SciVal

Case study: VTT Corporate Collaboration

Academia and industry working towards Sustainable Development Goals

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"The organization of the harmonized data in SciVal makes it possible to do all sorts of creative and insightful analysis."

Dr. Arash Hajikhani,
Senior Data Scientist, VTT Technical Research Centre of Finland

Science, Technology and Innovation (STI) plays a crucial role in increasing productivity and growth. Looking beyond the economic impacts, the Daejeon Declaration (2015) after the OECD ministerial meeting highlighted the broader role of STI in enabling "sustainable economic growth, job creation and enhanced wellbeing." The interplay between research organizations and industry plays a vital role in fostering innovation (Cohen 2002) and enabling STI to positively impact the economy and society.

The United Nations Sustainable Development Goals (SDGs) define a practical tool to prioritize actions towards a sustainable future. The SDG framework offers a challenge-driven approach that breaks industrial and disciplinary silos. Using SDGs as a tool to concretize actions and capabilities enables STI actors to mobilize the resources needed to tackle the challenges. Linking SDGs to scientific publications offer a practical vantage point to measure how science impacts SDGs. Further, through quantifying Academic Corporate collaboration we gain a valuable view into knowledge transfer and interplay between STI system actors.

Authors

Dr Arash Hajikhani – Senior Data Scientist, VTT Technical Research Centre of Finland.

Dr Arho Suominen – Principal Scientist and Research Team Leader at the VTT Technical Research Centre of Finland and Industrial Professor at Tampere University.

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"While knowing in detail the dynamics of science, technology and innovation of our base country, SciVal and Scopus enable controlled benchmarking with other countries."

Dr. Arash Hajikhani,
Senior Data Scientist, VTT Technical Research Centre of Finland

A significant body of literature is trying to build an understanding of the relationship between academia and industry (Mansfield & Lee, 1996; Szücs, 2018). 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 the collaboration between academic researchers and companies bears benefits for both parties (Agrawal & Henderson, 2002; Zucker et al., 2002). However, the relationship requires investments from both the research organizations (Suominen et al., 2021) and companies (García-Aracil & De Lucio, 2008), but also from other actors in the innovation system such as public and state fundings. The innovation system needs to facilitate frequent and iterative interactions among all the participating innovative actors, in which academic research organizations and private companies are central. University-Industry collaboration or Academic-Corporate collaboration (ACC) refers to the interaction between any part of the higher educational system and industry aiming mainly to encourage knowledge and technology exchange (Rudi Bekkers & Isabel Maria Bodas Freitas, 2008; Siegel et al., 2003).

Academic corporate collaborations, as determined through co-authorship of publications, have been increasing significantly (https://www.natureindex.com/news-blog/the-shifting-corporate-academic-relationship-in-pictures). According to Scopus, an expertly curated abstract and citation database with content from over 7,000 publishers, the global number of publications co-authored by a research institution and an industry partner is on a steady rise (elsevier.com/products/scival/contact-us)[1].

[1] In analyzing academic-corporate collaborations, 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 indexed in the Scopus® database that have been analyzed using SciVal (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.

In **Figure 1** the overall growth of Academic-corporate collaboration, as a percentage of total publications, from 1996 to 2020 shows different patterns for the United Kingdom (UK), China, United States (US) & Canada and the EU27. Europe (EU27) and North America's (United States & Canada) Academic-corporate collaboration rates,while above the world average, appear to have reached a plateau around 4 and 4.5% respectively, while China and the United Kingdom remain significant contributors to the overall growth with ongoing high growth in rates. Indeed China has grown consistently with rates just surpassing the world average since 2018.

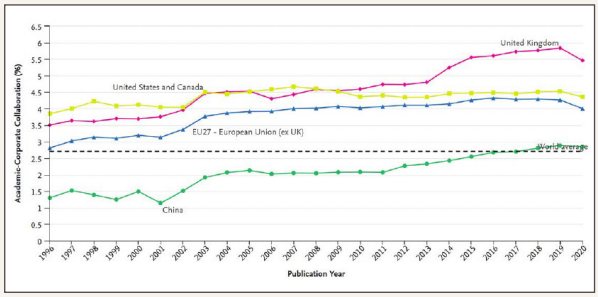

Figure 1: Academic-Corporate collaboration (%) for major global economies for 1996-2020.

Academic-corporate collaboration rates of the UK, China, US & Canada and the EU27 from 1996 to 2020. Analysis shows the academic-corporate co-authorship rates as a percentage of the country or regions total publications for each year measured.

Looking closer at a selected list of countries, we can focus the analysis by benchmarking United Kingdom, Germany, Spain, Netherlands, Sweden, Belgium, Austria, Denmark and Finland. **Figure 2**, shows the proportion of each countries total outputs which include a corporate co-author (Academic-corporate collaboration percentage (X-axis)) versus the number of scholarly outputs (Y-axis), with a trend line to capture the change in academic-corporate collaboration over the period 1996 and 2020.

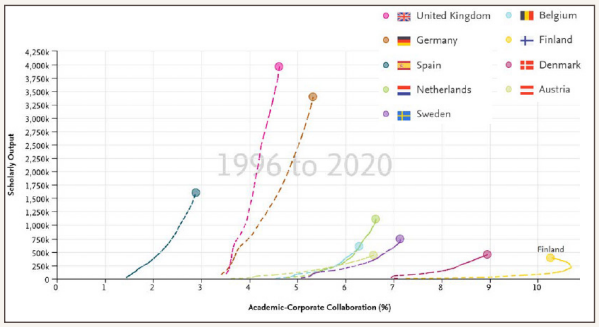

Figure 2: Academic-corporate collaboration (%) over time versus overall scholarly output. Benchmarking UK, DE, ES, NL, SE, BE, FI, DK and AT.

Figure 2, is not adjusted for country economy size or science and technology capacity to also show the more prominent contributors. Interestingly, while the UK, Germany and Spain are the top producers of scientific publications by volume; the rate of ACC is lower than the other countries in the study. On the other hand, while Finland has a higher ACC percentage (above 10%), it is the only country in the sample where a significant turn to less academic-corporate co-authored publications is observed. This is partly explained by the decline in activity within information and communications technology sector in Finland in the late 1990s and early 2000s, where the levels of activity reduced after 2010.

ACC levels in SDG related publications are also rising. However not equally among all SDG areas. **Figure 3**, shows the volume of SDG-related publications globally and their impacts in terms of Citations per Publication. We can see the ACC percentage in the SDG areas varies from around 0.5% to 5% with SDG 7 – affordable and clean energy displaying the second largest volume of articles as well as the highest percentage of total outputs involving ACC. Focusing on impact, measured by Citations per Publication, SDG 3 and 5 have the highest average citation rates.

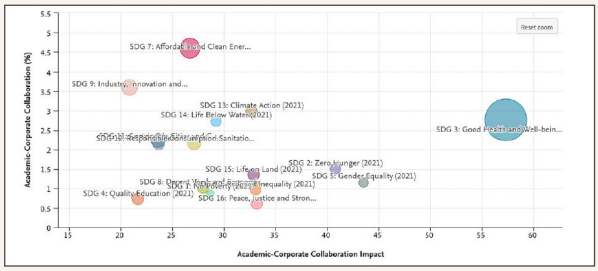

Figure 3: Academic-corporate collaboration (%) within SDG-oriented publications (X-axes) in comparison to the collaboration impact measured by Citations per Publication (Y-axes). The size of the circles indicates the volume of the publications.

Considering each individual country capacity in STI using publication volume as a proxy, we can get a country specific view of their overall publication volumes as well as the proportion of them involving AAC as shown in **Figure 4**. Intrepreting the average trend in ACC of all countries across all research fields from **Figure 4** indicates a slight increase in ACC rates from 5% in 1990s to above 7% in 2016, with the trend appearing to plateau around 7% afterwards.

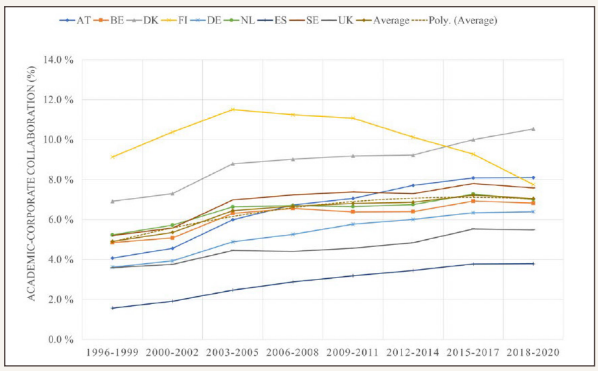

Figure 4: Academic-Corporate collaboration (%) normalized by countries STI capacities across all research fields. Poly. (Average) displays the Polynomial trend line.

Figure 5 however, shows an increase in focus towards the SDGs for ACC's between 1996 and 2020 in the selected countries. The ACC rate in publications related to the SDGs has risen from 5% to nearly 24%, with an 8% variation between the countries analyzed. Finland has the highest collaboration rate of nearly 24% followed by Spain. In comparison, in Belgium and Netherlands ACC rates in SDG related areas is 17%. It is important to note that while ACC appears to have plateaued around 7% in SDG related publications we are seeing increasing ACC in general.

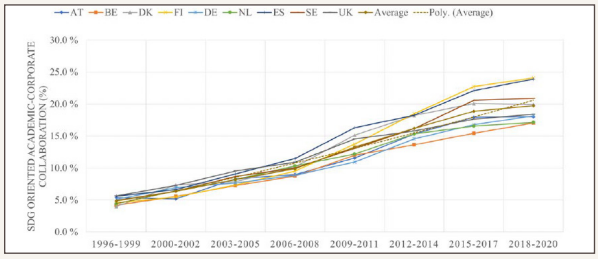

Figure 5: Percentage of SDG related research involving Academic-Corporate collaboration over time, normalized by countries specific overall academic-corporate collaboration capacities using volume of publications as a proxy for capacity. Poly. (Average) displays the Polynomial trend line.

While we see macro-level increases in Academic-Corporate collaborative patterns that highlight the ongoing importance placed on fostering collaborations between academic research organizations and industry, we can also look at the specific SDG category level analysis of countries contributions over time. We took SDG7-affordable and clean energy, which has the highest percentage of ACC. **Figure 6** compares the countries on their contribution to SDG7 related research across year periods.

It is evident from **Figure 6** that countries like Germany and UK have the highest contribution proportionally even though their share appears to be decreasing over time. Meanwhile, countries like Denmark, Spain have shown an increase in their research contribution aligned to SDG 7. **Figure 6** also demonstrates that ACC in Finland has dropped from a high of 9,8% in 1996-1999 to 5,2% in 2018-2020.

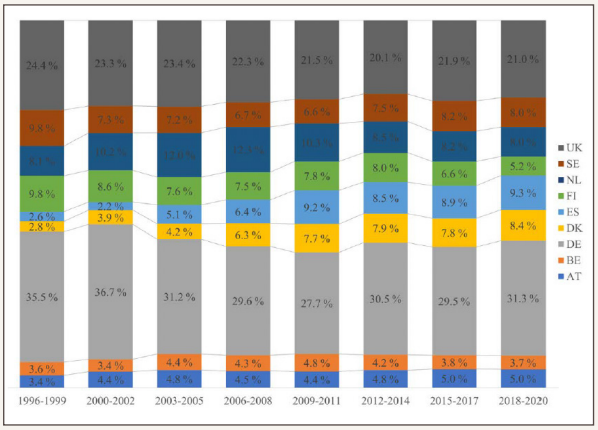

Figure 6: Benchmarking countries contributions towards SDG 7 over time. The pillar for each year period shows individual countries contribution to SDG 7 related research as a percentage of the total SDG publications produced by all countries analyzed.

The next analysis step can go to a micro-level of thematic evolution of academic collaboration rates in SDG related fields using SciVal's Topics of Prominence. Analyzing the publications in Topics related to SDG 7 which included ACC, we can see that over time some Topics where industry and academia used to collaborate have significantly reduced in size or disappeared from the analyses entirely. For example, **Figure 7** shows the thematic orientation of publications involving ACC in Finland for two time periods 2010-2015 and 2015-2020.

SDG 7 oriented publications involving ACC which clustered under Topics such as TC.5 – Climate models, Crystal structures or Controllers in the period 2010-2015, have not seen any ACC collaborations in the more recent period from 2015-2020. In addition, activities in topics such as TC.374 – hydrophobicity and TC.69 polypropylenes have started appearing between the two time periods.

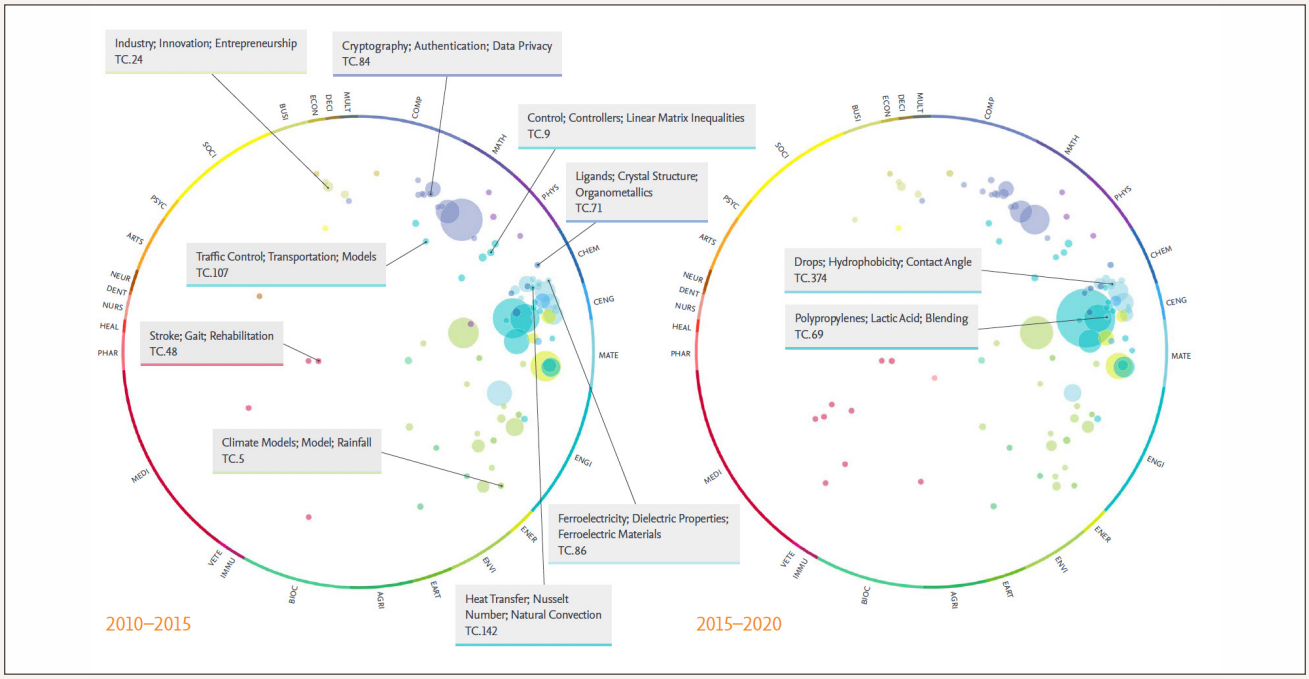

Figure 7: Analysis of Topics related to SDG 7 which involve academic corporate collaboration in Finland and how they have reduced or disappeared over time.

While some topics have reduced or are no longer visible in the analyses, **Figure 8** highlights emerging Topics which include significant levels of ACC, such as TC.87 – Gasification, TC.176 – Ventilation and TC.28 – Electric power transmission networks.

Collaboration between academic research organizations and industry is an important mechanism for meeting the SDG objectives. The analysis demonstrates strong evidence that collaboration between academic research organizations and industry in SDG related research has been increasing significantly compared to ACC rates across all fields, suggesting SDGs are of significant interest to industry.

It should be noted that the analyses presented measure academic corporate collaboration through co-authorships on publications, an outcome which is likely more relevant for the academic research organization. The results also highlight, compared to other countries, the strong integration in the Finnish innovation system. The ACC patterns are not, however, stable but change over time as policies, fields, expertise and knowledge expands. Innovation policy could be informed more fully by collaborative and Topic patterns observed within different parts of the innovation system to help society progress towards achieving critical challenges such as the SDGs.

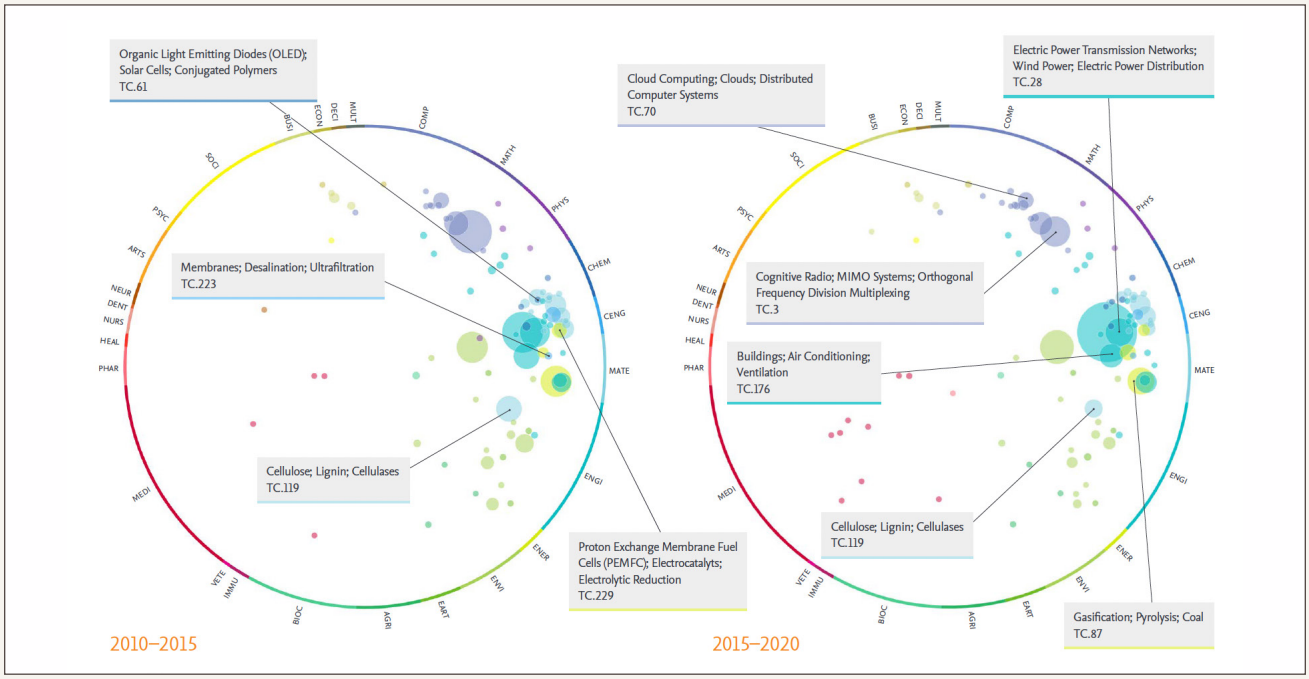

Figure 8: SDG 7, Topics involving ACC in Finland which have emerged in the more recent time period 2015-2020.

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