activities of Danish public or private companies or benefit society in other ways. It is thus advantageous if the beneficiaries of the project and other key stakeholders are active participants in the development stage as well as during the actual project period.

Grand Solutions has existed since 2015. It is the most complex IFD programme, with the largest investments, and projects should be benchmarked against the best research and innovation projects worldwide.

Target group

Any type of institution, such as a private company, research institution, public institution etc. is eligible to apply for a grant. Partners in Denmark or abroad can be project participants and receive funding from IFD. The number and types of project participants vary considerably across the projects. A Grand Solutions project can include up to 30 different partners.

Application process and project management

Themes are announced 2-3 months in advance of the deadline. In 2015 and 2016, IFD announced one call per year. The application process was two-phased, and on average it took 10 months from submission of the phase-1 application to the project start date. In 2017, IFD changed to a single-phase process, making time for two calls each year. Today, approved projects can kick off 6 months after the application is submitted.

One of the Danish project participants must act as the applicant organization, but the project can have multiple project partners (i.e. companies and private and public institutions). Applications are submitted electronically via IFD's online application system, E-grant, and must address the aim and strategic relevance of the project, state-of-the-art theory application, governance, risk management, implementation, and expected value creation.

About a month from the submission date, selected applicants are invited for a project interview and applications are sent for a peer review. Based on an overall assessment (including both internal strategic assessments, reviews of quality and potential impact, external peer reviews and project interviews), the IFD Board decides which projects to invite to investment agreement negotiations.

All project participants and IFD have 60 days to negotiate and sign an agreement. During this contract phase, IFD's Investment Managers are involved in the negotiations. IFD offers a template for a standard Investment Agreement, as well as an "inspirational draft" for preparation of a collaboration agreement. Grand Solutions projects begin with a kick-off session, and IFD Investment Managers actively follow up on projects through, among other things, bi-annual meetings of a steering committee and annual investment reviews.

3.1.2 InnoBooster

The purpose of InnoBooster is to enhance innovation in small and medium-sized enterprises (SMEs). To receive an InnoBooster grant, companies need to have an innovative idea that can significantly improve the competitiveness of the applying company.

It is possible to apply for between DKK 50,000 and DKK 5 million. The company itself must finance at least 2/3 of the total project costs, either through hours put into the project by the company's employees (in-kind contributions) or by a financial contribution. The grant can be used to finance a variety of elements, from production equipment and research to the recruitment of new employees with specialist knowledge and compensation to participating knowledge institutions.

Since 2014, the programme has undergone several small adjustments based on user input and accumulated in-house experience. Furthermore, the maximum grant size was raised from DKK 250,000 to DKK 5 million in 2015.

Target group

InnoBooster targets SMEs with a growth potential, as well as new, promising start-up companies and researchers with commercially promising ideas and results. This means that eligible companies should have fewer than 250 employees and yearly revenue of no more than €50 million or an annual balance of less than €43 million.

Application process and project management

InnoBooster is designed to offer fast and easy entry to companies and entrepreneurs. Companies apply via E-grant by submitting a brief presentation of the project and a budget. IFD assesses applications on a continuous basis and aims to provide a decision within a month. Companies applying for more than DKK 500,000 must pitch the project to a panel of experts.

Projects are managed online via E-grant using the profile the company created when the application was submitted. In E-grant it is also possible to request project adjustments (e.g. an extension of the project period).

During the project, companies must submit periodic accounts every three months with documentation of expenses incurred in the form of invoices. The grant is paid retrospectively based on the periodic accounts.

At project termination companies must: (i) submit final project accounts, (ii) fill out an online evaluation, and (iii) report on their results and experiences.

InnoBooster projects over DKK 500,000 are also required to prepare a short mid-term report and discuss project progress with IFD at a meeting during the project.

3.1.3 Industrial Researcher

The purpose of the Industrial Researcher programme is to raise the level of knowledge and innovation in Danish companies through research projects shared between a private company or public institution and a higher education institution.

IFD invests in Industrial PhD and Industrial Postdoc projects in which the candidate is affiliated with both a university and a company, with a supervisor in both places. To be considered, the research project must have the potential to create commercial value for the company and build on and exploit high-quality research.

An Industrial PhD project corresponds to a PhD degree and lasts for three years, while the duration of Industrial Postdoc projects varies between one and three years.

Target group

Any company, whether private or public, that collaborates with a Danish university on a PhD project or Post-doc project is eligible to apply for the programme.

Application process and project management

It is the company that formally submits the application to IFD, and it is possible to apply for an Industrial Researcher grant without having a specific candidate in place. In most cases, however, the company and the candidate prepare the application together – often in close dialogue with the university-affiliated supervisor. Applicants must explain the business potential and state-of-the-art theory application of the research project.

The application is assessed by the Industrial Researcher Committee, which consists of research and business experts within all the main fields of research. Applications are processed within two months.

When an Industrial PhD project is launched, the supervisors from the company and the university participate, together with the candidate, in a full-day kick-off meeting organized by IFD. The purpose of the meeting is to prepare the partners for successful cooperation.

In August 2017, a mandatory course for Industrial PhD students was (re-)introduced. The course is built around three modules in the first year of the project and focuses on strengthening the student's skills in management and entrepreneurship. Industrial Postdoc projects do not have a similar start-up scheme.

3.1.4 InnoFounder

InnoFounder is a one-year incubator course offered to new graduates with innovative and scalable business ideas. Graduates can apply if they have graduated within the last year, or are about to graduate, from a Danish HEI.

During the one-year course, InnoFounders receive a monthly grant of DKK 15,000 and a one-time grant of DKK 35,000 to support the development of their business idea.

The course also gives access to co-working spaces in five major Danish cities, a mentor who will follow the project, and a series of workshops for all InnoFounders across the programme.

The course is developed and run by an external operator in collaboration with IFD. In the three years following its introduction in 2014, InnoFounder was operated by a consortium consisting of the regional "Growth Houses" and Pluss Leadership.[7] In autumn 2017, daily operation of the scheme was relocated to the Danish Design Centre and Copenhagen Institute of Interaction Design. Consequently, the incubator course was redesigned to accommodate a more design-driven approach, focusing on people and the context in which they live as opposed to specific technologies or business models.

Target group

To be considered for an InnoFounder grant, applicants must have graduated from a higher education institution or hold a PhD degree or similar higher education degree from a private institution.[8]

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[7] This was known as "Entrepreneurial Pilot" before September 2017.
[8] Degrees from private research institutions must be recognized and eligible for student grants from The Danish Students' Grants and Loans Scheme.

Application process and project management

It is possible to apply twice a year, either individually or as a team of up to three graduates. The application is rather short and focuses on the business idea (innovative dimension, value creation, business potential and implementation). Applications are assessed by a panel consisting of experts with in-depth knowledge of entrepreneurship, as well as employees from IFD and the external operator.

Having reviewed applications, the assessment panel invites up to 40 of the best applicants to pitch their business ideas. The panel recommends approx. 20 applicants per application round for admission to the programme. The pitching session is part of the redesigned course, and has therefore only been run since autumn 2017.

3.2 The InnovationDenmark database

The Agency for Institutions and Educational Grants collects data on public research and innovation programmes. The data have been harmonized in a database called the InnovationDenmark database with the aim of improving the quality of analyses of the Danish research and innovation system.

The data for the current analysis were obtained from registered programmes and project applications, both rejected and accepted, in the InnovationDenmark database for the period 2015-2017. They have been cross-checked with IFD to ensure their comparability with previously reported numbers.

The database distinguishes between a project and the different institutions, i.e. applicants, included in the project application (Figure 3.1 below). A grant is considered as one project and is identified by a unique project ID.

Figure 3.1 Structure of the InnovationDenmark database
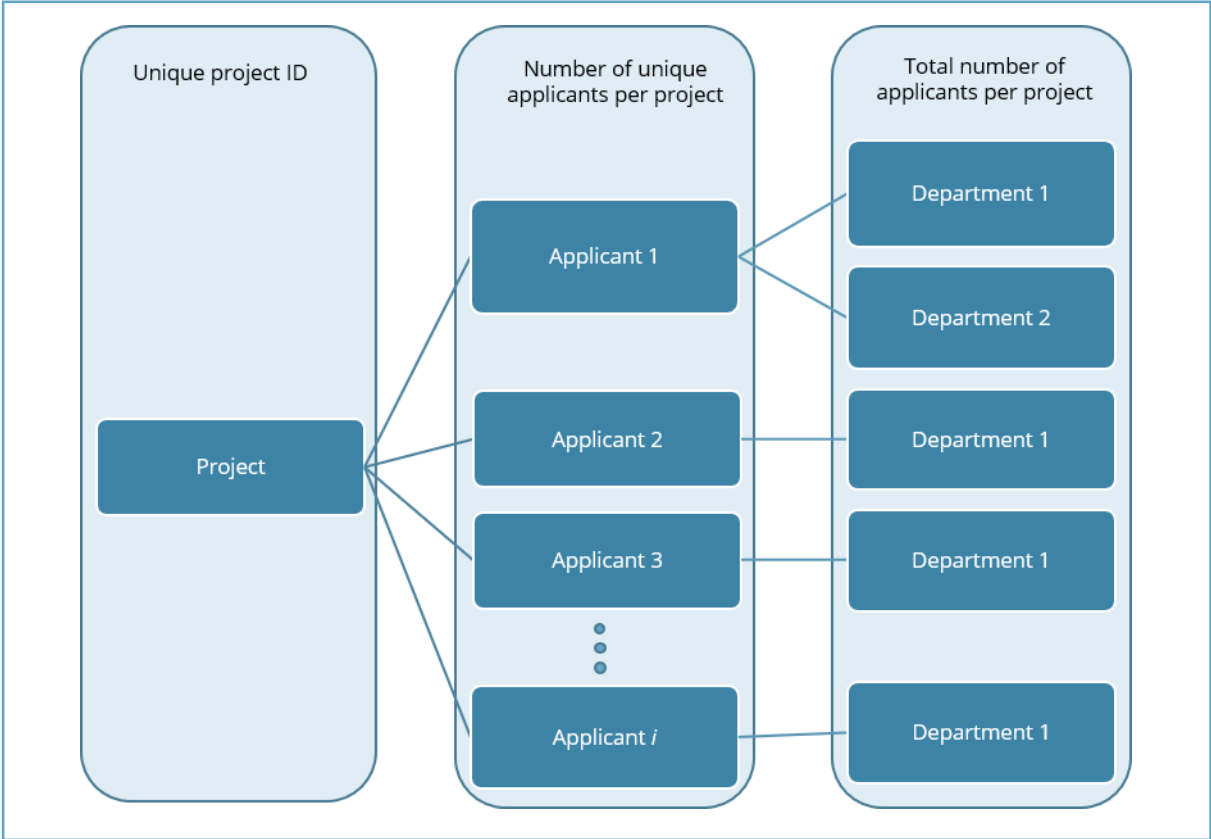
Source: IRIS Group

The projects administered under IFD require at least one applicant per project (except in InnoBooster, where a single company is the sole applicant). For example, an Industrial Researcher project includes both a higher education institution (HEI) and a private or public institution. For larger projects, such as those in Grand Solutions, up to 30 institutions may be involved in one project. A special feature of the large projects is that a single institution can be engaged in one and the same project through different depart-ments/branches. Universities are particularly likely to be represented more than once in the same project in their capacity as knowledge institutions. For instance, a university may participate in a single project through the involvement of several of its departments. This means that the total number of applicants per project may differ from the unique number of applicants per project (see Figure 3.1).

Table 3.1. gives an overview of the InnovationDenmark database for programmes managed under IFD. The figures reported in the table are based on applications submitted in 2015-2017, including both rejected and approved applications.

The table shows that almost 8,000 unique project applications were submitted in 2015-2017, and that most of the applications were for InnoBooster and Grand Solutions, which are also the IFD programmes with the largest budgets.

Table 3.1 Overview of the IFD data, 2015-2017

Programme	Unique project applications	Total number of applicants per project	Number of unique applicants per project
Grand Solutions	1,340	5,336	4,985
InnoBooster	4,521	4,521	4,521
Industrial Researcher	888	2,144	2,085
InnoFounder	931	1,300	1,300
Total	7,680	13,301	12,522

Source: InnovationDenmark database.
Note: All figures are based on submitted applications, including both approved and rejected proposals. Unique applicants include both companies and individuals.

More than 13,000 applicants were involved in project applications. Grand Solutions has the largest average number of applicants per project, with four applicants per project. There were 12,522 unique applicants per project, a somewhat lower figure than that for the total number of applicants, since HEIs are only counted once in cases were multiple departments from the same HEI har involved in the same project.

While projects are identified by a unique project ID, private and public institutions are identified based on the Central Company Register number (i.e. CVR number).[9] Using the CVR number it is therefore possible to identify an institution's involvement across different programmes and over time. However, it should be noted that often the participants in InnoFounder will not have founded a company at the time of their participation and therefore will not be registered with a CVR number. For this reason, participants in Inno-Founder are not included in the analysis of private companies in Chapter 4.

If InnoFounder participants are to be included in an analysis the InnovationDenmark database, that database will need to be continuedly updated with information about start-ups and their respective CVR number. Since the InnovationDenmark database does not include unique person ID, detailed analysis of Inno-Founder participants lies beyond the scope of this report.

3.3 IFD's grants during 2015-2017

Based on the InnovationDenmark database, Table 3.2 shows the number of applications received by IFD over time for each of the four programmes.

In the period 2015-2017, the IFD received more than 7,600 applications, of which 59 per cent were for Inno-Booster and 17 per cent for Grand Solutions. The number of applications slightly declined over time. In 2017, IFD received a total of 2,400 applications compared to 2,679 applications in 2015. The decline was driven primarily by a fall in the number of applications for Grand Solutions and InnoFounder, which also are the programmes with the higest share of rejected applications.

During the 2015-2017 period, 1,942 applications were approved, corresponding to an average approval rate of 25 per cent.

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[9] In Danish, *Det centrale virksomhedsregister*. It is mandatory for all active public and private Danish companies to have a CVR number.

Table 3.2 Number of project applications by year and status, 2015-2017

Programme		2015	2016	2017	Total
Grand Solutions	Project applications	568	493	279	1,340
	Approved applications	61	66	48	175
InnoBooster	Project applications	1,517	1,455	1,549	4,521
	Approved applications	462	403	393	1,258
Industrial Researcher	Project applications	205	319	364	888
	Approved applications	127	156	149	432
InnoFounder	Project applications	389	334	208	931
	Approved applications	25	27	25	77
Total	Project applications	2,679	2,601	2,400	7,680
	Approved applications	675	652	615	1,942

Source: InnovationDenmark database.

Note: Compared to the most recently published figures (UFM (2018): Tal om forskning og innovation 2017) there is missing information on 5 rejected applications for Grand Solutions. Moreover, there are 17 additional applications for InnoBooster, of which 6 are related to approved projects and 1 additional rejected application for InnoFounder.

Figure 3.2 shows developments over the period 2015-2017 in annual approval rates for each of the four programmes. The average annual approval rate across programmes has declined from 27 per cent in 2015 to 24 per cent in 2017.

The approval rates are highest for Industrial Researcher and lowest for InnoFounder. Over the period, they have been declining in InnoBooster and Industrial Researcher, but increasing in Grand Solutions and InnoFounder. The increase in approval rate observable in InnoFounder was driven primarily by a substantial decrease in the number of project applications in 2017.

In 2017, the approval rate for Industrial Researcher was noticeably high, at 41 per cent as compared with 25 per cent for InnoBooster, 17 per cent for Grand Solutions and 12 per cent for InnoFounder.

Figure 3.2 Approval rates by programme and year, 2015-2017
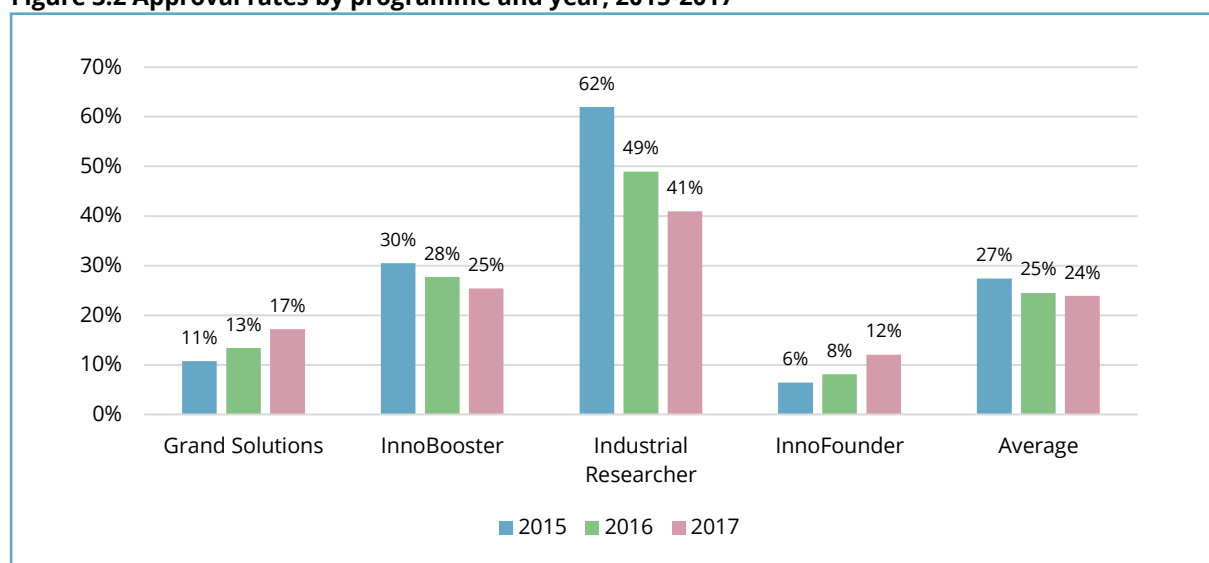
Source: InnovationDenmark database.

Note: Based on the number of unique project IDs.

With the decline in the number of applications, total applied funds also declined between 2015 and 2017. In 2017, IFD received applications for a total of DKK 5.9 billion. Projects for a little over DKK 1 billion were approved (see Figure 3.3).

Figure 3.3 Applied and granted funding size, DKK million, 2015-2017 (2017-prices)
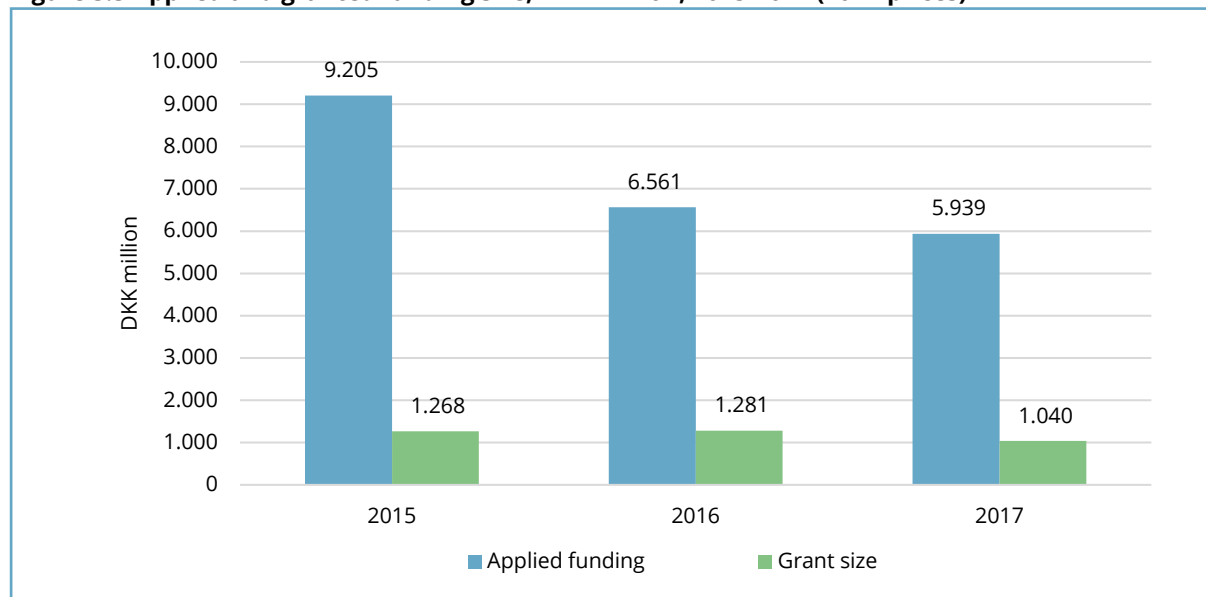
Source: InnovationDenmark database.
Note: Applied funding for each of the four programmes in 2017 is taken from UFM (2018): Tal om forskning og innovation 2017.

Figure 3.4 shows average grant sizes for 2015-2017 by programme type. Overall, the average grant size remained stable at approx. DKK 4 million per project over the period. The figure indicates that average grant sizes for the individual programmes were also largely stable during the period. Grand Solutions has the largest average grant size, at more than DKK 13 million per project. InnoBooster and InnoFounder – which are less complex programmes with fewer involved partners – have the lowest average grant size.

Figure 3.4 Average grants size by programme type, DKK million, 2015-2017 (2017-prices)
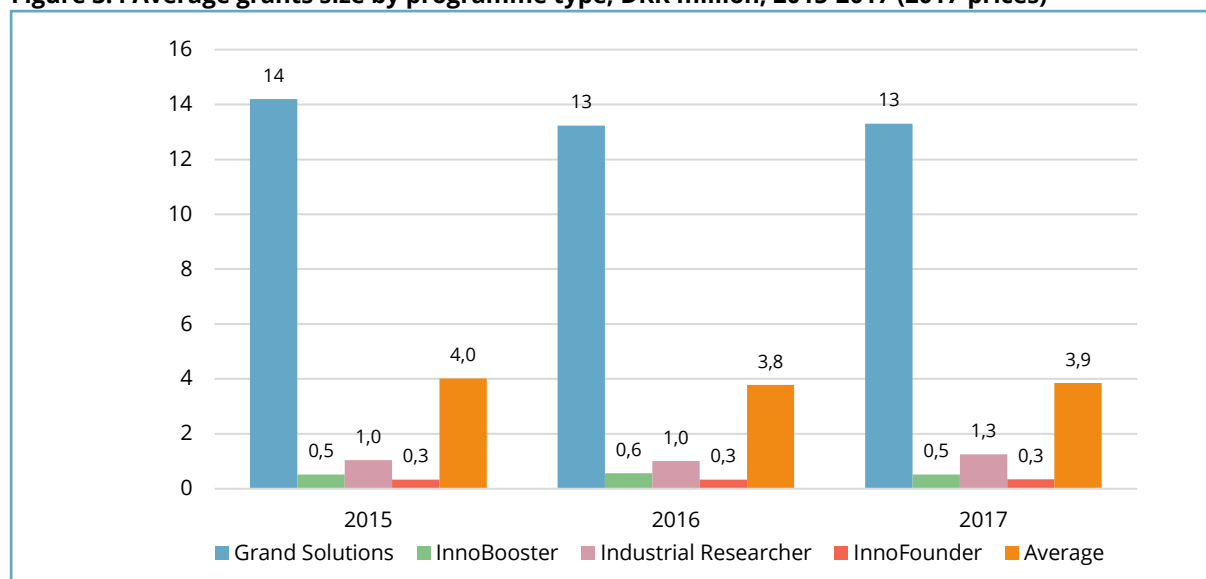
Source: InnovationDenmark database.
Note: Based on the number of unique project IDs.

4. Company characteristics of IFD applicants

This chapter focuses on private Danish companies, or "applicants", applying for grant from IFD in the period 2015-2017.[10] The purpose of the chapter is twofold. First, to examine the applicants with respect to their participation in IFD programmes and company characteristics (e.g. business sector, employment and productivity). Second, to compare the applicants on these different dimensions both with the total population of Danish private companies and with the population of potential research, development and innovation-active (RDI-active) companies in Denmark, i.e. IFD's potential target groups.

Section 4.1 describes the data used in the analysis and characterizes the target groups. Section 4.2 focuses on IFD users (i.e. accepted applicants) and explains how one-time users differ from multiple programme users. Section 4.3 profiles applicants (accepted and rejected) with respect to company size, age, sector and geographical location. Company characteristics related to different key knowledge indicators are examined in Section 4.4. The chapter ends by looking at company performance in terms of productivity and employment growth.

This chapter focuses exclusively on three IFD programmes: Grand Solutions, Industrial Researcher and Inno-Booster. The InnoFounder programme is omitted because participants in it are not registered with a company ID (i.e. CVR number) in the InnovationDenmark database.

4.1 Data

The subsequent analysis builds on two primary data sources:

- **The InnovationDenmark database**. As described in Chapter 3, this contains data on accepted and rejected IFD applicants in 2015-2017.

- **The Statistics Denmark employer-employee register** for 2006-2016 (2016 being the last available year). The data contained in these registers include information on a company's business sector, geographical location, age, number of full-time employees and their educational level, as well as the company's R&D and innovation activities, and labour productivity. See Appendix – Section A for further details of the different registers used and the data handling.

4.1.1 Identifying IFD applicants in the InnovationDenmark database

As mentioned above, the InnovationDenmark database contains information on every company that has applied for IFD funding in the period 2015-2017. The baseline sample of IFD applicants can therefore be identified by including companies that are registered as a Danish private company and have a valid CVR number in the InnovationDenmark database.[11]

Following this methodology, unique numbers of applicants, both accepted and rejected, are identified in each year. It should be noted that if a company has been both accepted and rejected for a grant in the same

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[10] The category of private companies includes publicly listed companies. Companies that are owned by the government (in Danish: offentligt ejede virksomheder) are excluded from the analysis.
[11] Danish private companies are identified in the InnovationDenmark database under the variable *Organisational type* by only including companies that are registered as *Private companies (incl. private hospitals), Danish SMEs* or *Danish: Private companies (incl. private hospitals)*. An additional merge with register data from Statistics Denmark (General enterprise statistics) identifies a small number of companies owned by the government in 2015 and 2016 that are excluded from the sample.

year, it will be counted as both accepted and rejected in that year. Furthermore, companies that have applied for a grant in different years are counted in each of those years. Table 4.1 shows annual numbers of unique accepted and rejected applicants in the period 2015-2017.

Table 4.1 Basline sample – Annual number of unique IFD users, 2015-2017

Application year	Accepted applicants	Rejected applicants
2015	694	1,103
2016	628	1,627
2017	596	1,474
Total	**1,918**	**4,204**

Source: InnovationDenmark database.
Note: A company can be counted as both accepted and rejected in the same year.

The baseline sample is used to estimate the IFD users' total and programme-specific participation rates in Section 4.2.

4.1.2 Combining IFD applicants with register data from Statistics Denmark

Using CVR numbers, the IFD applicants from the baseline sample can be combined with register data from Statistics Denmark in order to obtain information about company characteristics. Since the latest year for which register data from Statistics Denmark is available is 2016, IFD users from 2017 have had to be excluded from the analysis wherever company characteristics are being considered.

The procedure for combining IFD applicants with register data involves two steps.

In the first step, IFD applicants from the baseline sample are matched with register data from Statistics Denmark based on the application year. This allows us to obtain accurate information about the companies at the time of application. The group of identified applicants is then limited to companies that were economically active during the application year.[12] Table 4.2 shows the results of this first step.

In total 1,301 accepted applicants and 2,682 rejected applicants were identified. Of these, 1,139 of the accepted applicants and 2,013 of the rejected applicants were found to be economically active in the application year. This corresponds to 86 and 74 per cent of the total number of accepted and rejected applicants, respectively.[13] These samples are used in the subsequent analysis to describe the IFD applicants with respect to a range of company characteristics that vary over time, i.e. employment, revenue, productivity, R&D and innovation activities.[14]

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[12] Statistics Denmark defines a company as economically active if it upholds an employment or annual turnover equivalent to min 0.5 full-time employee.

[13] The majority of accepted and rejected applicants (67 and 71 per cent, respectively) that are registered as economically inactive are in the following three sectors: *Manufacturing, mining and quarrying, and utility*, *Information and communication* and *Business services*. Furthermore, both groups are InnoBooster applicants.

[14] Data coverage varies for each of the indicators, so the actual number of IFD users/observations are lower for some of the indicators.

Table 4.2 IFD users identified in register data, 2015-2016

Year	Identified companies	Economically active	Not economically active	Cannot be identified in the register data
Accepted applicants				
2015	683	*603*	*80*	11
2016	618	*536*	*82*	10
Total	**1,301**	***1,139***	***162***	**21**
Rejected applicants				
2015	1,086	*780*	*306*	17
2016	1,596	*1,233*	*363*	31
Total	**2,682**	***2,013***	***669***	**48**

Source: InnovationDenmark database and register data from Statistics Denmark.
Note: A company can be counted as both accepted and rejected in the same year.

In the second step, applicants that were not economically active in the application year are examined more closely. (These applicants were disregarded in the first step due to lack of economic activity.) Of these, 55 accepted and 130 rejected applicants were identified as economically active in a year other than the application year. These applicants are included in the sample when applicants' sectorial affiliations and geographical location are described in Section 4.3, since these characteristics are less likely to change over time.

Including these additional companies, the sample increases to 1,194 accepted applicants and 2,143 rejected applicants.

4.1.3 Potential target groups

Throughout this chapter, the applicants are compared with two potential target groups: (i) the total population of private Danish companies, and (ii) the population of potential research, development and innovation-active (RDI-active) companies.

The total population of Danish companies includes all economically active private companies in Denmark registered by Statistics Denmark in the General Enterprise Statistics (GES). In 2015 and 2016, the numbers of private Danish companies were 286,216 and 296,651, respectively. Hence, there were 582,867 Danish companies in total over the two-year period.[15]

The population of potential RDI-active companies in Denmark is calculated each year by Statistics Denmark. The calculation uses GES data and is based on company size (defined by number of full-time employees) and business sector. The aim is to identify the companies that are most likely to be RDI-active and therefore suitable respondents to Statistics Denmark's annual survey on private sector research, development and innovation – the so-called RDI survey. For more information about the survey, see Box 4.1 below.

In 2015 and 2016, the numbers of potential RDI-active companies were 17,952 and 13,856, respectively. Hence, there were 31,808 potential RDI-active companies in total over the two-year period.[16]

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[15] The Danish name for GES is "Den Nye Generelle Firmastatistik (FIRM)". On a discretionary basis, the sector *Culture and leisure* are excluded from the sample by Statistics Denmark. This sector includes approximately 7,000 companies each year.

[16] The decline in the number of potential RDI-active companies between 2015 and 2016 can be explained by an adjustment in the sampling method used by Statistics Denmark for the 2016 population. One of the main effects of the adjustment was that a number of smaller companies, in terms of full-time employees, were excluded from the population.

Box 4.1 The Research, Development and Innovation survey

Research, Development and Innovation survey, or RDI survey (in Danish: Forskning, Udvikling og Innovations Statistikken, FUIS) The purpose of the Research, Development and Innovation survey is to examine the scope, nature and effect of research, development and innovation in the business sector. The survey is conducted annually by Statistics Denmark in accordance with EU and OECD guidelines for innovation statistics described in the Oslo Manual. Data is collected to enable comparisons over time.

Data is collected via questionnaires from approx. 4,500 respondents among a population of approx. 13-17,800 companies every year. The companies are sampled depending on number of full-time equivalents and type of business activity. All companies with 100 or more full-time equivalents are included in the sample. Companies are more likely to be selected for inclusion if they have higher numbers of full-time equivalents or are engaged in more R&D-intensive activities. The enterprises in the sample are randomly selected. From the reference year 2009 the sample is designed as a 'rolling panel'.

Potential RDI-active companies (in Danish: Målgruppepopulation) Based on the answers to the questionnaire, Statistics Denmark calculates weights in order to make the survey representative for the entire population (approx. 13-17,800 companies each year). In this report, the IFD applicants are compared with the target population rather than the survey population.

4.2 Participation rate

IFD users differ in the number of times they have participated in IFD programmes (i.e. in what will be referred to as their participation rates) and in whether they use several types of IFD programme or just one. The present section focuses on accepted applicants and investigates how one-time users differ from users that used a single programme multiple times, or several different programmes, during the period 2015-2017.

Subsection 4.2.1 below describes the IFD users' total participation rate, i.e. the total number of programme participations. Subsection 4.2.2 then describes participation rates for each of the three IFD programmes.

4.2.1 Total participation rate

Total participation rate is defined as the total number of participations in 2015-2017, disregarding the programmes the user participated in. Thus, the IFD users from the baseline sample are categorized according to their total number of participations in the period. Following this methodology, Table 4.3. shows the number and share of unique IFD users by participation rate for the period 2015-2017. Of the baseline sample of 1,918 accepted IFD users, a total of 224 participated more than once in IFD programmes in 2015-2017. Thus, the total number of unique companies that received a grant in 2015-2017 was 1,694.

Table 4.3 Unique IFD users by total participation rate, 2015-2017

Participation rate	Number of users	Per cent
1 participation	1,447	85%
2-3 participations	213	13%
At least 4 participations	34	2%

Source: InnovationDenmark database and register data from Statistics Denmark.
Note: N=1,694 unique IFD users.

The majority of users, 85 per cent, participated once during the period. Only 15 per cent (i.e. 247) participated more than once. Of the 1,447 users that participated once in the period, 1,029 participated in Inno-Booster. Of the 213 users that participated 2-3 times in IFD programmes, 121 used one type of IFD programme (with 80 of these participating in InnoBooster), 91 used two programmes, and just one used three programmes. Of the 34 users that participated at least four times in IFD programmes, seven used one programme, 25 used two programmes and two used three programmes.

Based on the total participation rate of the 1,694 unique IFD users, Table 4.4 describes user company characteristics, giving average full-time employment, company age and educational level of the workers for the period 2015-2016. The company characteristics are estimated from the register data from Statistics Denmark available for 2015-2016, and are calculated based on the IFD users in both 2015 and 2016. Hence, the number of users is reduced to 1,139.

Table 4.4 Number of programme participations by company characteristics (averages), 2015-2016

Company characteristics	1 participation	2-3 participations	At least 4 participations
Full-time employees	90	150	2,346
Age (years)	14	15	32
Long-cycle higher education & PhD	25%	33%	33%
Medium-cycle higher education	12%	14%	14%
Short-cycle higher education	14%	16%	15%
Skilled	23%	17%	21%
Unskilled	27%	20%	17%
Number of observations	843	238	58

Source: InnovationDenmark database and register data from Statistics Denmark.
Note: N=1,139. The company characteristics are estimated from the register data from Statistics Denmark available for 2015-2016, and calculated based on the IFD users in both 2015 and 2016. This explains why the number of users is reduced to 1,139.

From the table, it can be seen that IFD users that participated more than once in the 2015-2016 period were generally larger in terms of the number of full-time employees. Users participating at least four times were older than the other users, and users participating at least four times were significantly older and larger than the other users of the IFD programmes.[17]

Turning to educational levels among employees, multiple programme users generally have larger shares of highly educated workers. In all, 33 per cent of the employees in companies that used IFD more than once have long-cycle higher education or a PhD. This number falls to 25 per cent among one-time users. Similarly, the one-time users employ more unskilled workers (27 per cent) than multiple IFD users (17-20 per cent).

The differences in company characteristics can be explained by the fact that most of the users that participated either once or two-to-three times were accessing InnoBooster – a programme targeting younger companies and SMEs.

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[17] Average employment size and age are biased towards a small number of large and older users. However, the rank of employment and age across the three user groups does not change when these outliers are removed.

4.2.2 Programme-specific participation rate

The previous subsection provided a general overview of the IFD users participation rates. However, it offered no insight into programme-specific differences. This section categorizes users according to their participation rate in connection with three programmes: Grand Solutions, Industrial Researcher and Inno-Booster.

Figure 4.1 shows users' programme-specific participation rates in 2015-2017. Users that participated in multiple programmes are included in each programme.

Figure 4.1 Participation rate by programme, 2015-2017
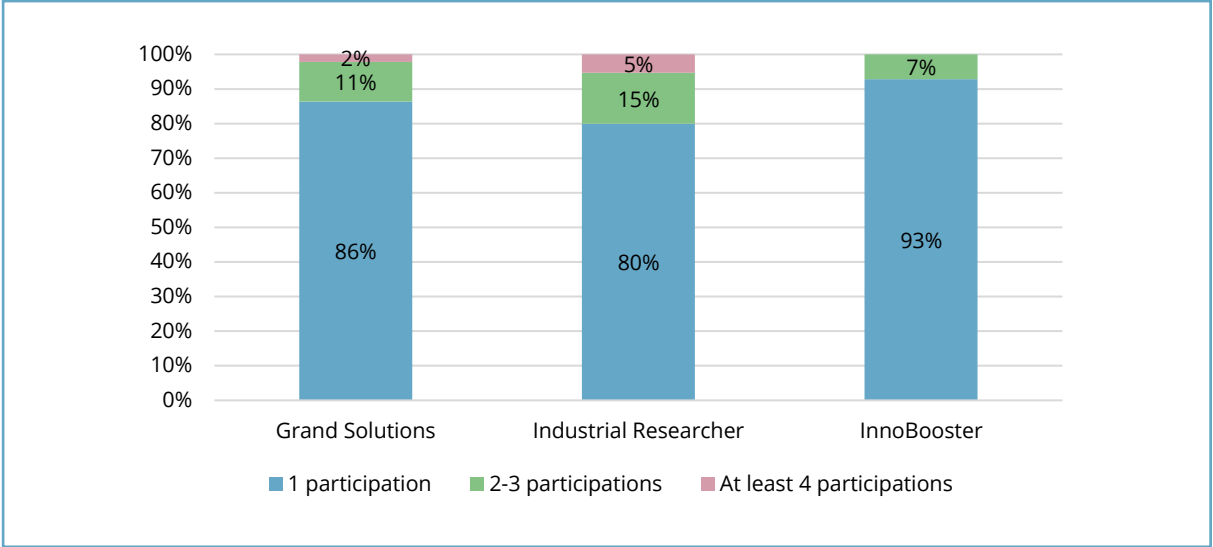
Source: InnovationDenmark database and register data from Statistics Denmark.
Note: N=1,816. Users that participated in multiple programmes are included in each programme.

Across all three programmes, a substantial majority of users participated only once during the period 2015-2017. The Industrial Researcher programme had the highest share of multiple programme users, and no IFD users participated more than three times in InnoBooster. InnoBooster also had the highest share of one-time users, which reflects the fact that users of InnoBooster are relatively young and small companies with a limited capacity to carry out multiple innovation projects within a short period of time.

Table 4.5 shows the users' company characteristics by participation rate for each of the three programmes. The company characteristics are estimated from the register data from Statistics Denmark available for 2015-2016, and are calculated based on the IFD users in both 2015 and 2016. Hence, the number of users is reduced to 1,295.

Programme-specific participation rates show whether certain users – e.g. old and large companies – are more likely to participate multiple times in a particular programme. The company characteristics considered include number of full-time employees, company age, and educational level of the workers. It should be noted, that company characteristics for users that have participated more than once are based on a relatively small number of observations.

Table 4.5 Number of participations by company characteristics and programme type (averages), 2015-2016

Participation rate	Grand Solutions	Industrial Researcher	InnoBooster
1 participation			
Full-time employees	239	283	12
Age (years)	21	22	10
Long-cycle higher education & PhD	30%	40%	23%
Medium-cycle higher education	13%	13%	12%
Short-cycle higher education	12%	14%	15%
Skilled	23%	14%	23%
Unskilled	23%	18%	28%
Number of observations	256	155	636
2-3-participations			
Full-time employees	920	953	11
Age	24	30	7
Long-cycle higher education & PhD	35%	31%	28%
Medium-cycle higher education	15%	15%	11%
Short-cycle higher education	12%	14%	19%
Skilled	19%	22%	18%
Unskilled	19%	18%	23%
Number of observations	62	54	90
At least 4 participations			
Full-time employees	4,372	2,877	*No data*
Age	37	31	
Long-cycle higher education & PhD	32%	37%	
Medium-cycle higher education	14%	13%	
Short-cycle higher education	15%	17%	
Skilled	23%	18%	
Unskilled	16%	15%	
Number of observations	15	27	

Source: InnovationDenmark database and data from Statistics Denmark.
Note: N=1,295. The company characteristics are estimated from the register data from Statistics Denmark available for 2015-2016, and are calculated based on the IFD users in both 2015 and 2016. Hence, the number of users is reduced to 1,295.

It can be seen that IFD users that participated more than once in Grand Solutions were on average older and larger (in terms of number of full-time employees) than those that participated just once. The purpose of Grand Solutions is to invest in high-quality research and innovation projects, which requires a substantial allocation of resources by the participating company. Thus, it is not surprising that the users participating more than once were larger and older than once-only users of Grand Solutions. The educational distribution is relatively stable across the three user groups.

As was the case for Grand Solutions, the users that participated more than once in Industrial Researcher were on average older and larger (in terms of number of employees) than those that participated just once. Participation in Industrial Researcher, like that in Grand Solutions, requires considerable resources, and this is likely to explain the differences in terms of employment and company age. The IFD users that participated two-to-three times employed the lowest share of workers with long-cycle higher education or a PhD degree (31 per cent of workers as compared with 37 and 40 per cent in the other groups).

No users participated more than three times in InnoBooster. It can be seen that the company characteristics do not differ substantially across the two remaining user groups of InnoBooster. The users that participated once employed 12 full-time employees on average and were 10 years old, and the users that participated two-to-three times employed 11 full-time employees on average and were 7 years old. Turning to employee educational levels, the once-only users of InnoBooster employed a smaller share of employees with long-cycle higher education or a PhD (23 per cent) and a larger share of unskilled employees.

To summarize, average numbers of full-time employees and company age rise with the number of participations for users of the research-oriented programmes, i.e. Grand Solutions and Industrial Researcher, but both are more stable across the InnoBooster groups.

4.3 Profile of the IFD applicants

This section describes the IFD applicants – accepted and rejected – with respect to sectorial affiliation, company size and age, as well as geographical location. In all dimensions, comparisons are made with figures for all private Danish companies and potential RDI-active companies in Denmark.

The data used in this section and in Sections 4.4 and 4.5 were obtained from the register data available from Statistics Denmark for 2015-2016, and is calculated based on the IFD applicants in both 2015 and 2016.

4.3.1 Sectorial distribution

Table 4.6 presents the distribution of IFD applicants by business sector for the period 2015-2016. Figure 4.2 shows how the accepted applicants are distributed by sector and IFD programme.

Most of the IFD applicants, both accepted and rejected, were operating in three sectors: *Manufacturing, mining and quarrying, and utility*, *Business services* and *Information and communication*. In the *Manufacturing, mining and quarrying, and utility* sector, the shares of accepted applicants and rejected applicants were 32 per cent and 24 per cent, respectively. The reverse is the case in the *Information and communication* sector, where the shares of accepted and rejected applicants were 18 and 25 per cent, respectively.[18]

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[18] See Appendix B for a subdivision of the business sector *Manufacturing, mining and quarrying, and utility.*

Table 4.6 Busines sector distribution by company population, average, 2015-2016

Business sector	Accepted applicants	Rejected applicants	Potential RDI-active companies	All Danish companies
Manufacturing, mining and quarrying, and utility	32%	24%	27%	7%
Business services	26%	27%	23%	18%
Information and communication	18%	25%	18%	6%
Trade and transport etc.	14%	13%	25%	23%
Construction	3%	2%	2%	11%
Agriculture, forestry and fishing	3%	2%	0%	9%
Public administration, education and health	2%	3%	0%	8%
Arts, entertainment and other services	2%	3%	2%	5%
Financial and insurance	1%	1%	3%	4%
Real estate	1%	1%	0%	9%
Number of observations	1,194	2,143	31,754	582,770

Source: InnovationDenmark database and register data from Statistics Denmark.

Note: 54 and 97 of potential RDI-active companies and all Danish companies, respectively, had no information on sector and are therefore excluded.

Overall, the accepted applicants' business sector distribution and the sectorial distribution of potential RDI-active companies are quite similar. When the IFD applicants are compared with all Danish companies, it emerges that the sectors *Manufacturing, mining and quarrying, and utility* and *Information and communication* are overrepresented among the IFD applicants. It is no surprise that the sectorial distribution of the IFD applicants resembles that of potential RDI-active companies most since it can be safely assumed that both populations are strongly RDI-active.

Figure 4.2 shows the business sector distribution of accepted applicants against two programme types. Each user is categorized as having participated either in Grand Solutions/Industrial Researcher or in InnoBooster. In all, 17 users participated in both Grand Solutions/Industrial Researcher and InnoBooster and are thus excluded from the figure.

Figure 4.2 Accepted applicants' busines sector distrubution by programme, average, 2015-2016

Source: InnovationDenmark database and register data from Statistics Denmark.
Note: N: 1,177, of which 440 are in Grand Solutions/Industrial Researcher and 737 in InnoBooster. A total of 17 IFD users participated in both Grand Solutions/Industrial Researcher and InnoBooster and are thus excluded. The category of other sectors contains Arts, entertainment and other services and Real estate. These were grouped together due to confidentiality of data.

IFD users in both of the defined programme types can be seen to be concentrated in four sectors: *Manufacturing, mining and quarrying, and utility*, *Business services*, *Information and communication* and *Trade and transport etc.* Users of Grand Solutions/Industrial Researcher are mainly located in the first two of these sectors (65 per cent), and to a lesser extent in the last two sectors (20 per cent). The users of InnoBooster are distributed somewhat more evenly across the four prominent sectors. This suggests that users in *Information and communication* and *Trade and transport etc.* primarily participates in InnoBooster.

Box 4.2 Accepted IFD applicants' share of total employment and turnover by sector, 2015-2016

Accepted IFD applicants (i.e. IFD users) make up only 4 per cent of potential RDI-active companies and less than 1 per cent of all Danish companies. However, when the users' economic activities, measured by the number of full-time employees and turnover, are taken into consideration the picture is somewhat different. In terms of full-time employees, the users account for 13 per cent of full-time employees in potential RDI-active companies and 9 per cent of employees in all Danish companies. Furthermore, when average turnover is considered, the IFD users account for 35 per cent of the potential RDI-active companies and 14 per cent of all the Danish companies. These numbers show that the IFD users play a major economic role within the Danish business community even though they constitute less than 1 per cent of all Danish companies in absolute numbers.

IFD users' share of total employment and turnover by business sector and population, average, 2015-2016

Business sector	Full-time employees		Turnover	
	Share of potential RDI-active companies	Share of all Danish com panies	Share of potential RDI-active companies	Share of all Danish com panies
Construction	9%	3%	20%	3%
Business services	13%	10%	34%	13%
Manuf., mining and quarrying, and utility	24%	22%	59%	31%
Information and communication	4%	4%	7%	3%
Arts, entertainment and other services	5%	2%	11%	3%
Other sectors*	9%	5%	-	-

Source: InnovationDenmark database and register data from Statistics Denmark.
Note: N=1,139 (full-time employees). N=934 (turnover). 54 and 97 companies in the potential RDI-active companies category and the all Danish companies category, respectively, had no information on sector and are excluded. The sectors with missing data are excluded due to confidentiality if data. Other sectors include Agriculture, Forestry and fishing, Public administration, Education and health, Real estate, Wholesale and retail, Financial and insurance.

The table above shows the shares of total full-time employment and turnover that IFD users constitute by sector. The IFD users play a substantial role in the *Manufacturing, mining, quarrying and utility* sector, where they account for 24 and 22 per cent of total full-time employment, and 59 and 31 per cent of total turnover, among potential RDI-active companies and all Danish companies, respectively.

4.3.2 Company size distribution

Next, company size among the IFD applicants and the target populations is considered. Table 4.7 shows the distribution of company sizes measured by number of full-time employees. Figure 4.3 shows the accepted applicants by size and programme type.

When comparing the IFD applicants and target populations with respect to size distributions, it should be kept in mind that InnoBooster targets SMEs and start-up companies, and that this might create a higher share of companies in these size categories among the IFD applicants.

Table 4.7 Size distribution (employees) by company population, average, 2015-2016

Company Size	Accepted applicants	Rejected applicants	Potential RDI-active companies	All Danish companies
0 full-time employees (only owners)	7%	11%	0%	46%
1-9 full-time employees	47%	53%	29%	46%
10-19 full-time employees	13%	12%	27%	4%
20-49 full-time employees	11%	9%	22%	2%
50-99 full-time employees	6%	4%	11%	1%
100 full-time employees or more	16%	10%	10%	1%
Number of observations	1,139	2,013	31,808	582,867

Source: InnovationDenmark database and register data from Statistics Denmark.

Companies with no full-time employees account for more than 40 per cent of ten companies in Denmark, but they represent only 7 per cent of the accepted applicants and 11 per cent of the rejected applicants. The difference in this size category between IFD applicants and all Danish companies is most likely due to the fact that a large number of the companies in the latter population are not research or innovation oriented, and therefore not targeted by the IFD programmes.

The medium sized companies, with 10-99 employees, make up larger shares of IFD applicants, both accepted and rejected, in comparison with all Danish companies. This is not surprising given InnoBooster's focus on supporting and enhancing innovation in SMEs.

Large companies with 100 or more employees account for 16 per cent of the accepted applicants and 10 per cent of the rejected applicants, but they only constitute 1 per cent of all Danish companies. This can be attributed to the Grand Solutions and Industrial Researcher programmes, for although they do not formally exclude companies based on the number of employees, these programmes mostly appeal to larger companies with the resources (both in terms of finance and in terms of skilled workers) that need to be allocated to the complex and resource-hungry projects.

The accepted and rejected applicants' overall size distribution does not resemble that of the potential RDI-active companies. This is a result of the sampling method used by Statistics Denmark. The method excludes most companies with no or few employees, meaning that the remaining size categories are overestimated in comparison with IFD applicants.

In order to compare the size distribution across programmes, the accepted IFD applicants were categorized according to the programmes in which they participated. Each user was categorized as having participated in one of two programme types: Grand Solutions/Industrial Researcher or InnoBooster. Figure 4.3 shows the size distribution of IFD users by programme type. The 16 users that participated in both Grand Solutions/Industrial Researcher and InnoBooster and are thus excluded.

Figure 4.3 Accepted applicants' size distribution by programme, average, 2015-2016
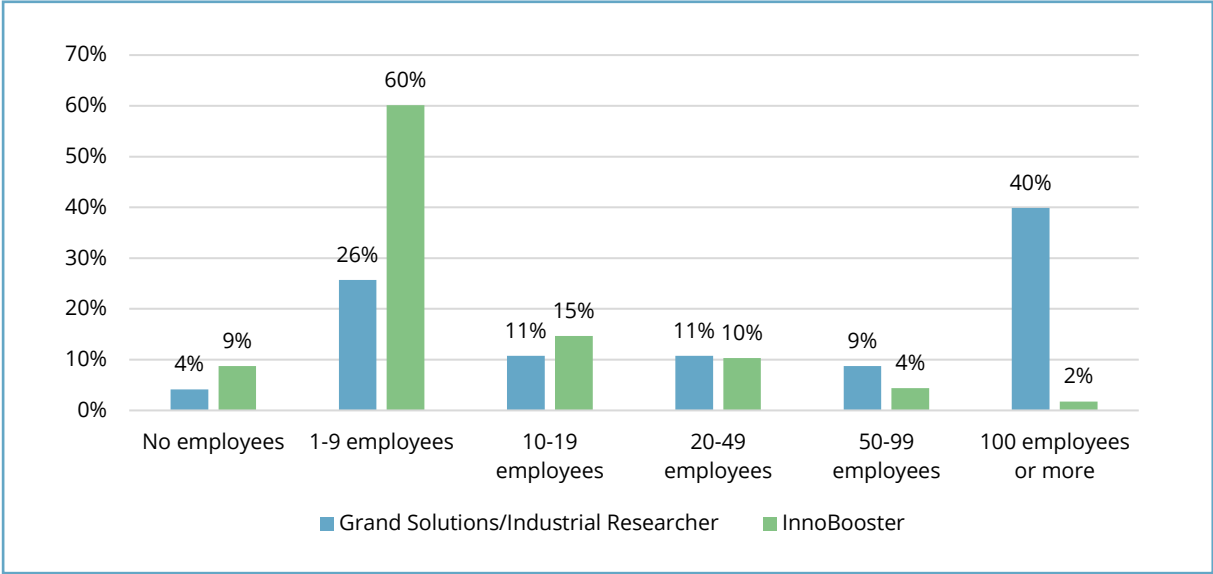
Source: InnovationDenmark database and register data from Statistics Denmark.
Note: N=1,123, of which 436 were in Grand Solutions/Industrial Researcher and 687 were in InnoBooster. 16 IFD users had participated in both Grand Solutions/Industrial Researcher and InnoBooster and are excluded.

In all, 49 per cent of the users that participated in Grand Solutions/Industrial Researcher have 50 employees or more, while the corresponding share of users of InnoBooster is 6 per cent. Thus, the participants in Inno-Booster are primarily users with 0-49 employees, and the majority of IFD users with at least 50 employees participate in Grand Solutions/Industrial Researcher. This result, as mentioned above, reflects InnoBooster's focus on SMEs and Grand Solutions/Industrial Researcher's bias towards larger companies with sufficient resources to manage the kinds of projects they fund.

4.3.3 Age distribution

This subsection describes the company age of IFD applicants. Table 4.8 shows the company age[19] distribution for each company population. Figure 4.4 shows the accepted applicants by age category and programme.

When comparing the populations' age distributions shown in Table 4.8, it is important to bear in mind that InnoBooster targets start-up companies, and that this might drive up the shares of young companies among IFD applicants in comparison with the corresponding shares in the potential target populations.

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[19] Ages are calculated from a company's year of establishment, as indicated by Statistics Denmark's GES, and its application year.

Table 4.8 Age distribution by company population, average, 2015-2016

Company age	Accepted applicants	Rejected applicants	Potential RDI-active companies	All Danish companies
0-2 years	18%	21%	3%	13%
3-5 years	19%	20%	10%	15%
6-10 years	17%	19%	19%	20%
11-20 years	22%	20%	32%	26%
21-30 years	10%	9%	16%	13%
More than 30 years	15%	10%	19%	13%
Number of observations	1,139	2,013	31,496	582,867

Source: InnovationDenmark database and register data from Statistics Denmark.

Note: 312 companies among the potential RDI-active companies had no information on age and are therefore excluded.

Compared with both the potential RDI-active companies and all Danish companies, the accepted and rejected applicants are overrepresented among the youngest companies aged 0-5 years. As has been mentioned, this result is not surprising given InnoBooster's focus on start-up companies (which, naturally, are young).

With the exception of accepted IFD applicants more than 30 years old, the shares of both accepted and rejected applicants are lower than those of all Danish companies in all of the remaining age categories. The higher share of accepted applicants more than 30 years old may reflect the fact that research-oriented IFD programmes with complex and resource-heavy projects of the sort provided by Grand Solutions/Industrial Researcher appeal to larger, older companies.

The share of potentially RDI-active companies between 0-2 years is only 3 per cent. This share is substantially smaller than the corresponding shares for the IFD users and all Danish companies. As was the case with company size, the low share of companies aged 0-2 years can be explained by the sampling method applied by Statistics Denmark. The method excludes companies with 0 or few employees, which tend to be young companies. This exclusion may also drive up the shares in the remaining age categories, explaining the relatively high shares of potential RDI-active companies in the age categories 11-20, 21-30 and more than 30 years old.

Figure 4.4 shows the age distribution of users by programme type. Again, each user is categorized as having participated in one of two programme types: Grand Solutions/Industrial Researcher or InnoBooster. The 16 IFD users which had participated in both Grand Solutions/Industrial Researcher and InnoBooster are excluded from the figure.

Figure 4.4 Accepted applicants' age distribution by programme, average, 2015-2016
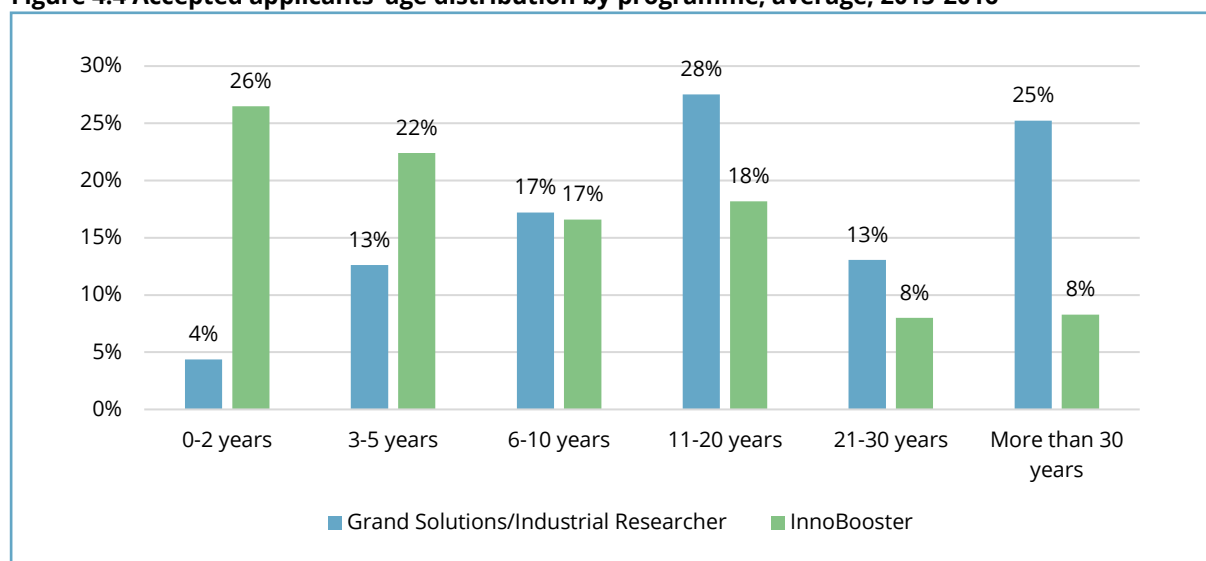
Source: InnovationDenmark database and register data from Statistics Denmark.
Note: N=1,123, of which 436 are in Grand Solutions/Industrial Researcher and 687 are in InnoBooster. 16 IFD users that participate in both Grand Solutions/Industrial Researcher and InnoBooster and are excluded.

Participants in the research-oriented programmes, Grand Solutions/Industrial Researcher, are overrepresented in the three oldest age groups, and underrepresented in the two youngest age groups, as compared with the users of InnoBooster. As was the case for company size (see Figure 4.3), this result reflects differences in the scope and target groups of the IFD programmes: InnoBooster focuses on young companies, while projects supported by Grand Solutions/Industrial Researcher are more attractive to larger, older companies, because they tend to be complex and resource-heavy.

4.3.4 Geographical distribution

The last aspect to be investigated in this section is the geographical distribution. Table 4.9 shows the companies' geographical distribution by Danish regions. Figure 4.5 shows the participation of accepted applicants by region and programme type.

Table 4.9 Geographical distribution by company population, average, 2015-2016

| Region	Accepted applicants	Rejected applicants	Potential RDI-active companies	All Danish companies
Capital Region	45%	48%	40%	33%
Region Zealand	6%	7%	9%	14%
Region of Southern Denmark	14%	13%	19%	20%
Central Denmark Region	24%	23%	23%	23%
North Denmark Region	10%	8%	9%	10%
Number of observations	1,194	2,143	31,808	582,867

Source: InnovationDenmark database and register data from Statistics Denmark.

Overall, the regional distribution of IFD applicants corresponds with that of the target populations quite closely. Both IFD applicants and the target populations have the majority of their companies located in the Capital Region, Central Denmark Region and the Region of Southern Denmark.

Looking at the three most popular regional locations, in comparison with the target populations a larger share of IFD applicants operates in the Capital Region and a lower share operates in the Region of Southern Denmark. These disparities may have resulted, in part, from the fact that a larger share of IFD applicants, as compared with the target populations, are engaged in *Information and communication* and *Business services*, as these services are concentrated principally in the Capital Region.[20]

Figure 4.5 shows the regional distribution of accepted applicants by programme type. As previously, each user is categorized as having participated in one of the two programme types, Grand Solutions/Industrial Researcher or InnoBooster. The 17 users which had participated in both Grand Solutions/Industrial Researcher and InnoBooster are disregarded in the figure.

Figure 4.5 Accepted applicants' regional distribution by programme, average, 2015-2016
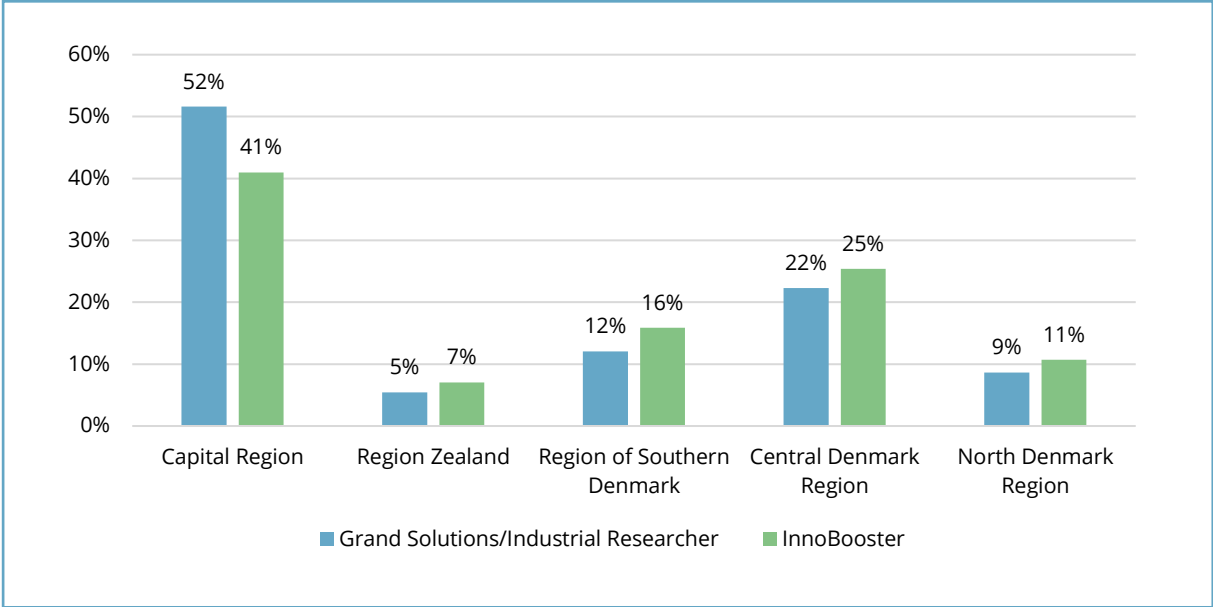
Source: InnovationDenmark database and register data from Statistics Denmark.
Note: N: 1,177, of which 440 are in Grand Solutions/Industrial Researcher and 737 in InnoBooster. A total 17 IFD users had participated in both Grand Solutions/Industrial Researcher and InnoBooster and are excluded.

The levels of participation in Grand Solutions/Industrial Researcher and InnoBooster are similar in each of the regions. Interestingly, the Capital Region has a slightly higher share of Grand Solutions/Industrial Researcher participants. This is probably because the users of Grand Solutions/Industrial Researcher are generally larger companies which are more likely to be situated in the Capital Region. In 2016, 53 per cent of all Danish companies with 250 employees or more were located in the Capital Region.[21]

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[20] In 2016, 58 per cent of the companies in *Information and communication* and 46 per cent of the companies in *Business services* were located in the Capital Region, while the corresponding numbers in the Region of Southern Denmark were 11 and 15 per cent. Source: Statistics Denmark – statistikbanken.dk -table GF6.
[21] Own calculations based on data from Statistics Denmark, statistikbanken.dk – Table GF8.

Box 4.3 Accepted IFD applicants' share of total employment and turnover by region, 2015-2016

Accepted IFD applicants (i.e. IFD users) make up only 4 per cent of the potential RDI-active companies and less than 1 per cent of all Danish companies. However, when the IFD users' economic activities, measured by the number of full-time employees and turnover, are taken into consideration the picture is somewhat different. In terms of full-time employees, the users account for 13 per cent of the full-time employees of the potential RDI-active companies and 9 per cent of the all Danish companies. Furthermore, when average turnover is considered, the IFD users account for 35 per cent of the potential RDI-active companies and 14 per cent of all the Danish companies. These numbers show that the IFD users play a substantial economic role within the Danish business community even though they constitute less than 1 per cent of all Danish companies in absolute numbers.

The accepted IFD applicants' share of total employment and turnover by region, 2015-16

Sector	Full-time employees		Turnover	
	Share of potential RDI-active companies	Share of Danish companies	Share of potential RDI-active companies	Share of Danish companies
Capital Region	15%	12%	36%	16%
Region Zealand	3%	1%	11%	3%
Region of Southern Denmark	7%	4%	20%	9%
Central Denmark Region	19%	12%	52%	18%
North Denmark Region	5%	3%	33%	10%
Total	13%	9%	35%	14%

Source: InnovationDenmark database and register data from Statistics Denmark.
Note: N=1,139.

The table above shows the shares of total full-time employment and turnover that IFD users constitute by region. The IFD users' shares of the potential RDI-active companies within the Central Denmark Region in terms of full-time employment and turnover are 19 and 52 per cent, respectively. Their shares of all Danish companies are 12 and 18 per cent for full-time employment and turnover, respectively, which shows that they play a major role in this region. Furthermore, the IFD users comprise 12 per cent (full-time employment) and 16 per cent (turnover) of all companies in the Capital Region. In the Capital Region, the users also constitute 15 per cent (full-time employment) and 36 per cent (turnover) of the potential RDI-active companies.

In Table 4.10, geographical distribution is mapped according to three municipality types. The municipality types are Urban, Intermediate and Rural. They are based on Eurostat definitions: see Box 4.4 for further information on the identification of the Danish municipalities.

Table 4.10 Geographical distribution (municipality type) by company population, average, 2015-2016

Geographical region	Accepted applicants	Rejected applicants	Potential RDI-active companies	All Danish companies
Urban municipalities	54%	55%	46%	34%
Intermediate municipalities	17%	18%	20%	21%
Rural municipalities	29%	26%	34%	45%
Number of observations	1,194	2,143	31,496	582,867

Source: InnovationDenmark database and register data from Statistics Denmark.

Approximately 54 and 55 per cent of the accepted and rejected applicants, respectively, are located in urban municipalities. This compares with 46 per cent of the potential RDI-active companies and 34 per cent of all Danish companies. Besides sectorial differences, a possible driver of the relatively large share of applicants located in urban municipalities, is proximity to a Danish university.[22] The universities are located in the urban municipalities, and proximity to them might make it easier for companies to establish cooperative relationships. These relationships are important for participants in Grand Solutions and Industrial Researcher.

The distribution of the potential RDI-active companies resembles those of the accepted and rejected IFD applicants, with 46 per cent of these companies located in urban municipalities and 20 per cent located in intermediate municipalities. In contrast with the other populations, the largest share of all Danish companies is located in Rural municipalities.

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[22] Roskilde University is the only university located in an intermediate municipality.

Box 4.4 Municipality types

Eurostat defines three categories of land district class for Danish municipalities. The municipalities are grouped by a combination of criteria relating to geographical contiguity and minimum population threshold which are applied to 1 km^2 population grid cells:

- *Urban municipalities*: At least 50 per cent of the population lives in urban centres.
- *Intermediate municipalities*: At least 50 per cent of the population lives in urban clusters and less than 50 per cent of the population lives in urban centres.
- *Rural municipalities*: At least 50 per cent of the population lives in rural grid cells.

The following map is based on the classification of the Danish municipalities prepared by the association Local Government Denmark (*Kommunernes Landsforening*).
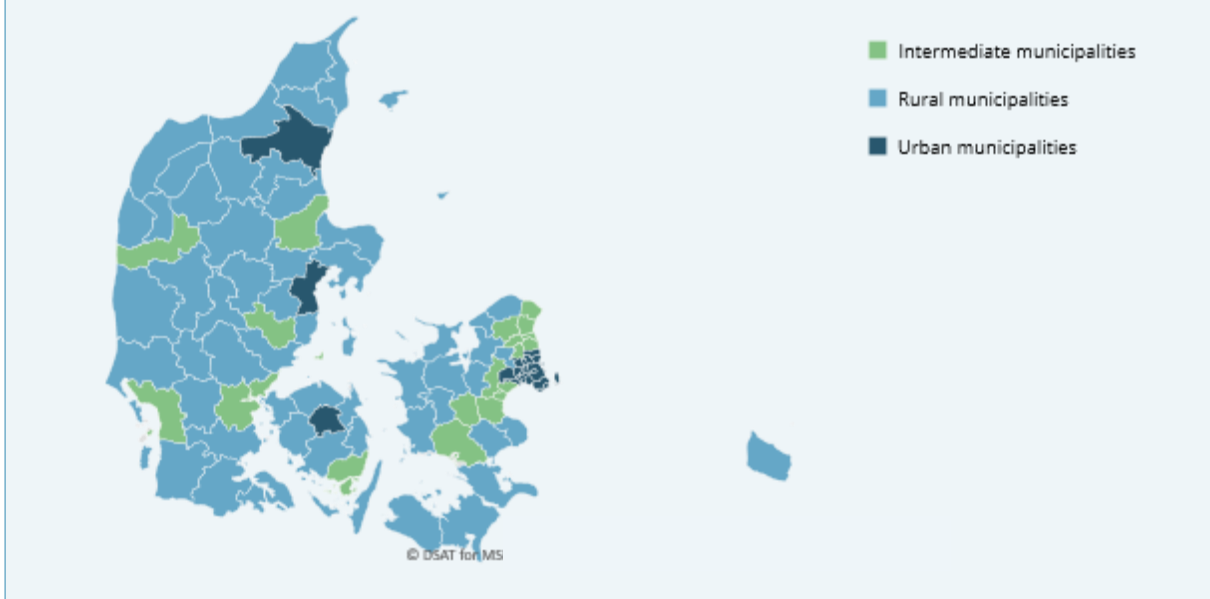
Source: KL (2014): Landkommunernes befolkningsudvikling – sammenhængen mellem land- og bykommuner and EU (2014): A harmonised definition of cities and rural areas: the new degree of urbanisation.

4.4 Knowledge indicators

To obtain more detailed insights into the IFD applicants, this section focuses on key knowledge indicators. These include measures of the employees' educational level, the company's R&D intensity level and the company's innovation activities, all of which were assessed in 2015 and 2016.

Each of the three knowledge indicators is examined in the following three subsections. To ensure that sufficiently large samples of accepted and rejected applicants were collected – especially with respect to R&D intensity and innovation – the three programmes were analysed together.

4.4.1 Educational distribution

First, we consider the skill levels of the applicants by examining the workers' highest level of education in the respective companies.

Table 4.11 show the distribution of the workers' educational level. The groups of accepted and rejected applicants are very similar. In both applicant groups, 27 per cent of the workers, on average, have long-cycle higher education or a PhD degree. This share is more than twice the size of the corresponding shares in the

two target populations (12 per cent and 10 per cent). The substantial difference between the potential RDI-active companies and the IFD applicants is partly explained by selection: the IFD applicants apply for funding to undertake RDI activities requiring highly skilled workers, but the population of potential RDI-active companies includes many companies without R&D activities and less need for highly skilled labour.

The tendency of the applicants to employ highly educated workers is also reflected in their relatively low shares of unskilled and skilled workers: 32 per cent of workers in the comparison populations are unskilled, but this number drops to 25 per cent and 27 per cent for the accepted and rejected applicants, respectively.

Table 4.11 Workers educational level, average, 2015-2016

Workers educational level	Accepted applicants	Rejected applicants	Potential RDI-active companies	All Danish companies
Long-cycle higher education & PhD	27%	27%	12%	10%
Medium-cycle higher education	12%	12%	10%	10%
Short-cycle higher education	14%	14%	11%	7%
Skilled	22%	20%	35%	40%
Unskilled	25%	27%	32%	32%
Number of observations (companies)	1,063	1,824	31,484	500,893

Source: InnovationDenmark database and register data from Statistics Denmark.

4.4.2 R&D intensity

Information about companies' R&D activities is based on the annual Research, Development and Innovation survey (the RDI survey). As a result, the IFD applicants' R&D activities can only be measured for companies that took part in the survey in 2015 and 2016. The survey process means that companies are more likely to be selected for inclusion if they have higher numbers of full-time equivalents or are more R&D-intensive. For more information about the survey, see Section 4.1 and Box 4.1.

In 2015-2016, the RDI survey included 9,356 respondents. Of these, 325 accepted and 408 rejected users were identified in at least one of the two survey years (see Table 4.12).[23] Overall, 73 per cent of the users identified in the RDI survey were Grand Solutions or Industrial Researcher participants. The remaining users were InnoBooster participants.

The following analysis is based on results concerning the identified IFD applicants only. These results should be interpreted with caution, as the IFD applicant population is not stratified in accordance with a survey population, and the full IFD population contains a share of smaller companies that is larger than the share in the population considered in the RDI survey. Moreover, while the RDI survey covers a wide range of companies, the IFD applicants apply for funding with a specific operational idea, or research project, in mind.

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[23] In all, 52 and 43 per cent of the accepted and rejected applicants, respectively, had at least 100 full-time employees, meaning that these companies were included in the survey by default.

Table 4.12 R&D population sample, 2015-2016

	Survey respondent numbers			Share of R&D active companies		
	RDI population	Accepted applicants	Rejected applicants	RDI population	Accepted applicants	Rejected applicants
2015	4,945	182	125	21%	69%	65%
2016	4,411	143	283	25%	76%	65%
Total / average	9,356	325	408	23%	72%	65%

Source: InnovationDenmark database and the Research, Development and Innovation survey collected by Statistics Denmark.

The identified IFD applicants – accepted and rejected – are generally more likely to undertake R&D activities. On average, 72 per cent of the accepted applicants in 2015 and 2016 had R&D expenditures. The corresponding figure for the RDI survey population was 23 per cent (see Table 4.12).

R&D intensity is measured against two criteria: (i) the share of the company's full-time employees working with R&D, and (ii) R&D expenditures as a share of total sales. Average R&D activities are calculated, and thus companies without R&D activities are also considered. It should be noted, however, that companies with no reported full-time employees or annual turnover are excluded from the calculation of R&D intensity.

Table 4.13 shows shares of companies in six rates of average R&D intensity. Intensity is measured separately against the two criteria mentioned above. It can be seen that the calculated R&D intensities are very similar for accepted and rejected applicants independently of the measure of intensity applied.

As expected, the intensity rates in the table also show that the IFD applicants are more R&D intensive than the potential RDI-active companies. For instance, on average 13 per cent of applicants have an R&D intensity in terms of share of full-time employees working with R&D of more than 50 per cent. The figure is 3 per cent for the potential RDI-active companies. The picture is similar when R&D expenditures as a share of total sales are considered. This is mainly because the RDI survey includes many companies that are not necessarily R&D active, while the IFD applicants are a special group of companies that often apply for funding to support existing R&D activities or to establish and strengthen new R&D.

Table 4.13 Average R&D intensity, 2015-2016

Average R&D intensity	Share of R&D full-time employees			R&D expenditures as share of total sales		
	Accepted applicants	Rejected applicants	Potential RDI-active 2016	Accepted applicants	Rejected applicants	Potential RDI-active 2016
0-2%	41%	46%	86%	56%	60%	90%
2-5%	11%	9%	3%	13%	12%	3%
5-10%	10%	8%	3%	9%	5%	2%
10-20%	9%	7%	3%	9%	9%	2%
20-50%	17%	17%	3%	8%	10%	2%
>50%	13%	13%	3%	6%	5%	1%
Number of observations	304	379	13,194	280	342	12,992

Source: InnovationDenmark database and the Research, Development and Innovation survey collected by Statistics Denmark.

Note: R&D intensity for 2015 applicants was measured as the average over 2014, 2015 and 2016 (where possible), while the intensity for 2016 applicants was measured as the average over 2015 and 2016. The table shows mean statistics across all applicants in 2015 and 2016. The R&D intensity for the target population is the average in 2016. Companies with no reported employees or annual turnover are excluded from the calculations of R&D intensity.

4.4.3 Innovation activities

Innovation activity is defined in the following way. Two types of innovation are separated: product and process innovation. A company is innovative if it has introduced at least one of these types of innovation over a three-year period. Hence, the share of innovative companies in 2016 is based on innovation activities recorded over the period 2014-2016.

In a little more detail, a product-innovative company is one that has introduced a new, or significantly changed, product or service, while a process-innovative company is one that has introduced new, or significantly changed, production processes, routines, methods of distribution or support functions.

Table 4.14 distinguishes between (i) companies with no product or process innovation activities, (ii) companies that have undertaken either product or process innovation in that period, and (iii) companies that have undertaken both product and process innovation-activities. All assessments relate to 2015-2016.

Table 4.14 Innovation activities, 2015-2016

Innovation activities	Accepted applicants	Rejected applicants	Potential RDI-active companies
No innovation activities	31%	38%	69%
Product or process innovation	31%	26%	19%
Product and process innovation	38%	35%	12%
Number of observations	325	408	31,171

Source: InnovationDenmark database and the Research, Development and Innovation survey collected by Statistics Denmark.

The table shows that in 2015-2016 accepted and rejected applicants were on average more innovative than the RDI-active companies. This finding is not surprising, since the companies that apply for funding from IFD are also companies with an innovative idea. Moreover, on average the accepted applicants were engaged in more innovation activities than the rejected applicants.

Some 69 per cent of the potential RDI-active companies had not introduced or significantly improved any product or processes. For the accepted and rejected applicants, the corresponding figures are 31 per cent and 38 per cent, respectively. Only 12 per cent of the potential RDI-active companies implemented both product and process innovations. The corresponding figure for accepted applicants is more than three times that, at 38 per cent.

Given the nature and scope of IFD, it might have been expected that applicants to it would be more innovation-active than Table 4.14 indicates. However, innovation here is measured for each application year on the basis of the preceding three years, while IFD funding applications are based on activities that applicant companies expect, or hope, to complete in the future with IFD's financial assistance.

4.5 Performance indicators

Another dimension meriting consideration is performance, and specifically whether accepted applicants to IFD perform better than rejected applicants, and how both groups perform relative to potential RDI-active companies and all Danish companies.

This section examines economic performance against two indicators: (i) labour productivity, and (ii) employment growth measured in terms of the number of full-time employees. Both indicators are estimated on the basis of register data from Statistics Denmark.

4.5.1 Labour productivity

Typically, labour productivity is measured as value added per worked hour. However, information about value added is often missing – especially among smaller companies of the sort likely to be IFD applicants. Thus, in order to maximize the number of observations available for the analysis, value added is approximated here by subtracting a company's total purchases from its total sales.[24]

Labour productivity is measured in terms of million DKK per full-time employee and reported as a three-year average for IFD applicants. Hence, for applicants in 2015 the productivity is estimated as the average over the years 2013, 2014 and 2015. Applying this methodology, the total numbers of accepted and rejected applicants are reduced from 1,139 and 2,013 to 872 and 1,440, respectively.[25]

The productivity of potential RDI-active companies and all Danish companies is estimated for 2016. Hence, Table 4.15 reports average labour productivity by company size and population.[26]

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[24] The definition of value added and labour productivity is based on methodology from Ministry of Higher Education and Science (2019): *Innovationsstøtte til køb af viden, samarbejde eller arbejdskraft – Ansøgere, tilsagn og afslag*.
[25] Including removal of extreme outliers. See Appendix C – Table C.1 for the average labour productivity by size group and populations based on the full sample.
[26] As a supplement to Table 4.15, Appendix C – Table C.2 shows average productivity where the productivity of potential RDI-active companies and all Danish companies is weighted with the sector distribution of the IFD applicants for each of the five company size groups.

Table 4.15 Average labour productivity (mDKK/FTE) by size and population, 2015-2016 (2017-prices)

Company size	Accepted applicants	Rejected applicants	Potential RDI-active companies	All Danish companies
Fewer than 10 full-time employees	0.19	0.38	0.54	0.51
10-25 full-time employees	0.48	0.70	0.88	0.64
26-50 full-time employees	0.43	0.56	0.76	0.70
51-100 full-time employees	0.56	0.49	0.65	0.76
More than 100 full-time employees	1.00	0.71	0.90	0.79
Number of observations	872	1,440	13,467	268,522

Source: InnovationDenmark database and register data from Statistics Denmark.

Note: 439 companies among the potentially RDI-active companies had no information on productivity and are excluded. 28,129 companies among all Danish companies had no information on productivity and are also excluded. For accepted IFD users, companies within the lowest percentile among Fewer than 10 employees have been removed. For rejected IFD users, companies within the 96th to 100th percentile among 51-100 employees have also been removed. Among the potential RDI-active companies, companies in the bottom and top percentiles have been removed among Fewer than 10 employees, and companies in the top percentile among 51-100 employees have also been removed. See Appendix C – Table C.1 for the average labour productivity by size group and populations based on the full sample.

Table 4.15 shows that the accepted applicants with up to 25 employees were on average less productive than comparable companies in the two target populations.[27] This is probably because the accepted applicants in these size categories were more likely to be in the early stages of their evolution, focusing on developing their technologies, and therefore to have only limited sales. It should be kept in mind that the potential RDI-active companies reported here do not include companies with 0 employees. This exclusion may explain why the productivity is higher in this group, as compared with the group of accepted users.

Figure 4.6 shows the average labour productivity of accepted applicants by company size and IFD programme type. Each user is categorized as having participated either in Grand Solutions/Industrial Researcher or in InnoBooster, and the 10 users which had participated in both Grand Solutions/Industrial Researcher and InnoBooster are excluded from the figure. To ensure a sufficient number of observations in each size category, IFD users with *51-100 employees* and *More than 100 employees* are grouped together in the category *More than 50 employees*.

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[27] For the remaining size categories, the differences are not statistically significant. Moreover, the differences between the accepted and rejected applicants are only significant for the size category *More than 100 employees* at a 5 per cent significance level. Appendix C – Table C.3 gives the standard deviation for each size category and population.

Figure 4.6 Accepted applicants' labour productivity (mDKK/FTE) by size and programme, 2015-2016 (2017-prices)
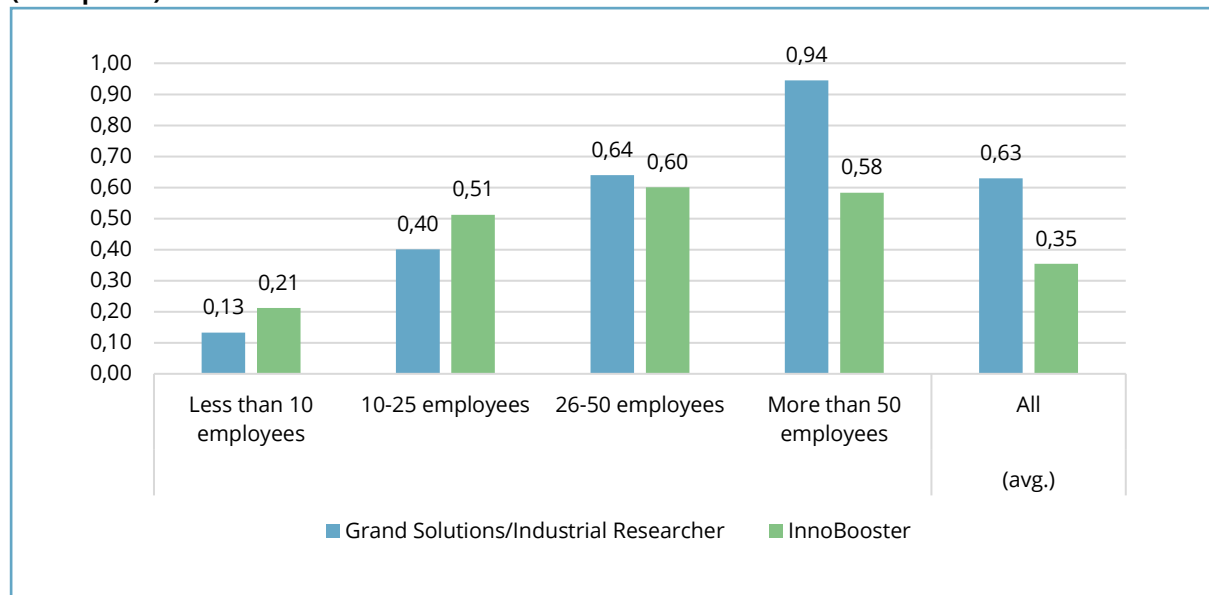
Source: InnovationDenmark database and register data from Statistics Denmark.

Note: N=861. 10 observations have participated in both Grand Solutions/Industrial Researcher and InnoBooster and are therefore excluded. One IFD user in Grand Solutions/Industrial Researcher – 26-50 employees, are excluded to ensure comparability.

On average, the overall labour productivity does not vary between the users of InnoBooster and the users of Grand Solutions/Industrial Researcher.[28] However, the users of Grand Solutions/Industrial Researcher with more than 50 employees were on average more productive than users of InnoBooster with the same number of employees. On average, the users of Grand Solutions/Industrial Researcher were larger, in terms of number of employees, than the users of InnoBooster, indicating that the former were more established having already commercialized a product that generates sales.

For both programme types, companies with 25 employees or fewer were on average less productive than the larger companies. This indicates that the users with 25 employees were more likely to be research and/or development-oriented companies without any finalized products to generate sales. In contrast, the users with more than 25 employees were more likely to have already commercialized products capable of generating sales, thereby increasing their productivity.

4.5.2 Employment growth rate

Employment growth is measured as average annual growth in the number of full-time employees (hereafter employment growth rate) from 2012-2015 and 2013-2016. It has been calculated for companies with at least 5 employees that were more than 3 years old in their application year.[29,30] Applying this methodology, the number of accepted and rejected applicants are reduced from 1,139 and 2,013 to 577 and 844, respectively.

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[28] The differences between Grand Solutions/Industrial Researcher and InnoBooster are only significant at a 5 per cent significance level for companies with *More than 50 employees.*

[29] Companies with 0 employees in year 2012 and 2013 are removed.

[30] Average growth rates in each size category for the potential RDI-active companies and all Danish companies are weighted with the relative distribution of IFD applicants in 2015 and 2016 in each size category.

Table 4.16 reports average employment growth by company size for each of the four populations in the period 2015-2016.[31]

Table 4.16 Employment growth rate by size and population, average, 2015-2016

Company size	Accepted applicants	Rejected applicants	Potential RDI-active companies	All Danish companies
5-9 full-time employees	13%	12%	1%	7%
10-25 full-time employees	13%	15%	5%	7%
26-50 full-time employees	15%	12%	6%	8%
51-100 full-time employees	7%	7%	5%	8%
More than 100 full-time employees	4%	4%	6%	8%
Number of observations	577	844	22,713	63,973

Source: InnovationDenmark database and register data from Statistics Denmark.
Note: The number of IFD users in each size category was relatively low compared with the other populations, and this makes the growth rates of the users more sensitive to extreme observations. However, the IFD users' growth rates remain high for companies with 25 employees or fewer after companies in the top five percentiles have been removed.

The table offers several interesting insights. First, growth rates do not vary between accepted and rejected applicants. Second, both accepted and rejected applicants with up to 50 employees have rates of growth that are higher than those for the two target populations. By contrast, in the size category 51-100 employees, the growth rate of the applicants is level with that in all Danish companies, but slightly higher than that in potential RDI-active companies. Finally, growth rates among the largest companies with more than 100 employees are lower among applicants than they are in all Danish companies.[32,33]

The relatively high growth rates among accepted applicant companies with 50 employees or fewer may be a further indication that they are in the early stages of evolution, focusing on developing their technology, as this often requires new personnel to be hired.

Figure 4.7 shows employment growth rates of accepted applicants by company size and programme type. Each user is categorized as having participated one of two programme types: Grand Solutions/Industrial Researcher or InnoBooster. The 6 users which had participated in both Grand Solutions/Industrial Researcher and InnoBooster are excluded from the figure. To ensure a sufficient number of observations in each size category, users with *51-100 employees* and *More than 100 employees* are grouped together in the category *More than 50 employees*.

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[31] As a supplement to Table 4.16, Appendix C – Table C.4 shows average productivity, where the productivity of potential RDI-active companies and all Danish companies is weighted with the distribution of the IFD applicants in 2015 and 2016.
[32] The differences in growth rates between the accepted applicants and potential RDI-active companies were not significant for companies with 51-100 employees and 100 or more employees. The differences in growth rates between the accepted applicants and all Danish companies were not significant for companies with 51-100 employees, but they were significant for companies with 100 or more employees (significance at a 5 per cent level). Appendix C – Table C.5 reports the standard deviation for each size category and population.
[33] The numbers of applicants in each size category are relat5ively low compared to the other populations, which makes the growth rates of the applicants more sensitive to extreme observations. However, the IFD applicants' growth rates remain high for companies with 25 employees or fewer once outlier companies in the top five percentiles are removed.

Figure 4.7 Accepted applicants' employment growth rates by size and programme, 2015-2016
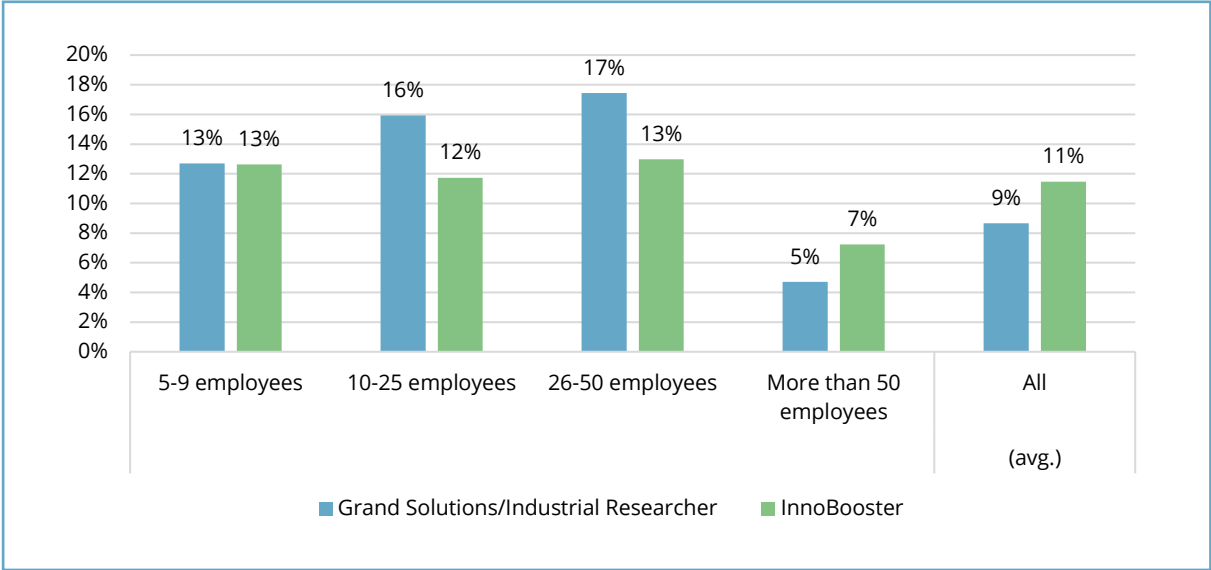
Source: InnovationDenmark database and register data from Statistics Denmark.
Note: N=571. Some 6 users have participated in both Grand Solutions/Industrial Researcher and InnoBooster and are therefore excluded.

Overall, the average growth rate, measured in terms of the number of full-time employees, does not vary between Grand Solutions and InnoBooster.[34]

For both programme types, companies with more than 50 employees have lower employment growth on average than companies with 5-50 employees. In the latter group, average annual employment growth was 15 per cent per year for participants in Grand Solutions/Industrial Researcher and 13 per cent for participants in InnoBooster. Users with 26-50 employees participating in the programme type Grand Solutions/Industrial Researcher enjoyed higher employment growth (17 per cent) than users with 5-9 employees participating in the same programme type (13 per cent). Where InnoBooster users were concerned, average employment growth was similar in the three size categories 5-9, 10-25 and 26-50 employees.

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[34] None of the size categories differs significantly between the two programmes at a 5 per cent significance level.

5. Higher Education Institutions

This chapter analyses the involvement of higher education institutions (HEIs) in Grand Solutions and Industrial Researcher.[35]

Section 5.1 investigates Danish HEIs' participation in Grand Solutions and Industrial Researcher and reports the share of funding received relative to the institutions' total R&D expenditures. Another way to analyse the participation of HEIs is by looking at their participation across research fields. Using information on HEI departments/institutions, Section 5.2 looks more closely at HEIs' participation in Grand Solutions and Industrial Researcher by main research field. Finally, participation by foreign universities is analysed, and their rates of approval are compared with the average rates of approval for Danish universities.

The unit of analysis in this chapter is the HEI department/institute. This means that if two departments from the same university are engaged in the same project, the university is counted twice in the analysis. This is particularly important when the main research field is the subject of the analysis, since different departments from the same university may represent different main research fields.

5.1 Participation by Danish HEIs

The Danish higher education institutions examined here include:

- **The eight universities:** The Technical University of Denmark, University of Copenhagen, Aalborg University, Aarhus University, University of Southern Denmark, Roskilde University, Copenhagen Business School and the IT University of Denmark.

- **The three Academies of Art:** The Royal Danish Academy of Fine Arts Schools of Architecture, Design and Conservation (KADK), Aarhus School of Architecture, and Design School Kolding.

- **The eight University Colleges:** UCL University College Denmark, University College VIA, University College South Denmark, University College Copenhagen, University College Absalon, University College of Northern Denmark, and Danish School of Media and Journalism.

- **The eight Business Academies:** Business Academy Aarhus, Business Academy Southwest, International Business Academy Kolding, Business Academy Midwest, Zealand Institute of Business and Technology, Copenhagen Business Academy, Dania Academy, and Copenhagen School of Design and Technology.

In the analysis that follows, the eight universities are considered separately. The three Academies of Art are considered as one entity, as are the eight University Colleges, owing to the levels of participation in these groups. The Business Academies received no funding from IFD in 2015-2017 and are therefore excluded.

In the period 2015-2017, Danish HEIs were involved with IFD 2,587 times in connection with 1,862 different projects.

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[35] InnoFounder and InnoBooster does not involve HEIs, and thus are not relevant for the subsequent analysis.

Of the 1,862 project applications to Grand Solutions and Industrial Researcher, 579 gained IFD approval. A total of 772 research partners were involved in the 579 approved projects. Out of these, 162 projects were approved Grand Solutions.

It is quite common for Grand Solutions to engage multiple HEIs per project. Of the 162 projects with HEI participation approved by Grand Solutions in the period 2015-2017, 26 per cent involved two HEIs, and 14 per cent involved at least three HEIs, while the remaining 60 per cent involved only one HEI.[36]

Figure 5.1 shows the number of participations by HEIs in approved Grand Solutions or Industrial Researcher projects. The top two universities (in terms of number of participations) accounted for 55 per cent of the HEI participations, while the top four universities accounted for 84 per cent of HEI participations from 2015-2017.

The Technical University of Denmark was the most frequently participating HEI with 233 participations, followed by the University of Copenhagen with 191 participations. The IT University of Denmark and the University Colleges were least likely to participate as partners in Grand Solutions or Industrial Researcher.

Figure 5.1 Participations by HEIs in Grand Solutions or Industrial Researcher, 2015-2017
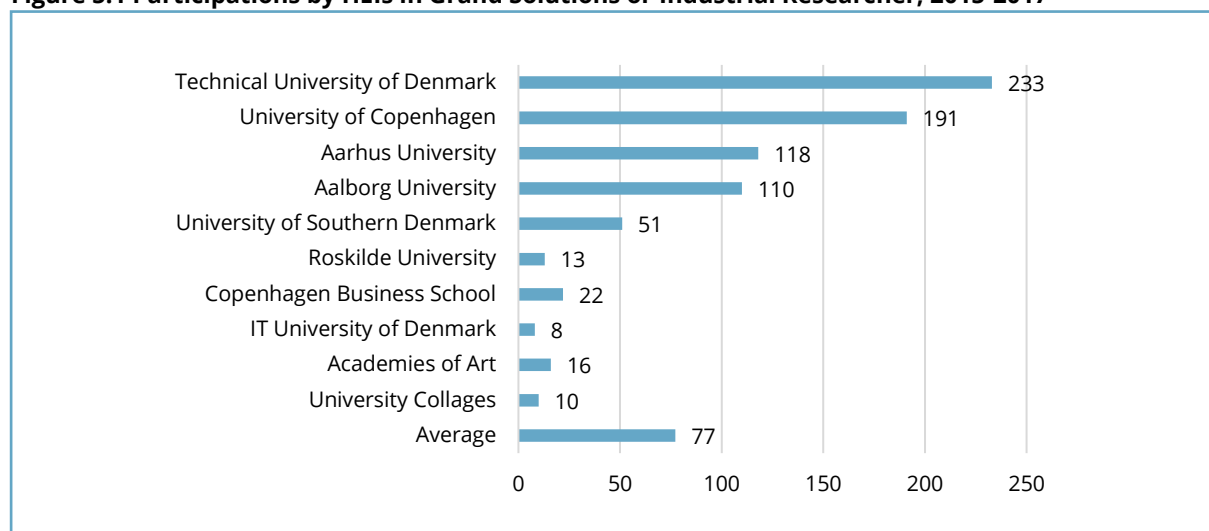
Source: InnovationDenmark database.
Note: N=772 approved applicants (Grand Solutions, N=326 and Industrial Researcher, N=446). No IFD applications by the Danish Business Academies received funding during the period 2015-2017.

Danish HEI's differ in size, e.g. in terms of number of students or researchers, and it is useful to adjust for this when comparing HEIs with respect to IFD participation. Hence, Figure 5.2 shows approved applications as a share of total applications (approval rates) for the individual HEIs. The average approval rate across all institutions is 32 per cent, meaning, roughly speaking, that every third application by a HEI is approved for funding.

When we consider the individual approval rates by HEI, we see that the approval rates vary between 25 and 41 per cent. Aarhus University and the University of Southern Denmark have the lowest approval rates, while the Academies of Art have the highest rate. Generally, the HEI with most approved projects (see Figure

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[36] The remaining 13 approved Grand Solutions projects include other public partners such as GTS-institutes and hospitals.

5.1) are also those with the highest number of applications. Thus, there is no indication that IFD funding is biased with respect to HEIs.

Figure 5.2 Approval rate by HEI, 2015-2017
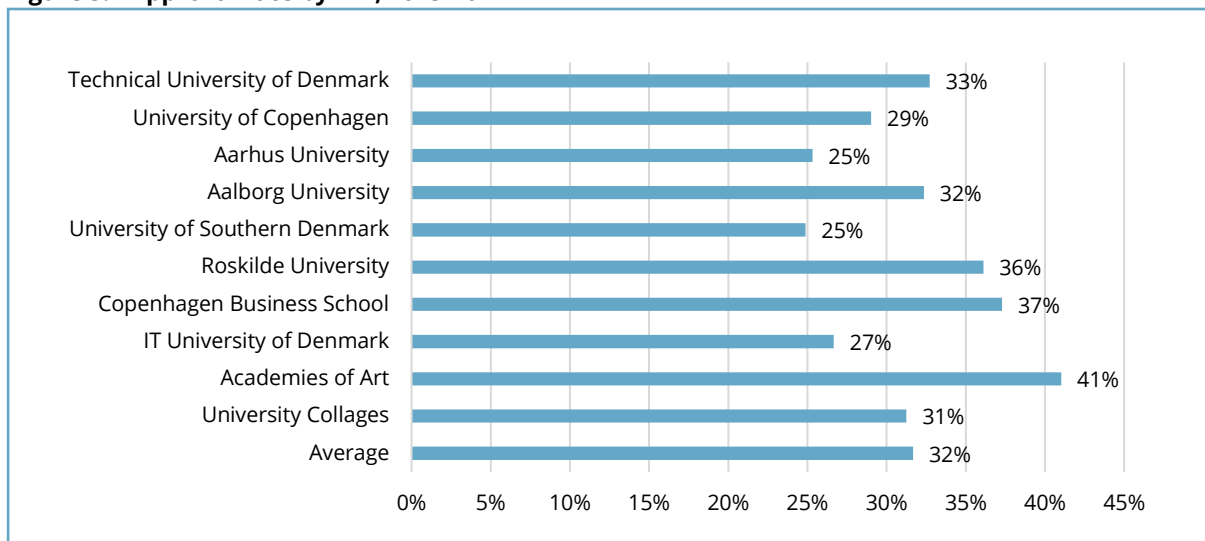
Source: InnovationDenmark database.

Note: N=2,587 approved applicants (Grand Solutions and Industrial Researcher) of which 772 are accepted projects applicants. No IFD applications by the Danish Business Academies received funding during the period 2015-2017.

In terms of funding, IFD made grants totalling DKK 4.2 billion in 2015-2017, with 31 per cent of this funding going to Danish HEIs involved in Grand Solutions projects.

Figure 5.3 below shows the distribution of Grand Solutions funding to HEIs as a share of the institutions R&D expenditures[37] together with total Grand Solutions funding in the period 2015-2017. Note that the figures reported only cover IFD's largest scheme, Grand Solutions.

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[37] The HEIs' annual accounts recording total R&D expenditures 2015-2017 were provided by the Danish Agency for Institutions and Educational Grants under the Ministry of Higher Education and Science.

Figure 5.3 Grand Solutions funding as a share of HEIs' R&D expenditures and total Grand Solutions funding, 2015-2017 (2017-prices)
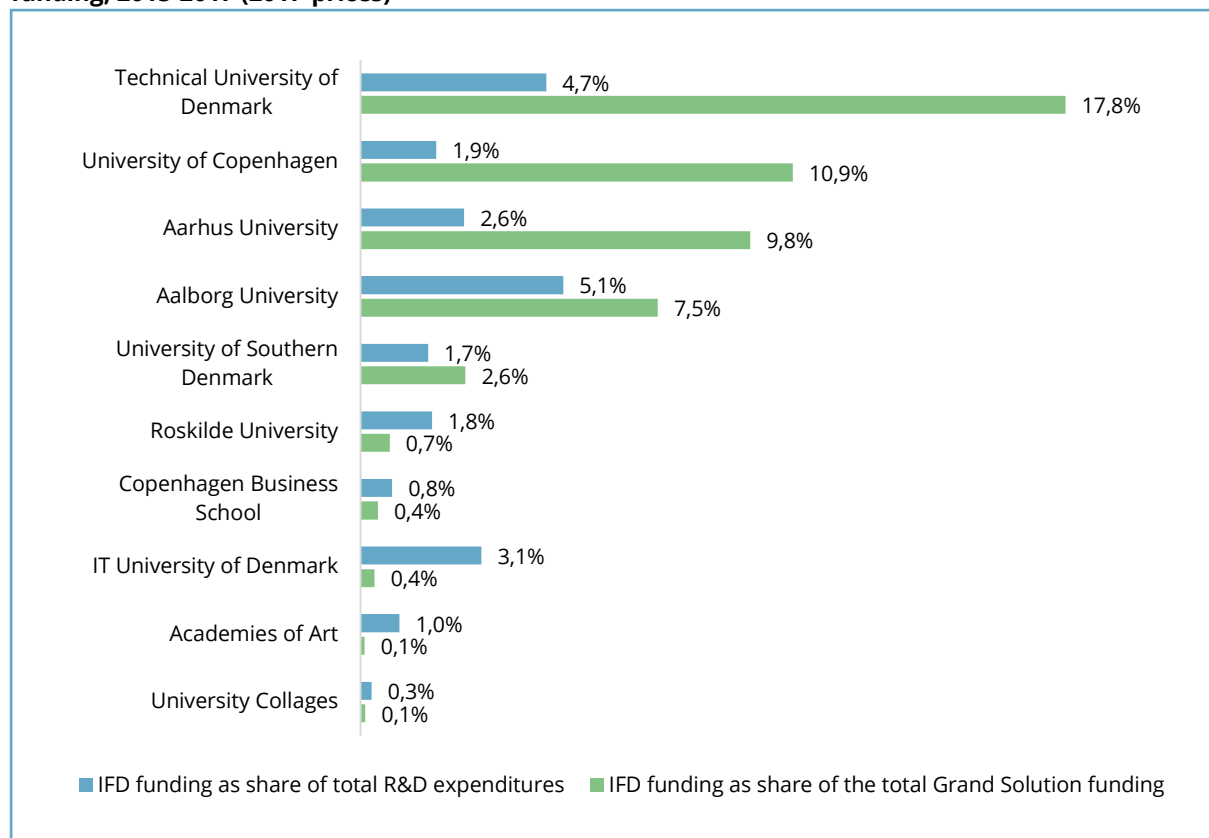
Source: InnovationDenmark database and information on the research institutions annual accounts.
Note: N=326 approved applicants. The figure only includes Grand Solutions projects.

Where the individual HEIs are concerned, the allocation of IFD funding is skewed towards the largest universities. These are also the universities with most project participation. The Technical University of Denmark received the largest share of the IFD funding (18 per cent). The second and third largest shares were allocated to the University of Copenhagen and Aarhus University (11 and 10 per cent, respectively).

The average funding received by the individual HEIs corresponds to 2.3 per cent of the institutions' total R&D expenditures. As a share of R&D expenditures, Aalborg University and the Technical University of Denmark received the largest share of IFD funding for Grand Solutions projects. Relative to the number of project participations, the IT University of Denmark also received a relatively large grant size relative to the university's total R&D expenditures (3 per cent).

Overall, the majority of the HEI participants are concentrated at the largest universities in Denmark, with the Technical University of Denmark as the frontrunner, in terms of both the number of participations and the share of IFD funding for Grand Solutions projects.

5.2 Participation by main research areas

To obtain more detailed insights into the type of research funded by Grand Solutions and Industrial Researchers, this section categorizes the approved projects by four main research areas: *Technical/Natural science*, *Health science*, *Social science* and *Humanities*.

The categorization of main research areas is based on the participating universities' individual departments.[38] Each department is categorized on the basis of its faculty affiliation.[39] This means that a project can be represented by more than one main research area if the participants in it are associated with different faculties and universities.[40]

A total of 725 approved applicants were categorized, of which 326 applied to Grands Solutions and the remaining 426 applied to Industrial Researcher. Missing information meant that it was impossible to categorize 20 applicants from Industrial Researcher projects.

Based on the categorization of the main research field, the number of interdisciplinary projects with HEIs participating from different research fields (i.e. projects combining two or more academic disciplines) was examined.[41] Some 17 per cent of Grand Solutions projects were found to be interdisciplinary. The corresponding figure for Industrial Researcher was less than 1 per cent.

Figure 5.4 below shows the distribution of IFD projects with university involvement by main research area. The majority of both Grand Solutions projects and Industrial Researcher projects (74 per cent and 62 per cent, respectively) fall in the research area *Technical/Natural science*. The second largest research area, *Health science*, has corresponding figures of 14 per cent and 23 per cent. *Social Science* accounts for 11 per cent of projects in both Grand Solutions and Industrial Researcher, and *Humanities* accounts for 1 per cent of projects, likewise, in both Grand Solutions and Industrial Researcher.

Figure 5.4 IFD projects by research areas and programmes, 2015-2017
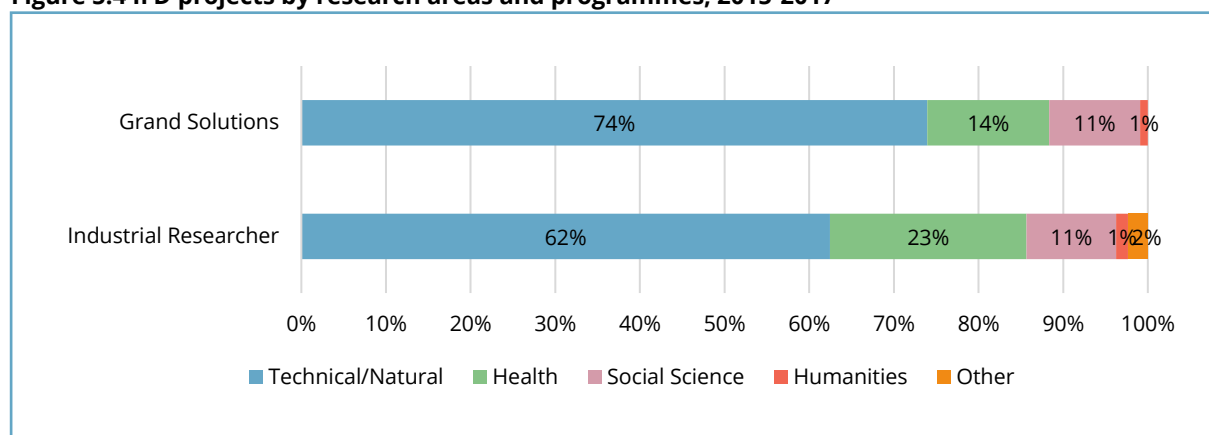
Source: InnovationDenmark database.
Note: N=752 approved applicants (Grand Solutions, N=326 and Industrial Researcher, N=426). Missing information about the main research area for 20 approved applicants for Industrial Researcher projects.

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[38] Hence, projects involving the participation of universities as such are not included in the following.
[39] All participants related to the Technical University of Denmark (DTU) are categorized as Technical/Natural science, since DTU does not have faculties.
[40] Some 28 of the 162 Grand Solutions projects were categorized into more than one main research area and thus multidisciplinary. Only two out of a total of 400 projects were categorized into more than one main research area.
[41] It should be kept in mind that this measure of interdisciplinarity only considers the HEI and not the other public and private partners involved in the projects. When all project partners are considered, more projects are likely to be identified as interdisciplinary.

The distribution of IFD funding across these research areas shows that IFD funding through Grand Solutions and Industrial Researcher is even more skewed towards *Technical/Natural science*. *Technical/Natural science* accounts on average for 67 per cent of the projects, but it receives almost 80 per cent of the total funding for Grand Solutions and Industrial Researcher (see Figure 5.5 below).

Although 11 per cent of the participants in the period investigated were in *Social science*, this research area received less than 7 per cent of the total IFD funding for Grand Solutions and Industrial Researcher. The 9 applicants in *Humanities* received just 0.3 per cent of the IFD funding.

Figure 5.5 Participants, R&D expenditures and IFD funding by main research area, 2015-2017
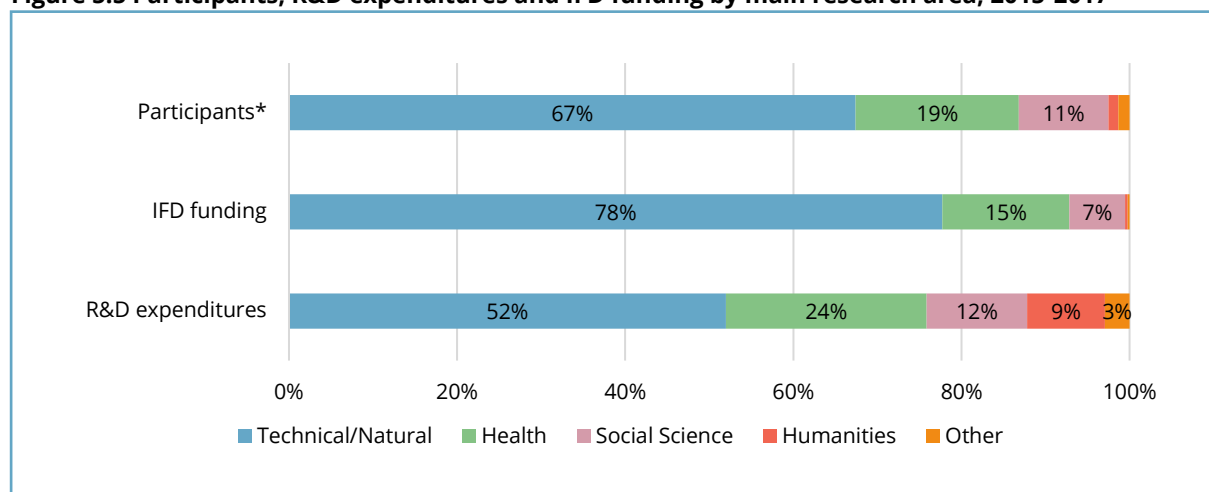
Source: InnovationDenmark database and the universities annual reports on R&D expenditures.
*Note: N=752 approved applicants. Missing information about IFD funding for 28 approved applicants for Industrial Researcher. Total R&D expenditures by main research area reported for universities only. * Numbers of participants include both Grand Solutions and Industrial Researcher.*

Figure 5.5 also shows the research areas' shares of the universities' total R&D expenditures. While 67 per cent of the users in Grand Solutions and Industrial Researcher projects were based in *Technical/Natural science*, this research area accounted for only 52 per cent of the total R&D expenditures. There is a noticeable contrast here with the *Health science* and *Humanities* research areas. For instance, users in *Humanities* were allocated 9 per cent of the total R&D expenditures but made up only 1 per cent of the Grand Solutions and Industrial Researcher users. In *Social science*, however, the share of users is quite similar to the share of R&D expenditures.

5.3 Involvement of Danish and foreign universities

Both Danish and foreign universities are eligible for Grand Solutions and Industrial Researcher funding. Of the 2,228 project applications in 2015-2017 (1,340 for Grand Solutions and 888 for Industrial Researcher), 1,869, or 84 per cent, had at least one university partner.[42]

When the nationality of the university project partners is considered, it emerges, unsurprisingly, that most of the applicants are Danish universities. At least one Danish university partner was involved in 1,655 of the project applications, 517 of which were approved for IFD funding. In comparison, 41 project applications involved at least one foreign university partner without the involvement of a Danish university partner, and 174 applications involved both a foreign and a Danish university partner.

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[42] This subsection focuses exclusively on universities to ensure comparability.

Figure 5.6 Participation of Danish and foreign universities in project applications, 2015-2017
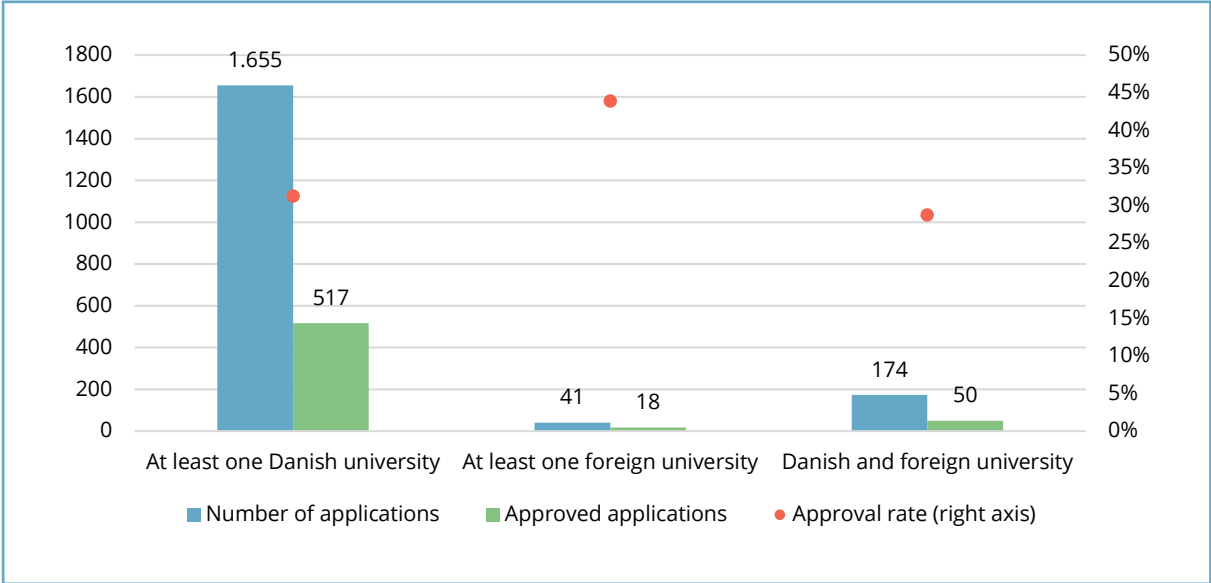
Source: InnovationDenmark database.

Note: Number of observations: 1,870. Covers both Grand Solutions and Industrial Researcher. "At least one foreign university" excludes projects with Danish university participation.

It can be seen from Figure 5.6 that the approval rate was highest among project applications involving only (one or more) foreign university partners (44 per cent). The vast majority of these projects were approved within the Industrial Researchers programme. The approval rate for applications involving at least one Danish university, but no foreign university partners, in the same 2015-2017 period was 31 per cent.

6. The investment portfolio

In 2008, the Danish government presented the first in what would become a series of catalogues identifying national themes for future strategic research. The catalogue, which was titled RESEARCH2015, was revised in 2012 (RESEARCH2020) and again in 2017 (RESEARCH2025). Each catalogue has served as input for politicians and stakeholders involved in discussions and the prioritization of public research funding.

This section studies the correspondence between the research projects funded by the IFD via the Grand Solutions programme in 2015-2017 and the 14 strategic research themes set out in the RESEARCH2020 catalogue.

Box 6.1 lists the five political visions presented in RESEARCH2020 and their underlying research themes. The themes are then used to categorize the Grand Solutions projects.

Box 6.1 RESEARCH2020 – Political research visions and themes

1. **A society with a green economy**
    1.1. Future energy technologies and systems
    1.2. From knowledge about the environment, water and resources to competitive technologies
    1.3. Climate and climate adaptation for the future
    1.4. Bio-resources, food and other biological products
2. **A society with health and quality of life**
    2.1. From basic research to efficient prevention, diagnostics
    2.2. The healthcare and care sector of the future
3. **A high-tech society with innovation capacity**
    3.1. Digital opportunities and solutions
    3.2. Future production systems and new types of innovation
    3.3. Strategic growth technologies
4. **An efficient and competitive society**
    4.1. Competitiveness, productivity and growth
    4.2. Efficient and innovative welfare and prevention
    4.3. Transport, logistics and living space
5. **A competent, cohesive society**
    5.1. Education, learning and competence development
    5.2. Cultural understanding and cross-cultural competences

The Grand Solutions projects were categorized according to the research themes by auditing abstracts on the scientific scope of each project and comparing them with the descriptions of the 14 research themes. Using this methodology, a total of 161 projects were classified of a total of 175 projects. Of the 161 projects classified, a total of 152 were assigned to single themes. The remaining nine projects were assigned to two themes and counted twice, and the funding for these nine projects was divided equally between the two themes.

Figure 6.1 shows the Grand Solutions projects divided into the five political visions outlined in Box 6.1 above. In total, 77 of the projects, equivalent to more than 40 per cent, fall under the political vision *A society with a green economy*. The political visions *A high-tech society with innovation and capacity* and *A society with health and quality of life* account for 20 per cent and 18 per cent of the projects, respectively. Each of the remaining three visions accounts for fewer than 15 projects.

Figure 6.1 Grand Solutions projects by political vision, 2015-2017
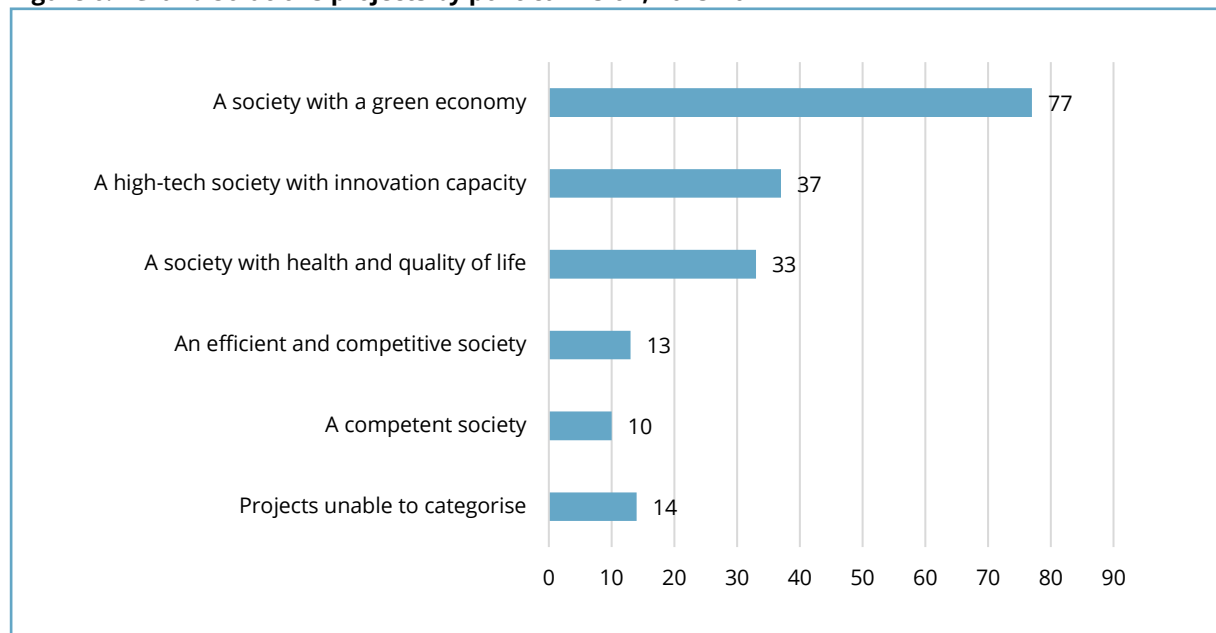
Source: InnovationDenmark database.

Note: N=184. Of the 175 projects that the IFD approved in 2015-2017, we were able to classify 152 projects into a single RESEARCH2020-theme. A further 9 projects were classified into two RESEARCH2020-themes and counted twice. Hence, a total of 184 projects were classified into RE-SEARCH2020-themes.

Looking at the number of approved projects by research theme (as shown in Figure 6.2), we find that the Grand Solutions projects approved in 2015-2017 were concentrated in a small group of themes. Thus, 61 per cent of the projects fitted into just four themes: *Bio-resources, food and other biological products*, *Future energy technology and systems*, *From basic research to efficient prevention, diagnostics and treatments* and *Digital opportunities and solutions*. Each of the remaining 10 themes accounted for between 7 per cent and 1 per cent of the projects.

In terms of actual funding, a total of DKK 2.4 billion was granted to Grand Solutions projects in 2015-2017. Once again, most of the funding was concentrated in the four themes just mentioned. In total, 69 per cent, or DKK 1,7 billion, was allocated to these themes, which is a little more than the share of projects represented. With one exception, i.e. *Future production systems and new types of innovation*, all of the remaining themes underperform in terms of funding when their share of the projects is taken into account.

Figure 6.2 Grand Solutions projects and funding by RESEARCH2020 research themes, 2015-2017
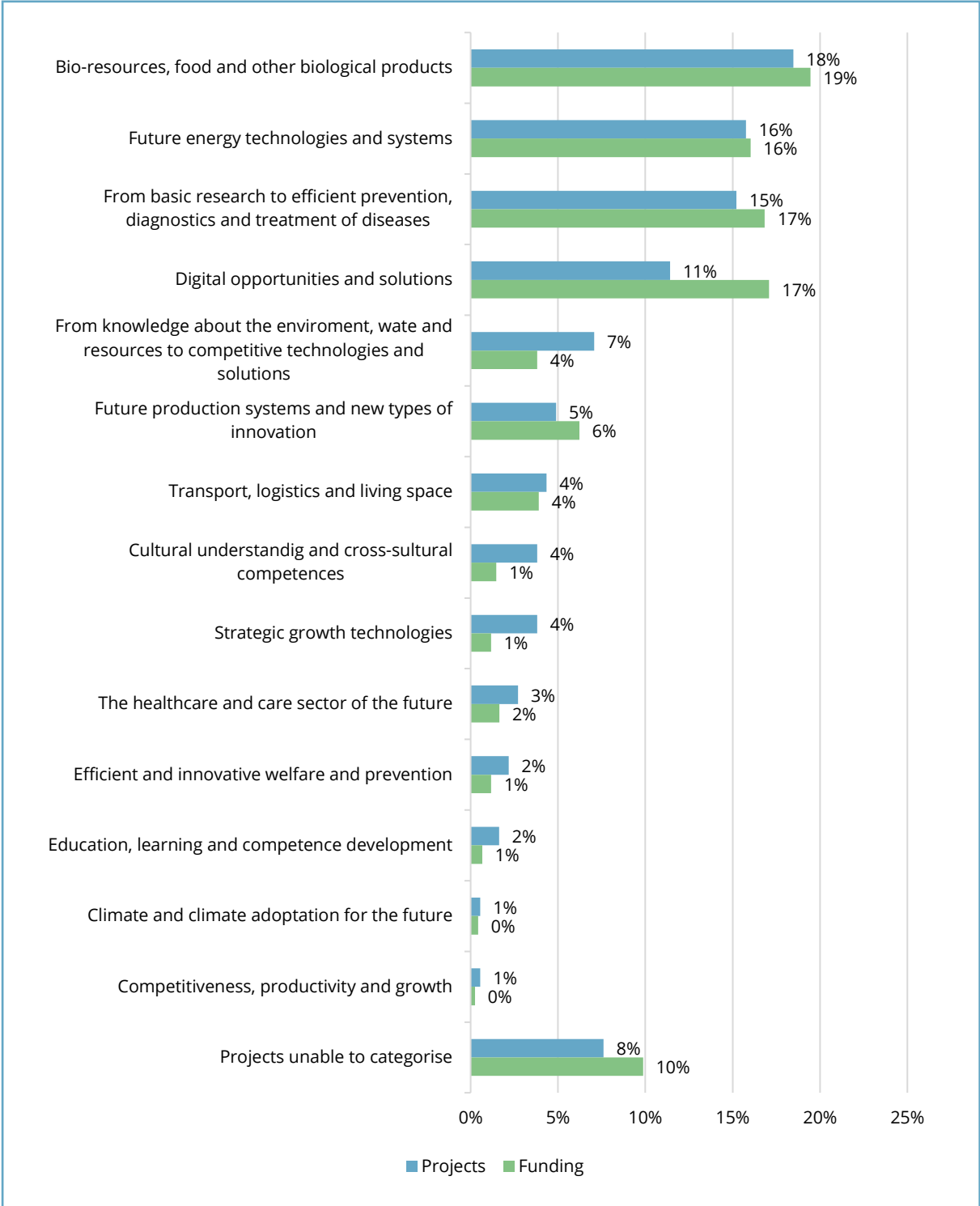

Source: InnovationDenmark database.

Note: N=184. Of the 175 projects that the IFD approved in 2015- 2017, we were able to classify 161 projects into a single RESEARCH2020-theme. The remaining 9 projects were classified into two RESEARCH2020-themes. Hence, a total of 184 projects were classified into RESEARCH2020-themes.

7. Characteristics of IFD users before and after 2014

This chapter compares the companies and universities that received funding from IFD from 2015-2017 with those, that received funding in the period up to 2014 from the three research councils[43] that were merged to form IFD. The purpose, broadly speaking, is to investigate the impact of IFD.

Data on companies and universities that received funding before 2014 are taken from an analysis of IFD's potential target group as determined in 2014. The analysis was commissioned by the Danish Agency for Science, Technology and Innovation and conducted by DAMVAD Analytics, a private Danish consultancy company. DAMVAD (2014) describes the characteristics and participation of companies and universities in receipt of funding from the Danish Council for Technology and Innovation, the Danish Council for Strategic Research and the Danish National Advanced Technology Foundation in the period 2007-2013.

Throughout this chapter, it should be borne in mind that the period after 2014 covers just two years (three years in the case of the universities). This makes the results for this period somewhat less robust than those obtained for the seven-year period before 2014.

7.1 Company characteristics before and after 2014

This section compares the companies that received funding before (2007-2013) and after (2015-2016) 2014 with respect to business sector, company size and age as well as regional distribution. For convenience, both populations are referred to as IFD users.

In DAMVAD (2014) company characteristics are based on the unique number of users in 2007-2013. However, it is not clear, whether they are estimated on the basis of the companies' (latest) year of participation or the latest year with data availability. In the following, the company characteristics after 2014 are based on the unique number of users in 2015-2016 and estimated for the latest year of participation.

Table 7.1 shows the number of participations and unique IFD users by sector for 2007-2013 and 2015-2016. The differences in the business sector distribution between the two periods indicate a shift towards more knowledge-intensive sectors. Before 2014, a larger proportion of companies were in sectors such as *Trade and transport etc.* and *Agriculture, forestry and fishing*. By 2015-2016 this had changed: a larger share of companies were now in *Information and communication* and *Business services*. There is a contrast here with the sector distributions displayed by all Danish companies in the same periods. Here the share of companies in *Information and communication* were stable, and the share of *Trade and transport etc.* and *Agriculture, forestry and fishing* decreased by only 2-3 percentage points. This suggests that the shifts in sectorial distribution set out in Table 7.1 were driven mainly by a shift in the scope of the IFD programmes before and after 2014.

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[43] The Strategic Research Council, the High Technology Foundation and the Council for Technology and Innovation.

Table 7.1 Distribution of IFD participations and users by business sector, 2007-2013 and 2015-2016

Business sector	2007-2013		2015-2016	
	Participations	IFD users	Participations	IFD users
Manuf., mining and quarrying, and utility	30%	29%	34%	31%
Business services	25%	23%	27%	25%
Information and communication	9%	10%	17%	19%
Trade and transport etc.	17%	20%	12%	14%
Construction	3%	4%	3%	3%
Agriculture, forestry and fishing	4%	5%	2%	3%
Public administration, education and health	2%	2%	2%	2%
Arts, entertainment and other services	2%	3%	2%	2%
Financial and insurance	5%	3%	1%	1%
Real estate	1%	1%	0%	1%
Number of observations	3,333	2,606	1,355	1,109

Source: DAMVAD (2014): Danmarks Innovationsfond – Målgruppeanalyse, Table 3.5. InnovationDenmark database and Statistics Denmark.
Note: In the 2007-2013 period a total of 690 companies, equivalent to 1,084 participations, are excluded owing to missing information on the business sector.

The sectorial distribution of the number of programme participations before and after 2014 follows that of the unique companies described above. Thus, *Information and communication*, especially, came to have a larger share of the total participations after 2014, whereas *Trade and transport etc.* came to have a smaller share of the participants.

Based on a company's number of full-time employees, Table 7.2 shows the company size distribution of IFD users and participations from 2007-2013 and 2015-2016.

Table 7.2 Distribution of IFD participations and users by company size, 2007-2013 and 2015-2016

Company size	2007-2013		2015-2016	
	Participations	IFD users	Participations	IFD users
1-9 full-time employees	37%	46%	45%	52%
10-19 full-time employees	15%	17%	13%	14%
20-49 full-time employees	18%	17%	11%	12%
50-99 full-time employees	8%	8%	7%	6%
100 full-time employees or more	23%	12%	24%	16%
Number of observations	3,585	2,554	1,221	983

Source: DAMVAD (2014): Danmarks Innovationsfond – Målgruppeanalyse, Table 3.9. InnovationDenmark database and Statistics Denmark.
Note: In 2007-2013 a total of 742 companies, equivalent to 832 participations, are excluded owing to missing information or their employment of 0 employees. In 2015-2016 a total of 74 companies, equivalent to 78 participations, are excluded because they employed 0 employees.

Comparison of the companies' size distribution before and after 2014, shows that shares of the smallest companies with 1-9 employees and the largest companies with 100 employees or more increased by 6 and 4 percentage points, respectively. In contrast, the share of medium sized companies with 10-99 employees decreased by 10 percentage points, from 42 per cent in 2007-2013 to 32 per cent in 2015-2016. This shift

indicates that the IFD programmes provided after 2014 appealed to small and large companies more strongly than the programmes provided before 2014.

In terms of programme participations, small companies with 1-9 employees constituted a larger share after 2014. This is a direct consequence of their higher share of IFD users. More surprisingly, the share of total participations by companies with 100 or more employees was stable over the two periods. Here it should be noted that the two periods differ in length by five years. With this difference in mind, it can be possible, ceteris paribus, that companies with 100 or more employees will account for a growing share of total participations in the coming years.

IFD's InnoBooster programme focuses more strongly on younger companies than similar programmes did before 2014.[44] This raises the question whether IFD's establishment shifted the users' age distribution towards younger companies. Table 7.3 shows the distribution of IFD users and participations by company age in 2007-2013 and 2015-2016.

Table 7.3 Distribution of IFD participations and users by company age, 2007-2014 and 2015-2016

Age category	2007-2013		2015-2016	
	Participations	IFD users	Participations	IFD users
0-5 years	14%	16%	34%	37%
6-10 years	18%	20%	16%	17%
11-20 years	23%	23%	22%	22%
21-30 years	11%	11%	10%	10%
More than 30 years	35%	31%	19%	14%
Number of observations	4,417	3,296	1,299	1,057

Source: DAMVAD (2014): Danmarks Innovationsfond – Målgruppeanalyse, Table 3.17. InnovationDenmark database and Statistics Denmark.

The age distribution of IFD users after 2014 differs most noticeably from that before 2014 in two respects: after 2014 there is a substantially larger share of young companies, less than 6 years old, and a smaller share of companies more than 30 years old. The shares of the remaining age categories were fairly stable across the two time periods. As speculated above, the changes here may have been caused by the intensified focus on younger companies in the InnoBooster programme.

Where programme participations are concerned, changes in the distribution of companies by age following 2014 echo those observed in connection with IFD users described above. Thus, after 2014 the young companies, aged 0-5 years, make up a larger share of the total participations and the oldest companies make up a smaller share.

It is also worth considering whether IFD's establishment affected the geographical distribution of IFD users. To this end, and with reference to the five Danish regions, Table 7.4 shows the geographical distribution of the IFD users and participations before and after 2014.

The table demonstrates that after IFD's establishment the users came to be more concentrated in the Capital Region and, to a lesser degree, in the North Denmark Region. The share of users in the remaining

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[44] The similar programmes before 2014 were the Innovation Voucher programme and the Innovation Assistant programme. The Innovation Voucher programme supported collaborative projects between SMEs and a knowledge institution. The objective was to encourage more SMEs to collaborate with universities, research and technology institutes and education institutions. The Innovation Assistant programme provided an incentive for SMEs to hire a highly educated staff. The rationale was that the employment of highly educated people on innovative projects would promote growth in the SMEs.

regions, in turn, declined. That decline was most pronounced in Region Zealand and the Region of Southern Denmark, where the shares of users decreased by 5 and 6 percentage points, respectively, between 2007-2013 and 2015-2016.

Table 7.4 Distribution of IFD participations and users by region, 2007-2013 and 2015-2016

Region	2007-2013		2015-2016	
	Participations	**IFD users**	**Participations**	**IFD users**
Capital Region	40%	34%	47%	45%
Region Zealand	9%	11%	6%	6%
Central Denmark Region	25%	27%	24%	24%
Region of Southern Denmark	19%	21%	14%	15%
North Denmark Region	7%	8%	9%	10%
Number of observations	4,085	N/A	1,355	1,109

Source: DAMVAD (2014): Danmarks Innovationsfond – Målgruppeanalyse, Table 3.16. InnovationDenmark database and Statistics Denmark.
Note: For the period 2007-2013 an unknown number of companies with missing information on region are excluded. The total number of partici-pations by the excluded companies is 332.

This shift in regional distribution towards a higher concentration of IFD users in the Capital Region may be explained, in part, by an underling sectorial shift, with the IFD users moving towards sectors that are located mainly in the Capital Region. For example, *Information and communication* increased its share from 10 per cent of IFD users before 2014 to 19 per cent after 2014 (see Table 7.1). By 2016, more than half of the total number of companies involved in *Information and communication* were situated in the Capital Region.

Where programme participations are concerned, changes in the distribution of companies by regional loca-tion following 2014 are in line with those just noted in connection with the IFD users. Thus, after 2014 the Capital Region and North Denmark Region make up a larger share of the total participations and the shares of the other regions decrease.

7.2 Universities' participation before and after 2014

The final topic to be covered in this chapter is the impact of IFD's establishment on participation rates among the eight Danish universities before and after 2014. Analysis of the universities' participation in IFD does not require register data from Statistics Denmark, so the period of analysis after 2014 is extended to include 2017. DAMVAD (2014) only includes university participations, and for this reason the Danish Univer-sity Colleges and the Academies of Art are excluded in what follows.

Table 7.5 presents participation rates for the eight Danish universities in 2007-2013 and 2015-2017. It can be seen that the participation rates remained conspicuously stable over the two periods. The exceptions to this are the University of Copenhagen and the University of Southern Denmark. By the second period, the former's share of participations had increased by 4 percentage points to 26 per cent, and the latter's share of participation had decreased from 10 per cent to 7 per cent.

These alterations in the participation rates of the University of Copenhagen and the University of Southern Denmark coincide with a shift in the location of private companies. As seen from Table 7.4, an increasing share of private companies are located in the Capital Region in proximity to the University of Copenhagen. By contrast, a decreasing share of private companies are located in the Region of Southern Denmark near

the University of Southern Denmark. However, the current analysis does not allow us to infer that there is a causal relationship between the two results.

Table 7.5 Distribution of the eight Danish universities' participation, 2007-2013 and 2015-2017

University	2007-2013	2015-2017
Technical University of Denmark	31%	31%
University of Copenhagen	22%	26%
Aarhus University	16%	16%
Aalborg University	14%	15%
University of Southern Denmark	10%	7%
Roskilde University	2%	2%
Copenhagen Business School	4%	3%
IT University of Denmark	1%	1%
Number of observations	2,397	746

Source: DAMVAD (2014): Danmarks Innovationsfond – Målgruppeanalyse. IFD project data.

Note: The numbers from this 2014 report are given in Table 3.18 in the report. Participation numbers for Academies of Art and University Colleges in 2007-2013 could not be obtained.

Appendix

A. Data

This section describes the registers from Statistics Denmark that are used in Chapter 4 to estimate the company characteristics. The analysis is based on the following registers:

- General Enterprise Statistics (FIRM)
- Account Statistics (FIRE)
- Research, Development and Innovation in the private sector (FUI)
- Employer-employee affiliation based on the labour force register (RAS)
- The Education Register (UDDA)

The registers are combined by using the unique company ID (CVR nr.). Furthermore, all economic variables are reported in 2017-prices, based on the deflator reported in the report "Tal om forskning og innovation i 2017" (UFM, 2018).[45]

General Enterprise Statistics

The General Enterprise Statistics (GES) contains individual information on every registered company in Denmark and are utilized to describe the companies with respect to:

- Business sector (GF_GR127_DB07)
- Full-time employment (GF_AARSV)
- Age based the company's year of registration (JUR_FRA_DATO)
- Geography based on the municipality and regional codes (JUR_BEL_KOM_KODE and JUR_BEL_RE-GION_KODE)
- Furthermore, we use the GES to identify public and private companies for both IFD applicants and for all Danish companies (variable *JUR_FUNKKODE*) and to distinguish between economically active and in-active companies (variable *GF_BAGATEL*).

Account Statistics

The Account Statistics contains information on the companies' annual sales and purchases. By combining the Account Statistics with GES at the company level via company ID, we can estimate the companies' annually labour productivity.

For company i in year t, labour productivity is estimated as $\frac{Total\ Sales_{i,t} - total\ Purchase_{i,t}}{Full-time\ employees_{i,t}}$. In case full-time employment are 0, it is estimated to 1 full-time employee.

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[45] Link to report: https://ufm.dk/publikationer/2018/tal-om-forskning-og-innovation-2017.

Research, Development and Innovation in the private sector

The Research, Development and Innovation statistics (RDI-statistic) contains information on the companies' RDI-activities. It should be noted that the RDI-statistics are survey based, and therefore contains information on ca. 4,500 companies annually. We have used the following variables from the RDI-statistic:

- R&D expenditures (u_total)
- Innovation activities with respect to product and process innovation (inpdgd, inpdsv, inpslg, inpspd and inpssu)

Employer-employee affiliation and the Education Register

The employer-employee data affiliate individuals with their employer via a personal ID (cpr. Nr.) and company ID match and are used to obtain information on the employees highest attained educational level for companies in GES.

Based on information on the individuals' highest attained education (HFAUDD) from the Education Register, we assign each individual into one of the following educational categories:

- Long-cycle higher education and PhD
- Medium-cycle higher education
- Short-cycle higher education
- Skilled
- Unskilled

B. Subdivision of the business sector *Manufacturing, mining and quarrying, and utility*

Table B.1 Subdivision of the business sector *Manufacturing, mining and quarrying and utility* by company population, average, 2015-2016

Business sector	Accepted applicants	Rejected applicants	Potential RDI-active companies	All Danish companies
Manufacture of machinery	21%	21%	15%	9%
Manufacture of electronic components	13%	14%	4%	3%
Manufacture of furniture and other manufacturing	10%	8%	13%	21%
Basic metals and fabricated metal products	10%	10%	21%	15%
Electrical equipment	9%	9%	4%	2%
Manufacture of food products, beverages and tobacco	9%	11%	14%	8%
Manufacture of plastic, glass and concrete	6%	6%	9%	5%
Manufacture of chemicals	5%	4%	2%	1%
Pharmaceuticals	5%	4%	1%	1%
Wood and paper products and printing	4%	4%	8%	7%
Transport equipment	3%	3%	2%	2%
Mining and quarrying & Electricity, gas, steam and air conditioning supply	2%	2%	2%	9%
Water supply, sewerage and waste management	2%	3%	2%	12%
Textiles and leather products	1%	1%	3%	4%
Oil refinery etc.	0%	0%	0%	0%
Number of observations	382	504	8,515	38,251

Source: *InnovationDenmark database and register data from Statistics Denmark.*

Note: *The subdivision of business sector Manufacturing, mining and quarrying, and utility is based on the standard 36-grouping of the 726 industries in DB07.*

C. Supplementary material to performance indicators

Table C.1 Full-sample - average labour productivity (mDKK/FTE) by size and company population, 2015-2016

Company size	Accepted applicants	Rejected applicants	Potential RDI-active companies	All Danish companies
Fewer than 10 full-time employees	-15.92	-3.89	14.85	0.51
10-25 full-time employees	0.48	0.70	0.88	0.64
26-50 full-time employees	0.43	0.56	0.76	0.70
51-100 full-time employees	0.56	0.98	1.15	0.76
More than 100 full-time employees	1.00	0.71	0.90	0.79
Number of observations	876	1,452	13,470	268,522

Source: InnovationDenmark database and register data from Statistics Denmark.

Note: 439 companies among the potentially RDI-active companies had no information on productivity and are excluded. 28,129 companies among all Danish companies had no information on productivity and are excluded.

Table C.2 Weighted average labour productivity (mDKK/FTE) by size and population, 2015-2016 (2017-prices)

Company size	Accepted applicants	Rejected applicants	Potential RDI-active companies (weighted)	All Danish companies (weighted)
Fewer than 10 full-time employees	0.19	0.38	0.38	0.76
10-25 full-time employees	0.48	0.70	0.78	0.68
26-50 full-time employees	0.43	0.56	0.84	0.72
51-100 full-time employees	0.56	0.49	0.60	0.72
More than 100 full-time employees	1.00	0.71	0.87	0.78
Number of observations	872	1,440	13,417	268,522

Source: InnovationDenmark database and register data from Statistics Denmark.

Note: Average productivity of Potential RDI-active companies and all Danish companies are weighted with the sector distribution of the IFD applicants for each of the five company size groups. 439 companies among the potentially RDI-active companies had no information on productivity and are excluded. 28,129 companies among all Danish companies had no information on productivity and are excluded. For accepted IFD users, companies within the bottom percentile among Fewer than 10 employees have been removed. For rejected IFD users, companies within the 96th to 100th percentile among 51-100 employees have been removed. Among the potential RDI-active companies, companies in the bottom and top percentiles have been removed among Fewer than 10 employees and companies in the top percentile among 51-100 employees.

Table C.3 Standard deviation for average labour productivity (mDKK/FTE) by size and population, 2015-2016 (2017-prices)

Company size	Accepted applicants	Rejected applicants	Potential RDI-active companies (weighted)	All Danish companies (weighted)
Fewer than 10 full-time employees	1.05	4.09	0.56	44.19
10-25 full-time employees	0.63	5.44	10.10	6.77
26-50 full-time employees	1.78	0.64	1.94	2.38
51-100 full-time employees	0.57	0.42	1.04	2.07
More than 100 full-time employees	2.11	0.78	2.38	2.14
Number of observations	872	1,440	13,467	268,522

Source: InnovationDenmark database and register data from Statistics Denmark.

Note: 439 companies among the potentially RDI-active companies had no information on productivity and are excluded. 28,129 companies among all Danish companies had no information on productivity and are excluded. For accepted IFD users, companies within the bottom percentile among Fewer than 10 employees have been removed. For rejected IFD users, companies within the 96th to 100th percentile among 51-100 employees have been removed. Among the potential RDI-active companies, companies in the bottom and top percentiles have been removed among Fewer than 10 employees and companies in the top percentile among 51-100 employees.

Table C.4 Weighted employment growth rate by size and population, average, 2015-2016

Company size	Accepted applicants	Rejected applicants	Potential RDI-active companies (weighted)	All Danish companies (weighted)
5-9 full-time employees	13%	12%	2%	7%
10-25 full-time employees	13%	15%	5%	7%
26-50 full-time employees	15%	12%	6%	8%
51-100 full-time employees	7%	7%	5%	8%
More than 100 full-time employees	4%	4%	6%	9%
Number of observations	577	844	22,713	63,973

Source: InnovationDenmark database and register data from Statistics Denmark.

Note: Average employment growth of Potential RDI-active companies and all Danish companies are weighted where the productivity of potential RDI-active companies and all Danish companies are weighted with the distribution of the IFD applicants in 2015 and 2016 for each of the five size categories.

Table C.5 Standard deviation for employment growth rate by size and population, average, 2015-2016

Company size	Accepted applicants	Rejected applicants	Potential RDI-active companies (weighted)	All Danish companies (weighted)
5-9 full-time employees	21%	23%	13%	17%
10-25 full-time employees	27%	26%	14%	18%
26-50 full-time employees	28%	25%	18%	20%
51-100 full-time employees	12%	13%	14%	20%
More than 100 full-time employees	22%	12%	18%	32%
Number of observations	577	844	22,713	63,973

Source: InnovationDenmark database and register data from Statistics Denmark.