RESEARCH EVALUATION

2024

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AARHUS BSS
DEPARTMENT OF BUSINESS DEVELOPMENT AND TECHNOLOGY
AARHUS UNIVERSITY

AACSB ACCREDITED
ASSOCIATION OF MBAS ACCREDITED
EQUIS ACCREDITED

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Preamble

As part of the 2024-2025 research evaluation at the School of Business and Social Sciences (Aarhus BSS) at Aarhus University, each department conducts a self-assessment.

The self-assessment report at hand presents the results of the self-assessment at the Department of Business Development and Technology. It includes an introduction to the department and a brief account of its self-assessment process.

The bulk of the report is organised around a set of evaluation themes. Three themes (research output, research collaboration and acquirement of competitive research funding) have been included as evaluation themes across all departments at Aarhus BSS. In addition, each department has selected two to three separate themes, reflecting its specific strategic research priorities, particular challenges, potentials for development, or need for external assessment and advice. Each theme is addressed in a separate chapter of the report. For the Department of Business Development and Technology, the chosen themes are:

1. Interdisciplinary collaboration
2. Industry collaboration

The final chapter looks forward, assessing the viability of the department's research activities and priorities in light of expected future developments within its research fields.

Hence, the report contains the following elements:

1. Executive summary
2. Introduction to the department
3. Description of the department's self-assessment process
4. Research output
5. Research collaboration
6. Acquirement of competitive research funding
7. Department-specific theme 1.: Interdisciplinary collaboration
8. Department-specific theme 2.: Industry collaboration
9. Viability of research activities and priorities

1.0 Executive summary

The department has a strong portfolio of research and study programmes in business, business engineering and IT/communication configured to local needs. It is therefore inherently interdisciplinary, with around 55 full-time faculty members and 25 PhD students organised into two research sections: Advanced Interdisciplinary Research on Organisational Development (AIROD) and Engineering & Technology (EngTech). The interdisciplinarity is underlined by the fact many of the department's PhD students have crossed the boundaries between the two sections and work in fields different from their immediate educational backgrounds.

In addition to the research sections, the department is home to the Centre for Energy Technologies (CET) and the strategic Digital Business Development (DBD) project encompassing researchers from IT, communication, business, and engineering disciplines. Similarly, strategically potent research projects are sustainability and Energy (Power-to-X).

The department has a comprehensive research agenda, which is driven by its diverse teaching portfolio that requires a broad set of competences. However, a common thread across all study programmes is an emphasis on business development, often with a technology perspective.

Over the last decade, the department has experienced significant growth in its research output. In general, the publications have more citations than comparable publications. The level of female authors has been at a relatively stable level, and there is a growing trend in the number of papers co-published with industry.

The department has a remarkable track record of international collaboration. This is mainly due to its significant success in attracting international researchers to the department as well as securing externally funded international research projects. Most international collaborations are centred in Europe, but strong international collaborations can be found world-wide.

Most of the competitive funding originates from the European Commission, including grants from the European Research Council, Marie Curie Doctoral Networks and Industry Leadership as well as Societal Challenges.

The department's main challenge lies in maintaining its current research position while also addressing future challenges in areas such as digitalisation, energy, ESG reporting and the technological changes in the manufacturing sector.

The path forward may involve motivating the researchers to take on the new challenges in a way that does not undermine the research foundation of the existing teaching portfolio.

2.0 Introduction to the department

The Department of Business Development and Technology
The Department of Business Development and Technology (BTECH) is part of Aarhus BSS, one of five faculties at Aarhus University. Aarhus BSS holds the distinguished accreditations AACSB, AMBA and EQUIS.

As of 30 May 2024, the department has 52 full-time faculty members, 25 PhD students, 13 administrative staff members and employs approx. 25 part-time lecturers. There are approx. 750 full-time students and 500 students enrolled in continuing and further education programmes. Around 35% of the full-time students are from other countries than Denmark.

BTECH focuses on research and educational excellence in the domains and intersections of business, business engineering, IT, and communication. As such, the department is home to four bachelor's programmes, three master's programmes and a PhD programme. In addition, the department offers several continuing and further education programmes.

The AIROD and EngTech research sections
The department is organised into two research sections: AIROD and EngTech. AIROD accommodates business-oriented researchers and lecturers, while EngTech is the hub for researchers and lecturers with a more technology-oriented approach. All members of the academic staff are affiliated with one of these sections.

The sections aim to facilitate collaborative research of the highest international standard, create a basis for research-based teaching and ensure the department's relevance for the surrounding ecosystem of companies, public organisations, and stakeholders.

The collaborative nature of the sections encourages cooperation both within the academic community (section, department, and Aarhus University, and across national and international universities and research institutions) as well as with a broad set of local, regional, national, and international stakeholders.

AIROD
The research focus of AIROD is aimed at various aspects of organisational and business development. The section is structured around four disciplines and sub-fields of research. First, one group of researchers are seeking to enhance the understanding of the role of the individual within the organisation, with key aspects including human resource management, leadership, and creativity. Second, another group is focusing on the organisation as the unit of analysis and explores research topics such as open innovation, inter-organisational collaboration, and ecosystems. Third, a group is concerned with the market side of business development. Primary topics are business modelling and business model innovation. Fourth, technology is a pervasive and cross-cutting interest shared by all section members. The research within AIROD is not concerned with technology per se, but rather the technology-based business opportunities and challenges in relation to the development of new products and services.

EngTech
The research focus of EngTech is technology and engineering with a view to creating new business opportunities for private companies and public organisations. The research revolves around technology as a catalyst for change and technology in an application perspective, including the impact of technology. The section often works with technology in a life-cycle perspective from idea and design to production and operations. The main target sectors are the manufacturing and technological service industry. Furthermore, the EngTech research section comprises a number of specialised research groups and labs to facilitate the specific research activities.

Number of researchers and teachers, 30 May 2024

	AIROD	EngTech
Professors	1	3
Associate professors	7	8
Assistant professors	4	0
Postdocs	7	2
PhD students	8	17
Full-time teachers and docents	12	8
TOTAL	**39**	**38**

Centre for Energy Technologies
In addition to the research sections, the department is home to the Centre for Energy Technologies (CET), which focuses on the development of new and innovative energy systems for businesses and consumers, primarily in the areas of electricity, renewable energy, energy efficiency and hydrogen. CET has affiliated researchers at all levels from both sections employed, and it aspires to be one of the leading national and regional producers of independent, high-quality academic research related to energy studies and energy policy. CET is currently coordinating an ERC Synergy Grant.

Strategic projects
The department has a strong focus on industry collaboration and being close to industry implies that new ideas present themselves continuously. While some may be short-lived, others touch on something more profound that shapes the agenda for years to come. Common to such ideas is that they point forward, and it is an integral part of university activity to investigate, understand, conceptualise, and ground such ideas in study programmes and research.

On this background, entering 2023, BTECH launched the strategic Digital Business Development (DBD) project. With researchers hailing from IT, communication, business and engineering disciplines, the department has a unique opportunity to understand digitalisation in both a profound and a broad sense and by that make significant contributions to industry, education, and research.

The department finds itself in a similar situation with respect to other potentially potent research areas such as sustainability and Power-to-X (PtX) and may well launch strategic projects in these areas in the time to come.

Another strategic project is the Manufactory project. BTECH is located in the heart of Denmark's leading production industry cluster with its ecosystem of

global companies and a myriad of SMEs. From this vantage point, the Manufactory project was launched in the autumn of 2022 as a department-wide project with the intention to involve a broad set of researchers and experts in industry projects with many SMEs. The overall purpose was to improve contextual knowledge, identify new ways of working with industry and to source industry-related research projects.

Future directions for the department

The department has a strong portfolio of research and study programmes configured to local needs, i.e. programmes in business, business engineering and IT, and communication.

In response to government regulation, Aarhus BSS has decided to strengthen the education portfolio at the department even further by moving all its activities related to the MSc study programme in IT, Communication and Organisation to BTECH. In addition to this, the department has developed a new MSc in Economics and Business Administration specialisation in sustainable business, which awaits final approval. Furthermore, the department is currently pursuing opportunities for offering a bachelor's degree and continuing education in these areas. Hence, BTECH is most likely looking at future growth in the areas of IT, communication, and sustainability.

This aligns with the department's research ambitions of focusing on the interplay between business development and technology with a particular emphasis on the digital and green transition for industry and public organisations.

3.0 Description of the self-assessment process

The self-assessment process was launched at a faculty meeting. Subsequently, the extended management group at the department developed a plan for the development of the self-assessment report, which resulted in a distribution of work across the head of department, the section heads and the head of the secretariat.

The next step was data collection, where some information was provided by back-office functions, and some was collected at the department level.

An important part of the process has been the involvement of department employees. In addition to general information at the department level and discussions in various formal department settings such as the Departmental Forum, and the local liaison committee (LSU), the process has been addressed on various occasions at section meetings. Part of this process has also been to collect information from faculty members through discussions and a survey.

In the time leading up to the panel visit, the report (in full) will be shared with department employees and addressed at section meetings. The department is also planning to host a department-wide seminar in the fall where the content of the report will be shared and discussed.

4.0 Research output

Over the last decade, the department has experienced significant growth in its research output. The department became part of Aarhus University in 2006, but it was not until 2013 that research activities began to flourish. Since then, BTECH has solidified its research foundation, and the number of research publications has been rising ever since.

Number of publications
Figure 1 below illustrates the number of publications over time. The number of publications shows a positive trend – both in terms of 'whole count' and 'fractional count' (a count adjusted for the number of collaborating institutions).

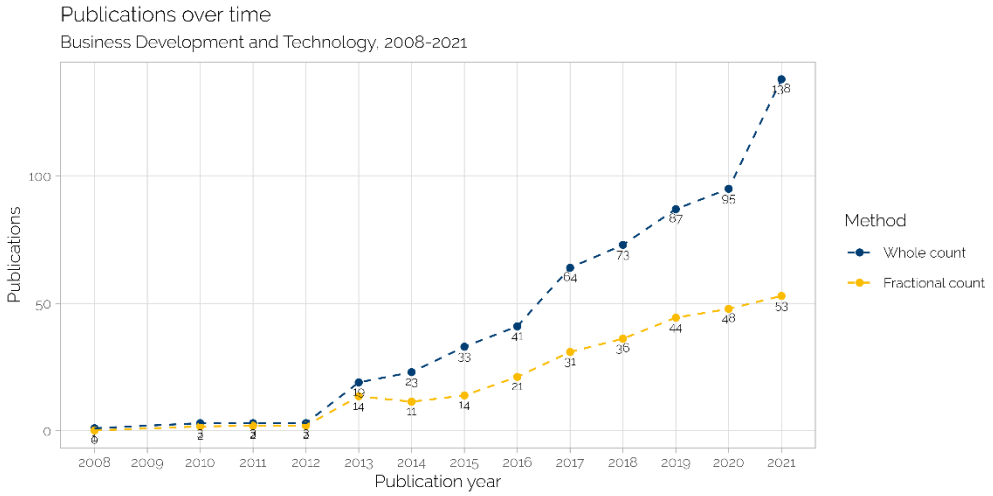

Figure 1: Publications over time (source: Impala – 22 March 2024).

The findings are corroborated by Figure 2, which shows that both the total number of publications and the number of publications in Web of Science have increased steadily. The relative number of publications in Web of Science has been comparatively stable over the years (in recent years in the range of 65-78%).

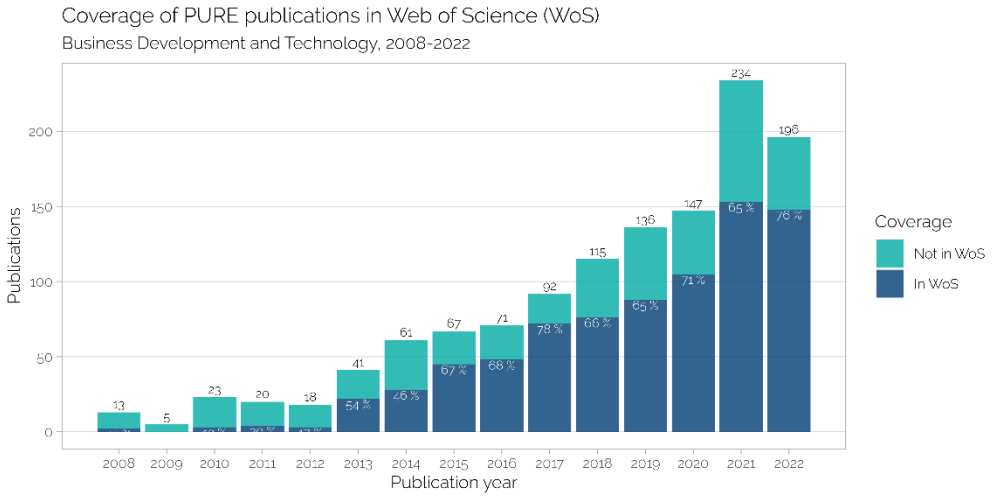

Figure 2: Coverage of publications in Web of Science (source: Impala – 22 March 2024).

Figure 3 shows the proportion of publications with female authors. Between 2014-2021, the level appears to be relatively stable (around 20%), with a probable upward trend towards the end of the period. It is worth noting that women made up approx. 20% of the department's researchers during this period.

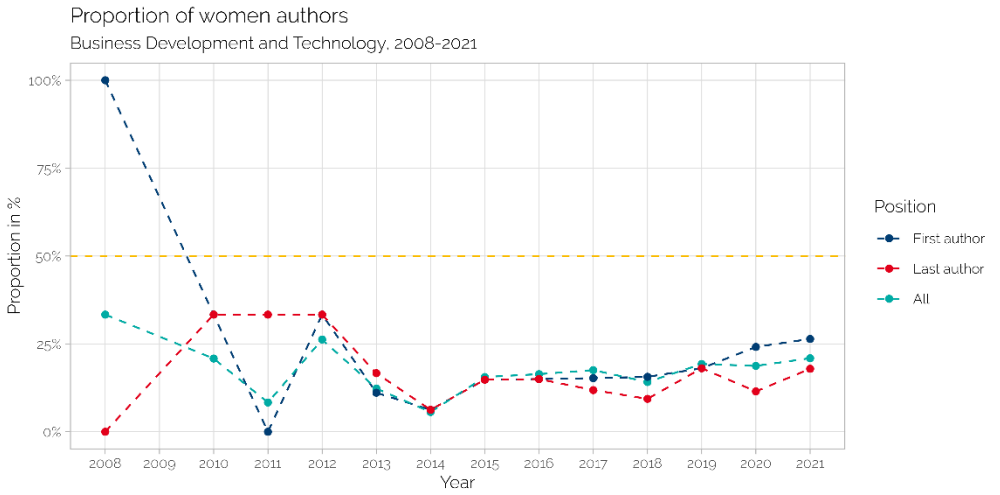

Figure 3: Gender analysis (source: Impala – 22 March 2024).

Impact of publications

The impact of the publications as measured by the number of citations is presented in Figure 4 and Figure 5.

Figure 4 shows the mean normalised citation score (the ratio between the citations of the department's publications and the average citations of publications in the same academic field published in the same year). In general, the publications have more citations than comparable publications (i.e. a score above 1). There seems, however, to be a tendency towards a decrease in the MNCS, although it remains above 1.

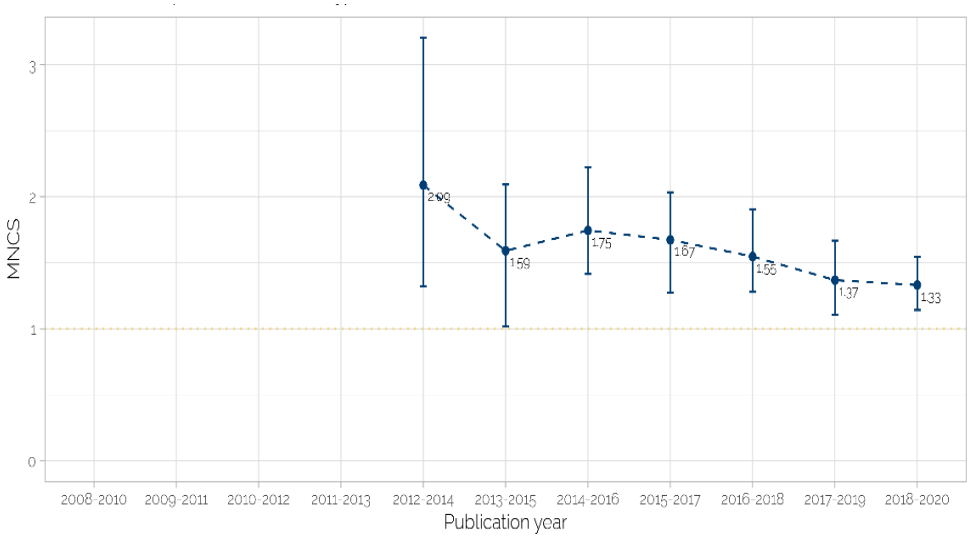

Figure 4: MNCS over time (source: Impala – 22 March 2024).

Figure 5 illustrates the one-year citation score, which exhibits considerable variation and is measured with imprecision. Yet, the figure seems to indicate a decreasing trend in the period up until 2019 and an increasing trend from 2019 to 2021.

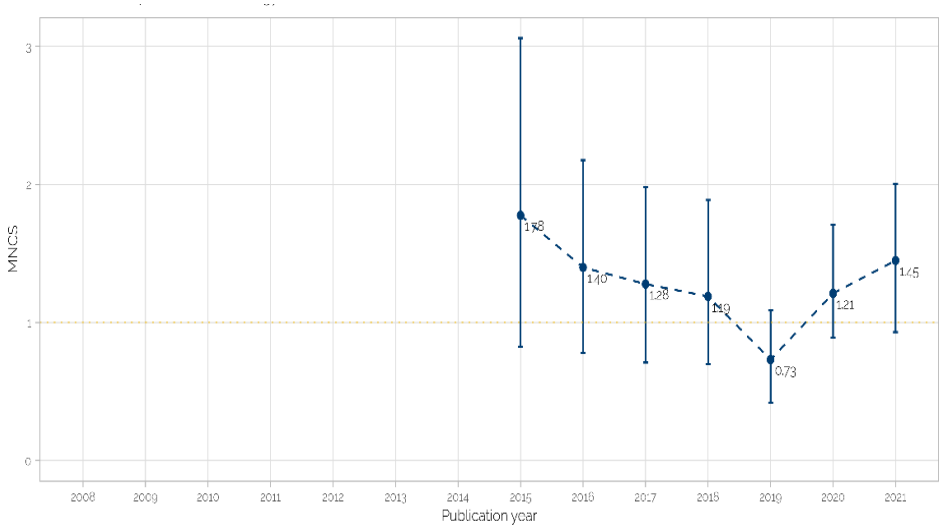

Figure 5: 1-year MNCS over time (source: Impala – 22 March 2024).

Building and maintaining high-quality research output

Research production is supported by the department through various instruments. Researchers at all levels have ample time to conduct research, as roughly half the workweek is allocated to research. For junior faculty the fraction is slightly higher.

The department contribute to researchers' network building by supporting conference participation, secondments, hosting of collaborators and coauthors, participation in network meetings, etc. (additional details below under Research collaboration).

Furthermore, the department provides resources and opportunities. Some researchers require data access, others rely on field research, and engineers often work in labs. It is a clear strategy for the department to support such activities and the department purchases data access for multiple researchers and supports recruitment of research assistants for project work.

In recent years the department has also successfully built multiple research labs and facilities, which allow research groups to form and teaching activities to flourish. Examples are xR² lab with its focus on VR and extended reality and DIGI Lab focusing on advanced production.

Equally important are the ongoing discussion at the department about what constitutes quality research. Being a department with broad research activities, research output varies across researchers and research groups in terms of volume, citations, shape and form. Such variation naturally shows on individual researchers' CVs.

The discussions on research quality among researchers, in section meetings and at the yearly BTECH conference are important to secure a common understanding of research quality/ambition and to convey that quality may take

different forms depending on academic traditions. Discussion of research quality, output, pipeline and ambitions is also an integrated part of the yearly Staff Development Dialogues (SDD) between the researcher and the immediate manager.

Future projections

The department has been through a transition period, during which it has built significant research capacity. Today, research output, measured by the number of publications (including per researcher), is at a high level, and research impact is notable compared to the relevant academic field(s). Part of this development is due to growth in the number of researchers, which is now slowing down. Hence, in the time to come, it is expected that the growth in research output will also slow down, and that the department will enter a period of consolidation.

5.0 Research collaboration

The department has a strong external orientation. In a typical year, the department is collaborating with more than 250 companies in relation to research and teaching, with multiple company-related research projects running at any given time. Furthermore, in 2024, around 35% of the academic faculty are international, representing 15 different nationalities. Additionally, most (if not all) researchers engage in international collaborations.

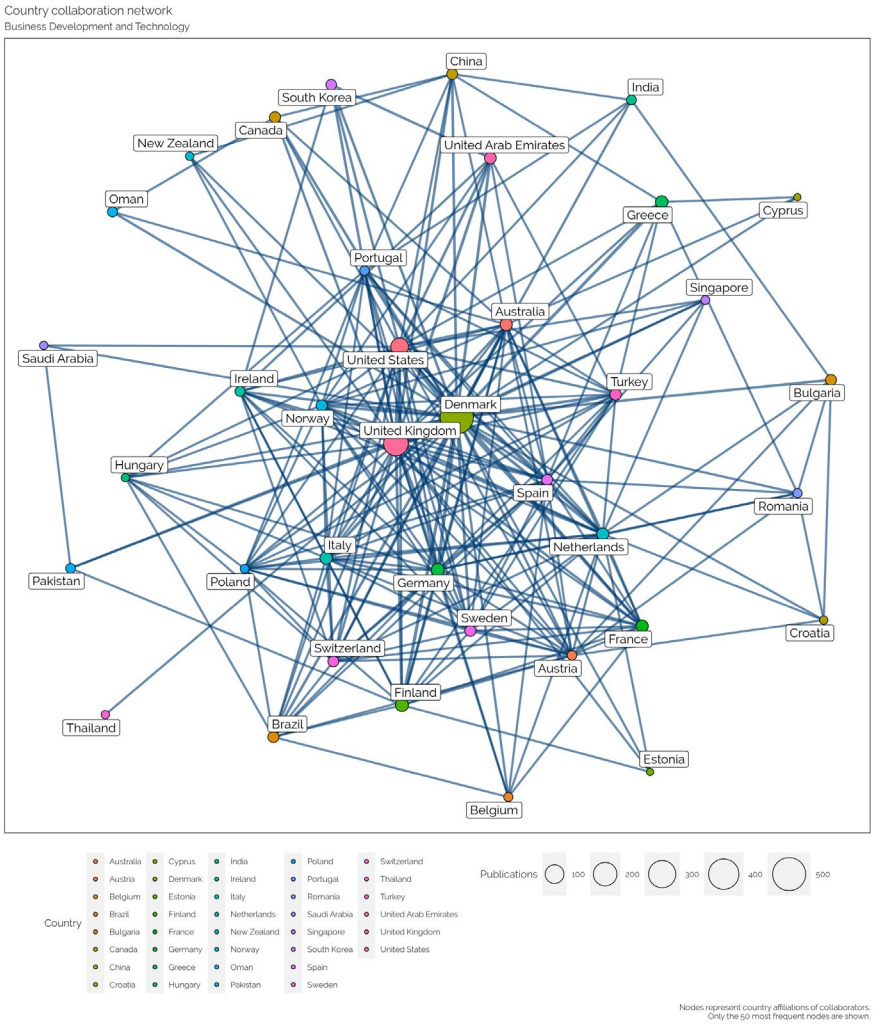

Figure 6: Country collaboration network.

Geographical spread of collaboration

Most international collaborations are with European partners (Figure 6). Especially collaborations with the UK and other Scandinavian countries are important. There are also strong collaborations with researchers in the US and Australia. In addition, the department has important, albeit more sporadic, collaborations with researchers in India, South Korea, Singapore, and other countries.

Several of the international collaborations are strategic and related to research projects. For example, UK collaborations are primarily linked to research in

energy technologies and climate change through our ERC Synergy grant GENIE, whereas some of the wider European collaborations are tied to European research projects. Global research collaborations with countries such as the US, Canada, India, Japan, and Australia may be linked to research projects, but are typically the results of individual research collaborations.

Figure 7, which maps papers co-authored with colleagues from other universities, confirms the particularly strong collaboration with UK universities. There are strong ties to the University of Sussex, the University of Manchester, the University of Oxford, and the University of East Anglia. At the national level, the primary collaborator is Aalborg University, renowned for its strength in engineering.

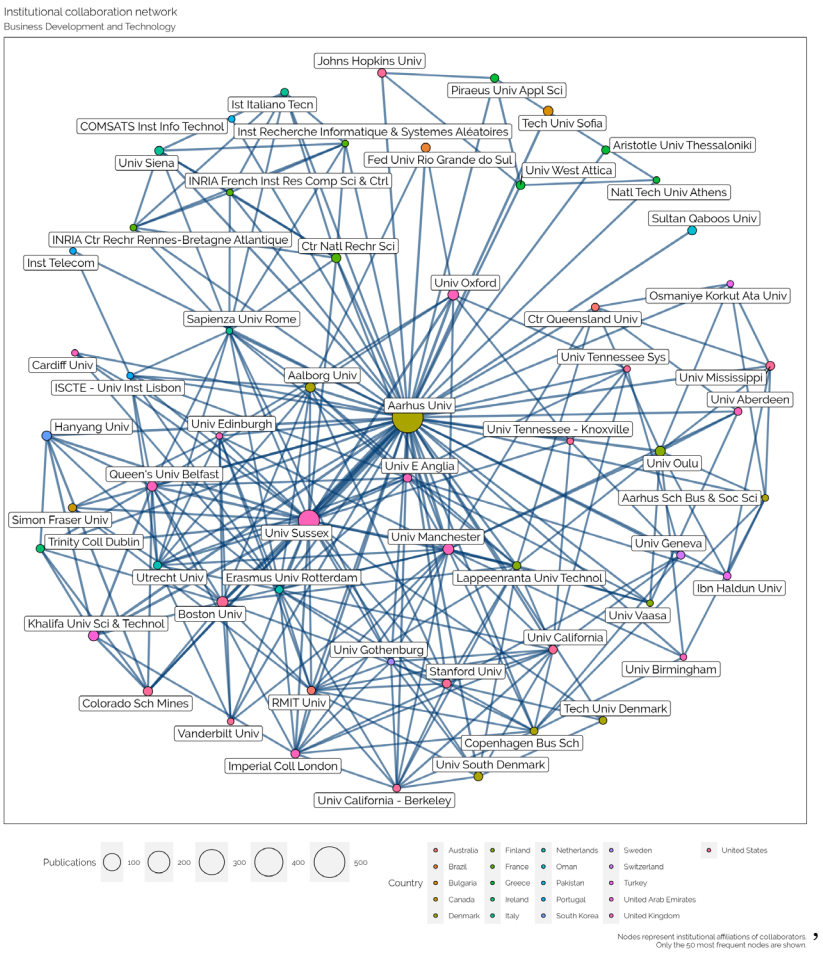

Figure 7: Institutional collaboration network.

Measures of collaboration and impact

The department's extensive collaboration is reflected in the number of publications with national and international collaborators (Figure 8). The number of papers published in collaboration with international partners is high and has remained stable over the years (especially after 2014). More than 75% of the papers are published together with international colleagues.

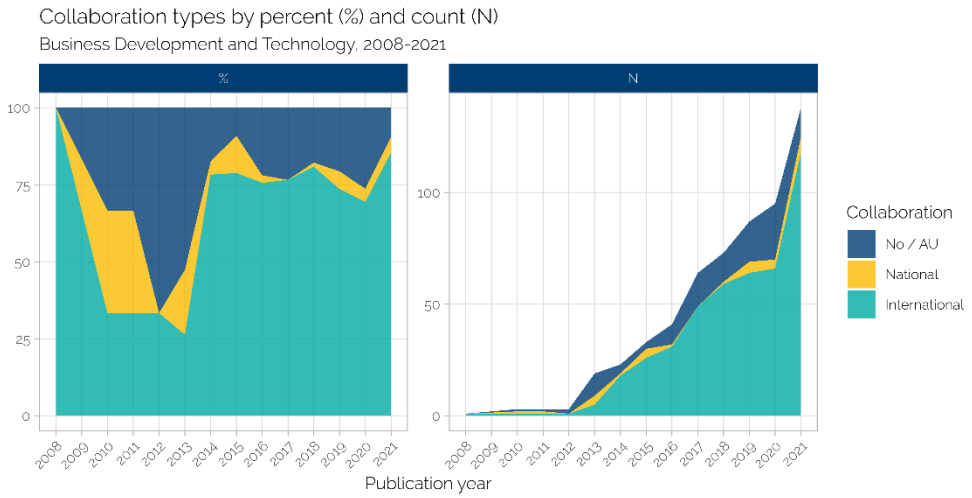

Figure 8: Collaboration types (source: Impala – 22 March 2024).

Furthermore, Figure 9 shows that the papers published through international collaboration have a higher mean normalised citations score (MNCS) compared to those published with local or no collaboration and national collaboration. The table also shows that the papers written with international partners have a higher likelihood of being published in high-ranked journals.

An additional insight from the table is that papers published based on industry collaboration have a higher MNCS than other types of publications. While it is not clear if this indicates a trade-off between relevance and academic prestige, supporting both industry and international research collaborations seems like a sound strategy for the department.

Indicator	Number of papers	Mean Normalized Citations Score (MNCS)	Share in top 10% (PPtop10%)
Local or no collaboration	114	0.95	8.43%
National collaboration	29	0.81	3.45%
International collaboration	440	1.68	21.39%
Industry collaboration	24	1.90	12.43%

Figure 9: Number of papers, impact and quality of paper collaboration types (source: Impala – 22 March 2024).

Building and maintaining research collaborations

Research collaboration is supported by the department through various channels. Regular BTECH seminars feature both internal and external speakers, while ad hoc seminars are organised when researchers, co-authors and collaborators visit the department. The department also hosts international researchers at various stages of their academic careers. As a recent example, in 2023-2024, the department was awarded the prestigious Otto Mønsted Foundation visiting professorship grant for one of the leading innovation management scholars in Europe.

In a similar fashion, the department supports activities outside the department, including conference participation and both short- and long-term secondments. Such secondments are a requirement for PhD students, but they are also used by faculty members.

Networking efforts are also evident in the department's contributions to the academic community. Researchers participate by either organising or co-organising conferences or serving as keynote speakers, panel discussants and session chairs.

Several researchers also contribute as editors-in-chief, associate editors, and editorial board members, some of whom hold highly prestigious positions such as editor-in-chief at Creativity and Innovation Management and associate editor at the Journal of Business Research. In addition, all researchers are naturally contributing to the refereeing process across numerous academic journals.

Within Aarhus University, researchers engage in several collaborations. While most of these take place on a person-to-person basis, the department is also involved in initiatives such as the COPE lab, which is a cross-departmental experimental lab, and the DIGIT project as the project lead on the Digital Business Development work package.

Collaboration with companies often rely on (or is initiated by) personal relations and build on trust. Furthermore, companies involved in research activities are typically also engaged in student-related activities such as student projects, internships, etc. Consequently, company collaborations commonly span across multiple levels and serve multiple purposes. Hence, developing and maintaining company collaborations that can lead to research projects require multidimensional support, and the department is heavily engaged in such activities.

Future projections

The department engages in extensive external collaborations that involve researchers at all levels. These are global, with more activity domestically and in the UK. Research collaborations with industry are also common, with companies participating either as co-authors or as subjects of investigation. Both types of collaboration are of vital importance for the department.

The department has implemented structured activities targeted at maintaining and expanding research collaborations with academic research partners and industry. Yet, such activities can always be strengthened.

The department's broad international collaboration is the result of the recruitment of international talent and the global outlook of its researchers, in combination with a high success rate in securing strong externally funded international research projects (see Section 6). It seems natural to continue down that path.

What may be fruitful for the department is to set up more structured (repeated and long-term) collaborations with international research groups/departments. A first experience with such a setup is a recent collaboration with the Science Policy Research Unit (SPRU), University of Sussex Business School, United Kingdom. In this context, a particular research project spawned additional research collaboration across a broader set of researchers and topics. Whether this can or should be repeated with SPRU and other partners remains an open question (as it is also time-consuming and requires dedicated resources).

Company collaborations occur for many reasons, and the firms and researchers have different motivations for participating. What contributes to such activities is the fact that, for decades, the department has built and maintained an industry network. The activities involved in this process are too numerous to list, but some are structured, and others occur ad hoc. Because many wheels are in motion at the same time, it may be beneficial to have a more structured approach to such collaborations; however, it is not obvious how to do this. Perhaps more projects like the Manufactory project described in Section 2 could offer a viable path forward.

6.0 Competitive funding

Competitive research funding has proven valuable for the department to bolster existing research activities and to pursue new avenues of research. External funding of department activities has seen a steady growth in recent years, constituting approx. 17% of the budget in 2017 and 35% of the budget in 2022.

Level and sources of competitive funding
Although acquired research funding varies significantly from year to year, there is a steady inflow of research grants across all years, and the trend has been increasing (Figure 10). The average funding received per senior academic staff member over the last six years amounts to approx. DKK 800,000.

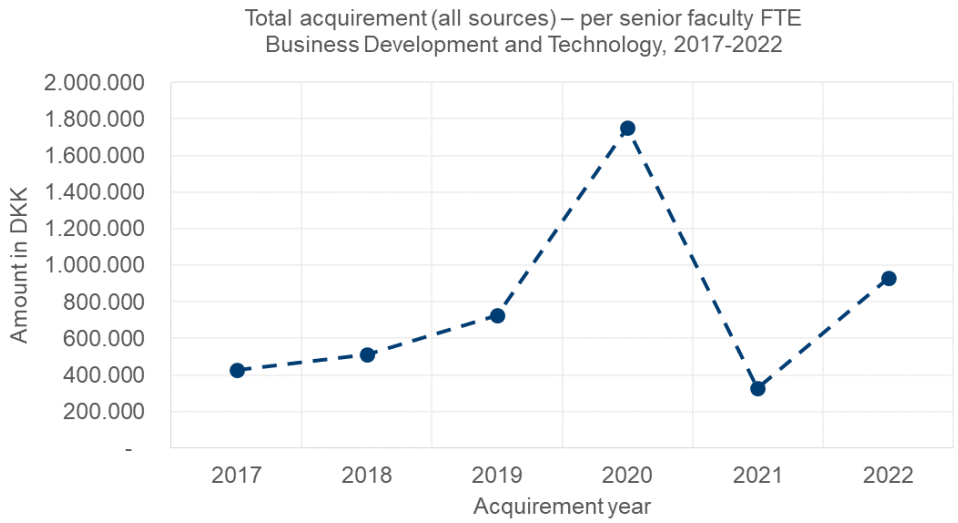

Figure 10: Successful research funding per senior academic staff member.

Figure 11 shows that most of the department's competitive funding originates from the European Commission, including grants from the European Research Council, Marie Curie Doctoral Networks and Industry Leadership as well as Societal Challenges. Other funding sources include national and wider international research grants as well as private foundations and industry-sponsored research. Within this landscape, EU funding plays a dominant role, but it is important to note that the department's funding originates from a multitude of sources, providing robustness in the project portfolio.

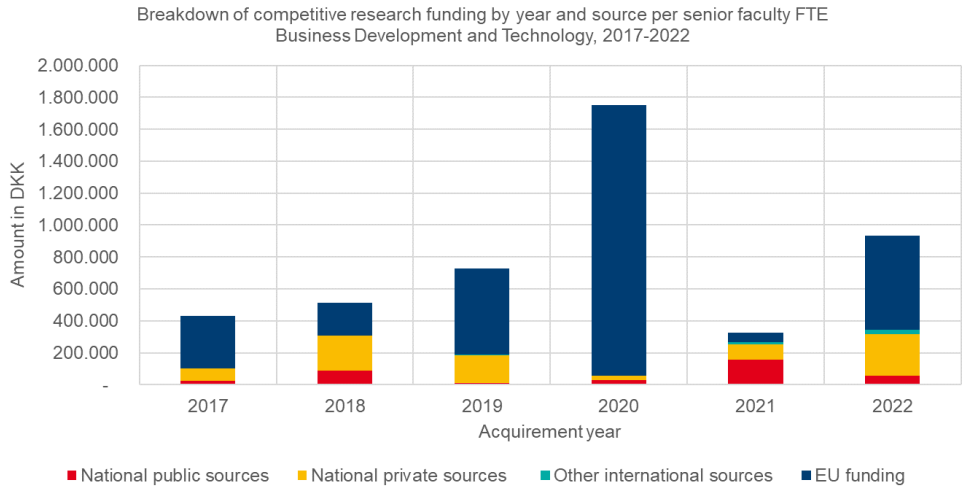

Figure 11: Acquirement of competitive research funding.

Success rate

Because acquisition of competitive research funding requires resources, primarily researcher time diverted from other activities, the success rate becomes important. As shown in Figure 12, the department has done well with an average success rate close to 50%. The success rate in terms of 'amounts applied for' is somewhat lower. It should be noted that these numbers are based on larger grants registered in the tracking system upon submission; some smaller grants go below the radar and are excluded from analysis.

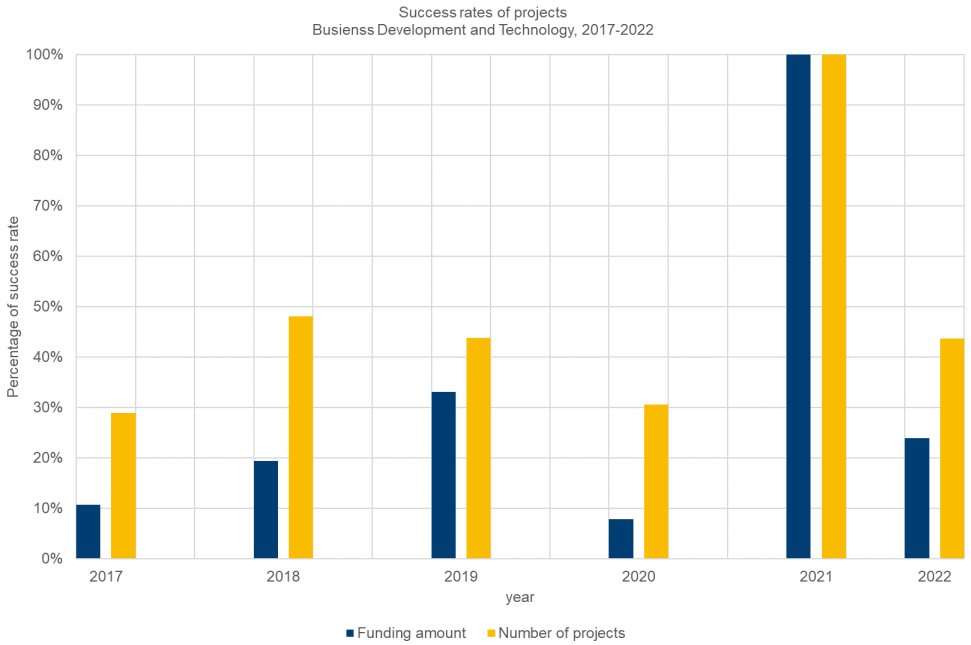

Figure 12: Success rates of projects (funding amounts and number of projects).

Use of research funding

The increase in external research funding has also led to an increase in research grant spending per senior academic staff member. Figure 13 shows how this has evolved over time, highlighting the growing significance of EU funding. This

spending typically comprises the recruitment of postdoctoral researchers, data collection and increased international collaboration.

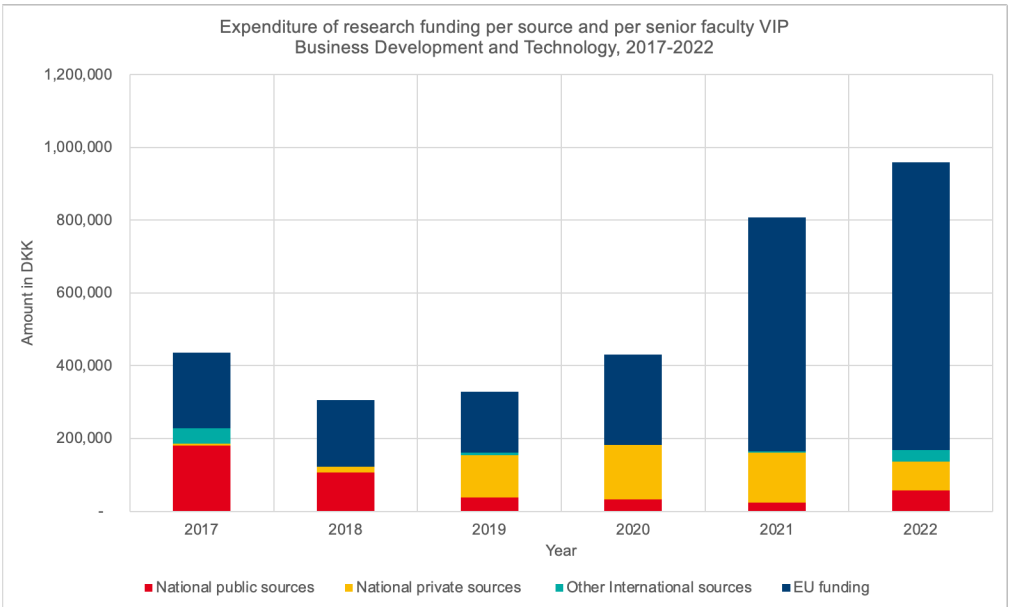

Figure 13: Expenditure of competitive research funding.

Future projections

The department exhibits excellent success rates and competitive funding levels, allowing for increased research activities, data collection and international research collaboration. The current state (early 2024) is that the department is nearing the saturation point when it comes to expenditure of competitive funding. Previous successes and current activities imply that researchers are fully occupied. It is therefore reasonable to expect a decrease in project acquisitions and an increase in the expenditure of existing competitive funding.

Yet, in the not-so-distant-future (when funds start to dry up), applying for external funding will regain its relevance. We have already initiated discussions on how to become more strategic in our funding acquisition, i.e. acquiring funding within specific research areas and from specific programmes. The aim is to have a balanced mix of funding that enables us to carry out research in international collaboration while also supporting regionally and locally oriented research projects.

We have also discussed – but not yet concluded – what will be an appropriate level of research funding for the department. At present, competitive funding constitutes approx. 35% of the department's budget, leading to significant volatility in the budget and personnel. The optimal level for competitive research funding should strike a balance between value-creating activities and turbulence to ensure that it remains a rewarding activity for the people involved and the department as a whole.

7.0 Interdisciplinary collaboration

Interdisciplinary collaboration is important at a department as diverse as BTECH, as we are the department of business development AND technology. Being this diverse is both a challenge, as the department has to cover a lot of ground, and an opportunity, as researchers from various fields interact, collaborate, and produce new knowledge, which would struggle to flourish in a mono-disciplinary department.

However, interdisciplinary research is notoriously difficult. Researchers typically spend their apprentice years in departments with a narrow academic focus that operate within a specific research paradigm and only consider a select few academic outlets as prestigious. When such scholars come together at BTECH, their backgrounds may blend, but an interdisciplinary outcome is not guaranteed.

Interdisciplinary collaboration
The department actively supports interdisciplinary collaboration. The Digital Business Development (DBD) project is an attempt to unite researchers with backgrounds in IT, communication, business, and engineering, and to create unique opportunities for such scholars to produce new knowledge in the domain of digitalisation. The Manufactory project is another attempt to create a platform where scholars, businesses and knowledge institutions can produce new solutions to pertinent industry challenges.

The research sections also work as catalysts for interdisciplinary research. The department is broad in scope, implying that its two sections: AIROD (business) and EngTech (technology) are broad as well. As such, the sections bring together researchers of various backgrounds. Furthermore, section heads coordinate across sections and explore opportunities for cross-section collaborations. Such collaborations manifest in projects like DBD and Manufactory, but also lead to cross-fertilised research opportunities, two prominent examples of which are Modstandygtig.DK (on organisational resilience) and UnWind (on blockchain technology).

Modstandsdygtig.DK focuses on organisational resilience and is aimed at a broad understanding of the ability of SMEs to navigate turbulence in the environment and develop new business opportunities in such conditions. The project, which is implemented by a long list of Danish research and technology organisations, was funded by the Danish Industry Foundation over a four-year period (2021-2024). As the only participant from the Danish university sector, BTECH has been engaged as ‘the knowledge partner’, contributing with new theoretical perspectives and technical solutions. Hence, both the broadness of the research profiles at the department (from both business and technology) and the in-depth knowledge of theory and technology have been instrumental for the project’s success.

The UnWind project aims to develop a blockchain use case for the European wind industry. Initiated and managed by the department and carried out in partnership with, among others, Fraunhofer Blockchain Lab, the project builds on an analysis carried out by some of the business researchers at the department on the potential benefits of blockchain technology within the wind industry (traceability, quality assurance, etc.). To develop the actual use case, the project drew heavily on the rich engineering and software competencies among the

colleagues from the technical section. The project provided empirical basis for research papers on both business and technology aspects of blockchain technology, many of which were co-authored by researchers from both sections.

Standing on the shoulders of these projects, the sections have ongoing initiatives that ask new questions in these domains. The cybersecurity project spawns questions related to novel designs and research challenges important for companies. In AIROD, researchers are typically interested in quantitative and qualitative analyses of the challenges companies face, while it is common for researchers in EngTech to provide insights on potential technical solutions to such challenges.

The organisational resilience efforts have led to discussions of a large-scale project with the Danish research and technology organisations (the Danish Institute of Fire and Security Technology, FORCE Technology and the Technological Institute). This may lead to important research on organisational resilience, with the department making valuable contributions by providing technical and business-oriented solutions to key challenges in businesses.

Recently, several smaller interdisciplinary research grants have been secured and shared among section members. These include studies on organisation and organising practices in free open-source software projects, as well as Team Alchemy employing Q-learning tools to support research within organisational search. Both grants are national research grants.

Interdisciplinary PhD projects
Production of interdisciplinary research at the PhD level is a key focus area for the department. Interdisciplinarity can manifest in at least three ways:
1) Through 'crossover' of the research background of the PhD student, 2) through the interdisciplinary organisational setup behind the PhD project and 3) through the interdisciplinary nature of the project theme, scope, and aim.

Interdisciplinarity expressed in 'crossover' of the research background of the PhD student
A number of the department's PhD students have transcended the boundaries between the two sections, working in fields different from their immediate educational backgrounds. For instance, a physisist, who is doing a PhD project on search behaviour in an online universe, primarily focuses on the implications for (innovation) management and is therefore supervised by social scientists and a member of the AIROD section. A second example involves a PhD student with a background in psychology working with virtual reality researchers.

Interdisciplinarity of the organisational setup behind the PhD project
This second type of interdisciplinarity characterises several of the PhD projects supervised by researchers from AIROD and EngTech. As an example, a PhD student working on blockchain technology is supervised by both a social scientist (who supports the business aspects of the project) and an engineer (who supports the technical development of the use case on which the project is based). Another example is a PhD project on Industry 4.0, which falls within the realm of EngTech due to its technical nature. However, the project contains substantial elements of business model development and commercialisation, and one of the co-supervisors is therefore part of the AIROD section.

Interdisciplinarity of theme, scope and aim
A third kind of interdisciplinarity, closely linked to the first two, is expressed

through the theme, scope and aim of the PhD projects. Prominent examples are PhD projects on emerging technologies like Industry 4.0 and blockchain technology, which are dependent on competencies from both sections to thrive and meet the expectations of both the academic community and the practitioners/companies often involved in the projects. An additional theme, which is rooted in both EngTech and AIROD, is thematic research within cybersecurity and organisational resilience, as addressed above.

These PhD projects benefit substantially from being able to engage in discussions within both social science/business and technology/engineering, and the PhD students are associated with both sections. Similarly, research and PhD students at the Centre for Energy Technologies are often supported by researchers belonging to both sections.

8.0 Industry collaboration

Staying relevant is important and our approach is to be close to industry. Industry collaboration constitutes a fundamental part of many core activities at the department and often they materialize as research projects where companies are directly involved, or they supply information and data that can be used for analysis.

Research relevance
Industry collaboration is part of a larger discourse on the need for researchers to engage with real-life problems – within industry, within society and beyond. To gain insight into these aspects of the department, examining the profile of the topics addressed in the researchers' publications may serve as a good proxy. Figure 14 below shows the extent to which the publications relate to the United Nations' Sustainable Development Goals.

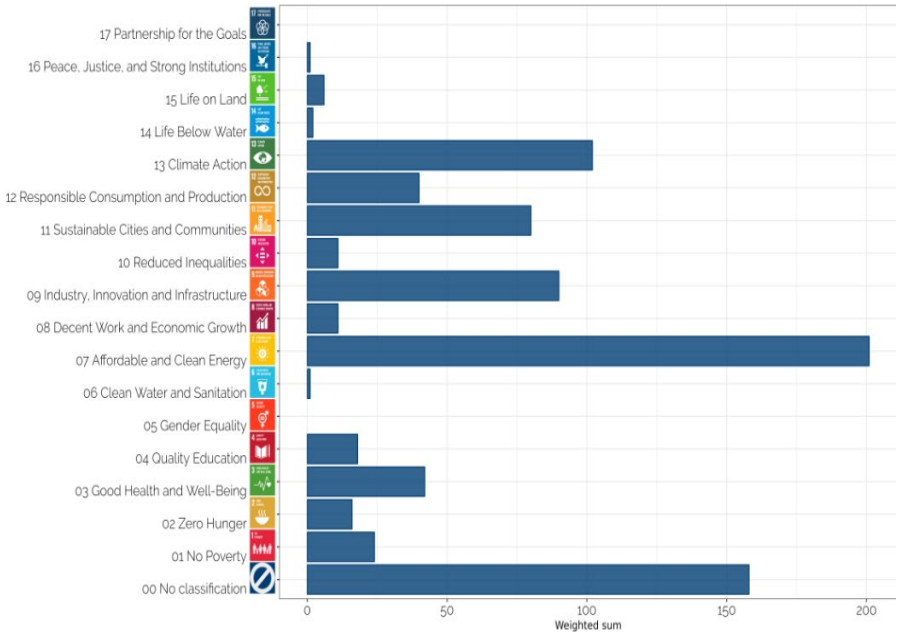

Figure 14: Publications across the UN Sustainable Development Goals.

As shown, the primary research focus of the department is 'Affordable and Clean Energy' (SDG 7), which has been addressed in more than 200 papers between 2017 and 2023. 'Climate Action' (SDG 13), 'Industry, Innovation and Infrastructure' (SDG 9) and 'Sustainable Cities and Communities' (SDG 11) are also prominent themes in the publications. This demonstrates the department's ability to engage in UN-defined problems and translate them into significant research output.

Publication data and industry collaboration
Figure 15 illustrates the number and development of co-publications with industry over the years. The number of publications is measured as papers that include at least one co-author with an industry affiliation.

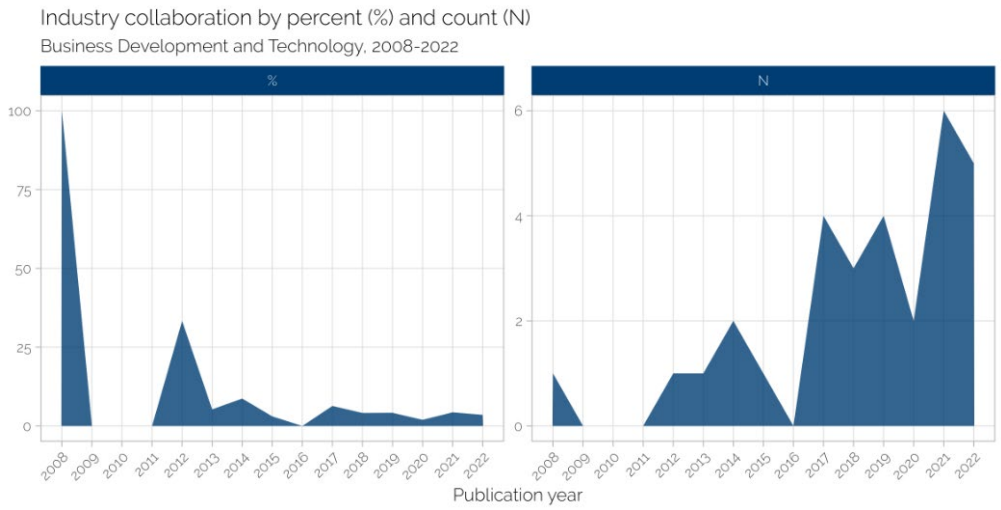

Figure 15: Publications with industry.

The figure shows a growing trend in the number of co-published papers with industry. However, the proportion of these publications relative to the total number of published papers is diminutive.

Industry-related research (projects)
A substantial part of the industry-related activities at the department are carried out within more or less formalised collaborative structures. Prominent examples of formalised collaboration include research projects, which entail partnerships between researchers and companies. Less formalised collaboration occurs through, for instance, agreements between researchers and companies, facilitating access to industry data for publishing research articles and broadening companies' knowledge bases.

Formalised research projects
The department is involved in multiple research projects with industry. Some of these are funded by national sources, others by international organisations like the European Union. A notable example of the former is the Manufactory project, which sought to bring the research at the department into play among local SMEs. This project involved close to 20 SMEs, department researchers, external knowledge partners, political and industry stakeholders, and was sponsored by the Danish Industry Foundation.

Other examples include CyPro (a project on cybersecurity among SMEs), UnWind (a project aiming at developing a blockchain use case within the wind industry), Servitize.DK (which sought to enhance the use of servitisation among Danish manufacturing SMEs) and Modstandsdygtig.DK (aimed at creating awareness on and enhancing the organisational resilience among Danish manufacturing SMEs). All these projects are/were funded by the Danish Industry Foundation and have produced a combination of research briefs, reports, and publications.

Other EU-funded projects, for example NGI Pointer and NGI Search, aim at developing technologies for the next generation internet in collaboration with small and medium-sized enterprises as well as startups. Specifically, NGI Pointer addresses internet architectures and protocols, while NGI Search focuses on search, discovery and indexing. These projects directly investigate the research

context surrounding generative AI and large language models and indirectly the organisational theory around open-source software development and the software supply chain.

Finally, EU-IoT, another EU-supported project, developed an online learning platform for digital business development, providing over 30 IoT cases from industry and assembling a toolbox of openly accessible and usable business development tools. The platform also provides the department with new dissemination opportunities for teaching, projects, and industry collaborations.

Less formalised research collaboration with industry
Examples of less formalised research collaboration are projects in which the main currency is access to data. In such projects, researchers obtain access to company data from production sites, financial statements, HR systems, etc., or they gain access to key personnel who serve as experts or subjects in research projects.

While such research naturally leads to detailed company studies or studies of relevance for companies, they rarely involve company employees as co-authors, and for that reason, they are not included in the count of 'industry collaborations' presented in Figure 15 above.

Benefits and challenges of industry collaboration
When asked about the benefits of industry collaboration, researchers emphasise the importance of making a real difference in society. The department's researchers exhibit a notable awareness of the essence of 'the third role' of universities (the first two roles being education and basic/free research). Industry collaboration is perceived as an important driver in fulfilling this third role.

The primary challenge related to company collaboration is recognising the fact that collaboration comes at a cost. Collaboration requires networking and trust, which is time consuming to build. Companies also often expect 'quick wins' and easily understandable research results – expectations that the research projects sometimes cannot meet. Furthermore, industry collaboration means getting very close to one or a few companies. Yet, in some cases and to some high-ranked journals, detailed study of a limited number of companies (case study) is not appreciated.

Hence, the ambition to conduct research in collaboration with industry presents benefits (relevance and more citations) and challenges. Researchers at the department balance these trade-offs on a daily basis.

9.0 Viability of research activities and priorities

The department has been through a transition period during which it has built significant research capacity. Today, its research output, measured by the number of publications (both per researcher and overall), is at a high level, and its research impact surpasses that of the academic field(s).

It is clear that the department has a comprehensive research agenda, which is driven by its diverse teaching portfolio that requires a broad set of competences. However, a common thread across all study programmes is an emphasis on business development, sometimes with a technology perspective. This implies that the department shares a common focus on business development.

Business development in all its variations is a discipline that is constantly evolving and will continue to do so. Therefore, the overarching research agenda of the department will remain relevant in all foreseeable future.

Being relevant, however, does not imply that there are no challenges associated with research. Research in business development can take many forms: It can lead to advancement of a particular research field, it can lead to implementation of a particular technology in a given company setting, but it often spans across multiple disciplines. The department can meet this challenge given its broad setup, but it requires an interdisciplinary approach, which is notoriously difficult.

Another aspect of being relevant is the department's close collaboration with industry. Trust is a key aspect of collaboration, and building trust takes time. Additionally, collaboration must be mutually beneficial for all parties involved. The above discussion demonstrates that the department is very successful in its research collaborations with industry, including attracting research funding. Hence, research does not suffer due to company collaboration; instead, it thrives as a result of it.

So, what is the real challenge for the department? An evocative description of the challenge is that the department is teetering on a fine line between theoretical business and deep-tech. On one side, sister departments at Aarhus BSS and elsewhere have a better setup for addressing issues in business and social science, and on the other side, there are technical faculties at Aarhus University and elsewhere with technical knowledge that we can never match. The challenge for the department is to maintain its balance on that line.

But how do we stay on the line? A stabilising factor is the teaching portfolio. The study programmes at the department are aligned with local business needs, and for this reason, they span business, business engineering and IT/communication. Continuing to conduct research in the intersection of these areas (to secure a research foundation for the teaching programs) will pull the department back on the line.

Scanning the future

At the department, there is a clear understanding that the business environment is constantly changing. Being close to industry makes this obvious to all. The question is when to respond to such changes. In our current setup, there is ample opportunity for researchers to pursue new and changing research agendas and still remain within the nexus of business, business engineering and

IT/communication. However, in certain situations, it may be wise to pay extra attention to the wind of change.

One ongoing area of change is digitalisation. Because digitalisation will continue to influence business for the foreseeable future, it will be of key importance for the department to be able to understand, conceptualise and engage in discussions related to all aspects of digitalisation. In response to this change, the department launched the Digital Business Development (DBD) project in 2023.

Another wind of change is the energy sector, including Power-to-X. While it is still uncertain if it will be more than a gentle breeze, there are political discussions and business activities that may trigger the change – and if it gains momentum, it may hit as a hurricane. The department has capacity to meet part of this challenge, but partnership (especially on the technical side) is warranted.

Another hurricane is known to hit this year. The recent EU directive (EU 2022/2464) on corporate sustainability reporting (CSRD) poses one of the biggest challenges to companies in the EU. They now have to report not only on their own emissions (scope 1) but also on the emissions caused by the energy used by the company (scope 2) and even those stemming from the rest of the value chain (scope 3). Despite having spotted this hurricane years ago and having developed a new MSc in Economics and Business Administration programme focusing on sustainable business, we are by no means ready to meet this challenge. Reasons are that this is regulation in the making, it is notoriously difficult to recruit researchers with such competences in competition with companies, and that it is a field that requires tremendous amounts of research as we are stepping into unknown territory. Nevertheless, the belief is that key competences and interests among the researchers at the department within disciplines such as marketing, accounting, strategy, business development, digitalisation, etc. will represent a substantial asset when addressing the future sustainability challenges in both research and teaching.

Lastly, local manufacturing companies contribute significantly to GDP and Danish export. At the same time, they find it challenging to recruit skilled workers, and they face pressure from technological change. Assisting these companies in their efforts to succeed and grow is of paramount importance for Denmark. While we have a framework for engaging in this challenge, we are far from having a setup capable of meeting the demand.

Research priorities

This set of challenges suggests a tremendous need for research, and at the same time, it raises the broader question: How should the department prioritise? The department's current research (and teaching portfolio) is highly relevant, as evidenced by the publication numbers (and demand for the departments graduates), so how can this position be sustained while simultaneously addressing important future challenges?

There are three answers to the question, and they are intertwined. First, as the department's primary source of income is teaching, one way to address the pertinent research questions is to secure teaching activities in the respective fields, allowing for the recruitment of researchers. Second, a secondary source of income is project funding. While project funding can be directly targeted at important future challenges, it introduces other issues, as it rarely leads to permanent employment unless there are relevant teaching obligations in the

domain. Third, motivating researchers to address a particular set of research questions is a viable approach, but only to the extent that it does not detract focus from other research that constitutes the research base for existing study programmes. Hence, the path forward is complex as the solution involves balancing research with projects/funding and teaching activities.

Conclusion
The department has built significant research capacity in recent years, which has resulted in a large number of publications (also per researcher) and impactful research. The current research portfolio is considered relevant both as a foundation for the department's teaching activities and for companies.

Yet, a main challenge for the department lies in maintaining this research position while addressing important new research questions in areas such as digitalisation, energy (including PtX), ESG reporting and technological changes in the manufacturing sector.

The path forward could be to motivate researchers to take on the new questions in a way that does not undermine the research foundation of the existing teaching portfolio; alternatively, the department could begin offering study programmes in relevant new research areas. Project funding may alleviate some of the pressure but is not viewed as a lasting solution to the overall challenge.

Important questions for the future
From a strong vantage point, it is important that the department can continue to find answers to the following questions:

- *How can the department work with its interdisciplinary structure to develop answers to future business/societal challenges?*
- *How to motivate researchers to address important future challenges without detracting focus from research that constitutes the research base for existing study programmes?*
- *How can the department set up a more structured (repeated and long-term) collaborations with international researchers, research groups and departments?*
- *How could a more structured approach to company collaborations be designed?*
- *What is an appropriate level of research funding for the department?*
- *How can the department become more strategic in funding acquisition?*