

## Academic Corporate Collaboration in the Context of Sustainable Development Goals: Benchmarking Finland

**What is the interaction between research organizations and industry in the context of Sustainable Development Goals (SDGs)?**

How we measure the impact of innovation is quickly moving beyond economic gains (e.g. productivity) to look at the broader societal impacts. The United Nations Sustainable Development Goals (SDGs) have emerged as the de facto framework to frame these broader impacts of innovation. Yet measuring impact against the Sustainable Development Goals (SDGs) is challenging. The INNOSDG project is attempting to create an approach to leverage big data analytics to operationalize the SDG impacts of Research and Development (R&D). The project delivers a state-of-play analysis on mapping sustainable development activities, its evolution and impact in R&D. This policy brief focuses on our analysis of the interactions between research organizations and industry, which is seen as a European priority area in innovation policy.

**Collaboration between research organizations and industry in SDG relevant research is more significant than in research overall.**

Collaboration between research organizations and industry is an essential tool for meeting the SDG objectives. We have strong evidence that collaboration between research organizations and industry in SDG relevant research is more significant than in research overall. Our approach utilizes scientific collaboration and bibliometrics as its measure to perform benchmarking on countries in their academic corporate collaboration capacities. It should be noted that the measures capture collaboration in scientific publishing, an outcome most significant to the research organization. The results also highlight, compared to other countries, the strong interaction in the Finnish innovation system. The Academic Corporate Collaboration (ACC) patterns are not, however, stable but change over time. This increases the need for innovation policy to be informed on the collaborative patterns.

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**Research and innovation play a key role in how we reform our industry and combat climate change with Finnish exports**

## Introduction

“Research and innovation play a key role in how we reform our industry and combat climate change with Finnish exports”, says CEO Jaakko Hirvola from Technology Industries of Finland. Science, Technology and Innovation (STI) is the main driver behind productivity increases and long-term economic growth and prosperity (Daejeon Declaration, 2015). STI’s role in the sustainability transition is central, and the interaction between academy and industry plays a significant role in innovation (Cohen et al., 2002).

United Nations Sustainable Development Goals (SDGs) define global priorities and a pathway to a sustainable future. The broad nature of the SDGs requires multi-disciplinary and holistic approaches that break existing silos (Technology Adviser to the US Secretary of State). The SDG is a practical tool that can concretize our capabilities to mobilize STI to achieve SDGs. Attaining the SDGs / SD goals requires measuring how our innovation systems work towards achieving the objectives.

Understanding the ACC interaction has attracted significant academic discourse (Mansfield & Lee, 1996; Szücs, 2018). ACC refers to the interaction between any parts of the higher educational and research organization system with industry aiming mainly to encourage knowledge and technology exchange (Rudi Bekkers & Isabel Maria Bodas Freitas, 2008; Siegel et al., 2003).

The relationship between companies and research organizations is embedded in the notion of knowledge transfer, particularly from research organizations to industry. Research has shown that ACC will create meaningful benefits for all parties (Agrawal & Henderson, 2002; Zucker et al., 2002). However, these benefits will not materialize without investment from researchers (Suominen et al., 2021) and companies (García-Aracil & De Lucio, 2008). In addition, other stakeholders in the research system also have a role to play in facilitating ACC. For example, facilitating frequent and iterative interactions among innovative actors, in which universities and private companies are central.

## Data/materials

In analyzing ACC, we consider the co-authored publication as a proxy and therefore investigate the level of such activity on various levels (global, national, topics and clusters). The analysis is based on publications in the SCOPUS database that have been analyzed using SciVal (<https://www.elsevier.com/solutions/scival>). Publication data in SciVal are available from 1996. In SciVal, all affiliations are classified as belonging to one of the following sectors: academic, corporate, government, medical, or other. International co-publications include at least two authors and affiliations in two countries. Academic–corporate co-publications are defined analogously.

## SUSTAINABLE DEVELOPMENT GOALS



**Attaining the SDGs requires that we can measure how our innovation systems work towards achieving the objectives.**

**Facilitating the frequent and iterative interaction between companies and research organizations.**

**Academic-Corporate Collaboration (%) for major global economies indicates an overall growth for the past 20 years.**

## Results

ACC has been increasing significantly (NATURE INDEX, 2017). According to Scopus, a comprehensive scientific peer-reviewed database with coverage on medical, technical and social science literature, the global number of papers co-authored by a research institution and an industry partner is steadily rising (Elsevier, 2021). In Figure 1, the overall growth of ACC over the 20 years shows different growth patterns between countries. Europe and North America's rates are above the world average and have reached a saturation point of 4.5%, while China drives the overall growth with an aggressive growth rate just surpassing the world's average.

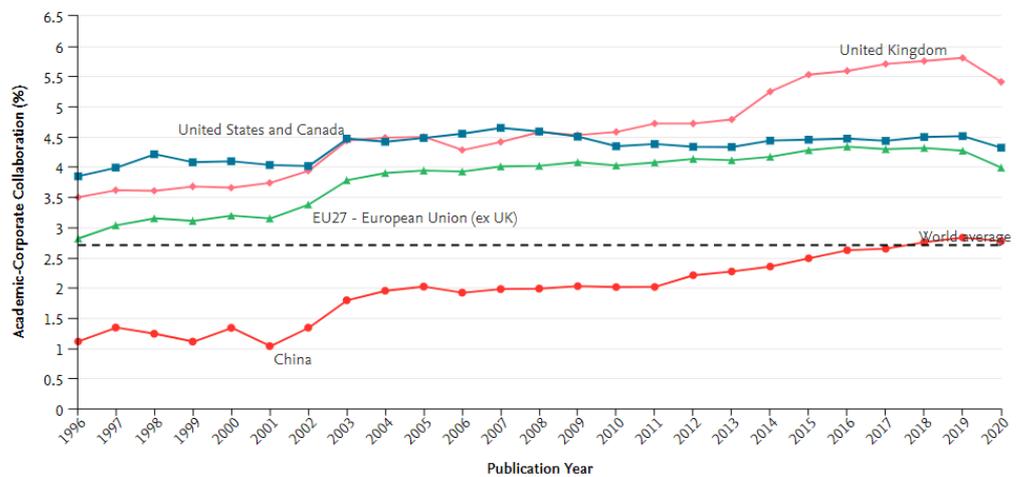


Figure 1. Academic-Corporate collaboration (%) for major global economies for 1996-2020. The figure compares the Academic-corporate collaboration of different economies. The measure reports the percentage of Academic-corporate collaboration to the overall publication output and projects the ratio over the years since the late 1990s. Source: Scival

Focusing on a selected list of countries, we deepen the analysis by benchmarking United Kingdom, Germany, Spain, Netherlands, Sweden, Belgium, Austria, Denmark and Finland. Figure 2, shows the ACC percentage (X-axes) by portraying the scholarly outputs (Y-axes) and a trend line to capture the time horizon.

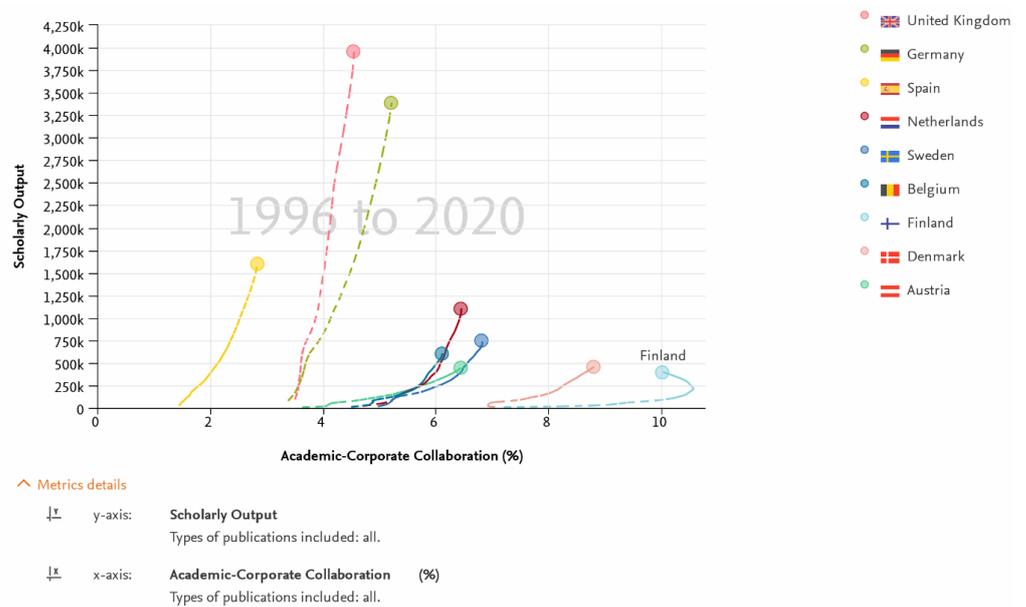


Figure 2. Academic-corporate collaboration (%) overtime comparing to overall scholarly output. Benchmarking UK, DE, ES, NL, SE, BE, FI, DK and AT.

Figure 2 is not adjusted for countries' economies or their science and technology capacity to also show the more prominent contributors. For example, UK, Germany and Spain are the top producers of scientific publications by volume; however, the rate of ACC on average is lower than the other countries in the study. On the other hand, while Finland is performing at a higher ACC percentage point (above 10%), Finland is the only country in the sample where a turn towards decreasing rates of ACC. This is partly explained by the decline in activity within the ICT sector.

ACC collaboration in SDG related publications are also rising. However not equal among all SDG categories. Figure 3, shows the volume of SDG-related publications globally and their impacts by citation measures. The ACC percentage variation in the SDG categories differs between 0.5% to 5%, SDG7 on affordable and clean energy with the highest percentage. Focusing on impact, measured by citations SDG 5 and 2 measure highest.

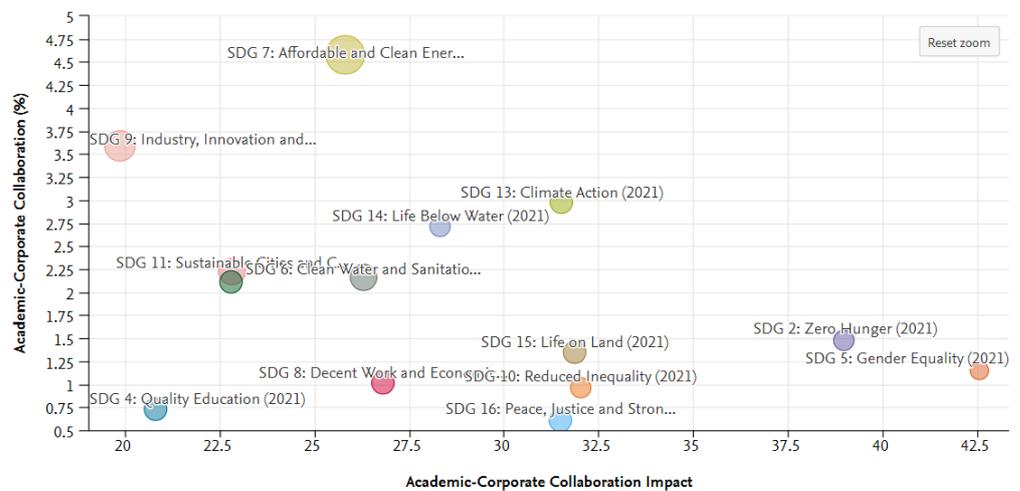


Figure 3. Academic-corporate collaboration (%) within SDG-oriented publications (X-axes) in comparison to the collaboration impact (measured by average citation per publication) measured by citations (Y-axes). The size of the circles indicates the volume of the publications.

Figure 4 shows the SDG relevancy of ACC over 25 years in selected countries. The collaboration has risen from 5% to nearly 25%, with an 8% variation between countries. Finland has the highest collaboration rate of nearly 24% followed by Spain. In comparison, in Belgium and Netherlands collaboration rate is 17%. Important to notice is that while ACC has saturated at 7%, with the exception of China, in SDG related science publications we are seeing increasing ACC.

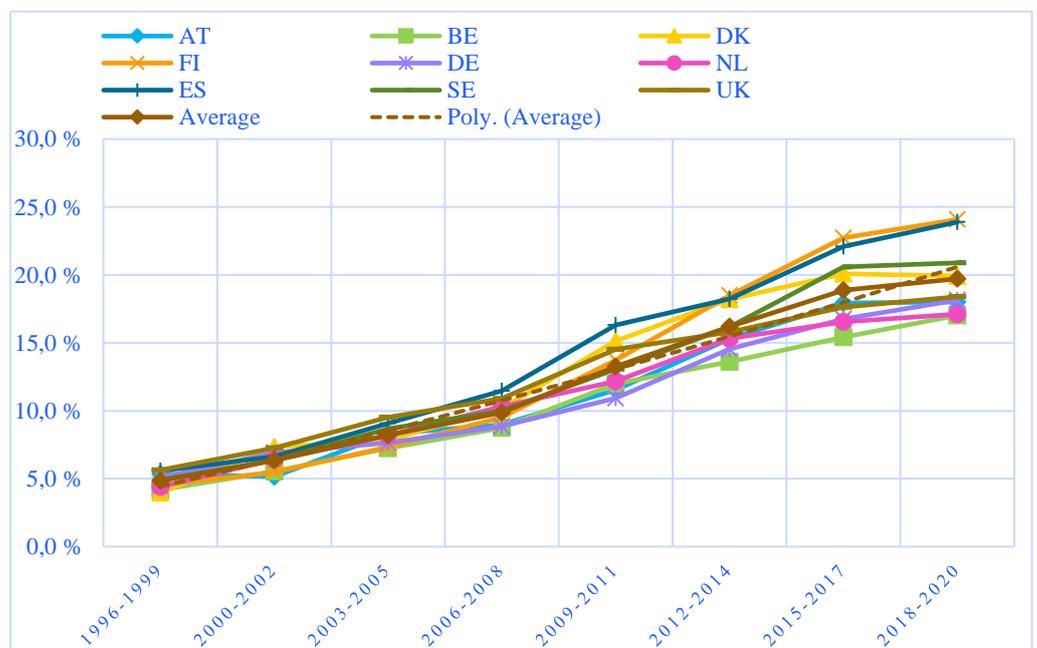


Figure 4. Academic-Corporate collaboration with SDG orientation normalized by countries specific overall academic-corporate collaboration capacities.

While we see macrolevel increases in collaborative patterns that highlight the importance of fostering the collaboration between research and industry, we should

The aim of Innovation and Growth Research funded by Business Finland is to find solutions to the global challenges of the Finnish economy and society.

also look at the thematic evolution of collaboration. Taking SDG 7, which had the highest percentage of ACC, as an example, ACC in Finland has dropped from a high of 9,8% in 1996-1999 to 5,2% in 2018-2020.

This has resulted in some topics<sup>1</sup> where industry and academia used to collaborate to be significantly reduced or vanished. To illustrate Figure 5 shows the thematic orientation of ACC for two time periods 2010-2017 and 2017-2020. For example, SDG 7 oriented publications clustered under topics such as Climate models, Crystal structures or Controllers have not seen ACC collaborations in later period. In addition, activities in topics such as hydrophobicity and polypropylenes rate of activity have reduced over the years.

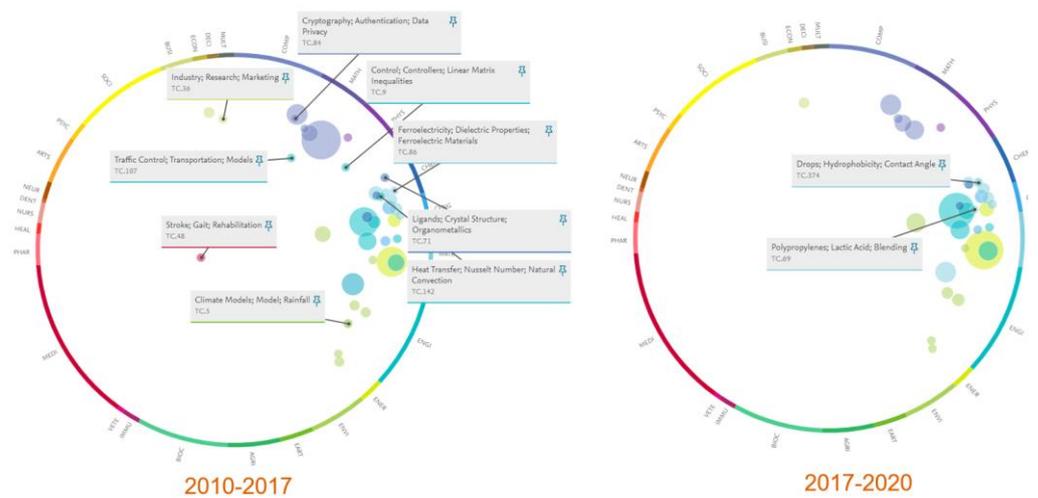


Figure 5. SDG 7 vanished collaboration topics between academic and corporate in Finland

While some topics have reduced or vanished, Figure 6 highlights emergent topics of ACC, such as Gasification, Ventilation, Electric power transmission networks.

<sup>1</sup> Topics / Topic Clusters are a collection of documents/publications with a common, focused, intellectual interest based on citations.

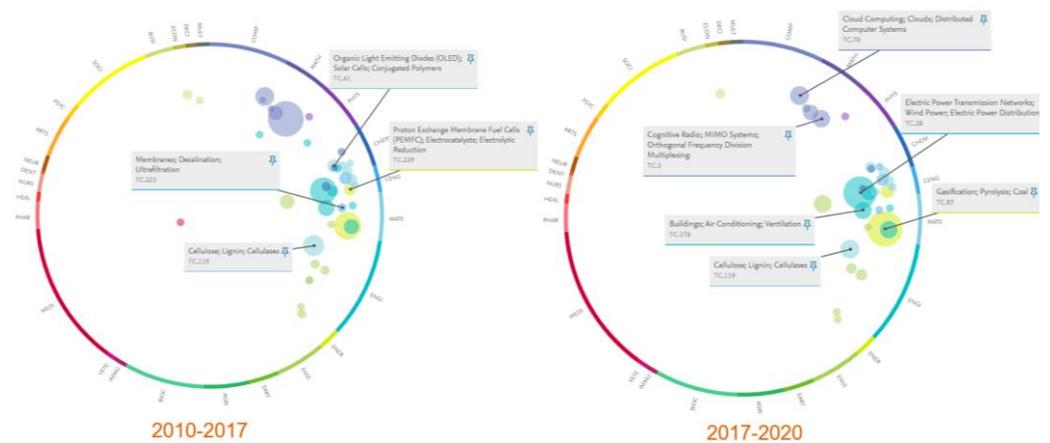


Figure 6. SDG 7, emerged collaboration topics between academic and corporate in Finland

### Challenges for innovation policy

Collaboration between research and industry is an important tool for meeting the SDG objectives. We have strong evidence that collaboration between research and industry in SDG relevant research is more significant than in research overall. The results highlight, compared to other countries, the strong interaction in the Finnish innovation system. The ACC patterns are not, however, stable but change over time. This increases the need for innovation policy to be informed on the collaborative patterns.

The analysis offers the added value of publications meta-data that shows some links to academic corporate collaborations. We should take full advantage of bibliometric analyses methods that can provide a rich contextualization of knowledge production. This contextualization can be valuable in thinking about science policy, not only for ex-post evaluation but also for strategic purposes, such as on priority setting, particularly for mission-oriented research programmes in which societal goals are key policy objectives.

At Finland national policy level, the state has several roles to play in the process of transformation. By re-shaping regulation, standards, strategic directions and visions, political legitimization can help overcome these path-dependencies and reduce uncertainty for the industry and university sector.

It is relevant to notice that this approach of using publication data and bibliometrics does not aim to provide a country-level performance analysis (success or failure) but aim to characterize and provide contextualized information on the research environment and potentials in academic-industry collaborations.

### Proposals for action

Our findings make three proposals for action:

- The motivations of firms across sectors vary when it comes to interact and engage with research organizations. The lack of knowledge on the sectoral

variance in collaboration with research organizations calls for systematic studies and evaluation to shed light on this aspect of smart policy design.

- Analyze in-depth why Finland has an adverse turn in ACC, and how much can be explained by ICT sector activity.
- Analyze in-depth the reasons why SDG related ACC is more impactful in an academic sense and if this is the case for the industry also.
- Analyze the policy instruments and observe the intervention effects on ACC collaborations.

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