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“Scientists are, to a large extent, a lost or forgotten “tribe” of academic writers”
(Emerson, 2017)

Introduction and background

What do scientists write beyond scientific publication? How do they communicate their work to actors outside academia, such as those in industry, professional organizations, policy makers, and the general public? These questions motivate this research project, currently ongoing at Chalmers University of Technology: *Scientific communication and metacognition: thinking outside the box*. Starting from the premise that scientists’ communication practices need more attention, this project aims to find out what scientists write, besides articles in scientific journals and academic volumes. In this project, we wish to obtain a detailed and complex picture of the type of texts that scientists produce: the topics they write about, the intended readers, the underlying “genres” under categories such as magazine articles and newspaper articles, and the frequency of their collaboration with other scientists in this kind of “public” writing. While dissemination of scientific knowledge is increasingly relevant, it is easy to assume that scientists are not engaging in it, or not doing it well. But are they?

In 2019, the foundation Vetenskap & Allmänhet published a report from a joint project titled *Jag Vill men Hinner inte*¹ (Bohlin & Bergman, 2019), the result of a funding collaboration among all the major research funders in Sweden: the Swedish Research Council (Vetenskapsrådet), Formas, Forte, Vinnova and Riksbankens Jublieumfond. This document reports on scientists’ views on communication and open science, as collected through a nation-wide survey. The term “Open Science” reflects the increasing demand on academics and scientists to make their findings available and accessible to the public: the most prestigious scientific publishers demand steep subscriptions fees to their journals, and in 2016, EU countries agreed on a common push towards a more open access to scientific knowledge. Indeed, current Swedish legislation requires universities to inform about their activities and “endeavor to ensure that research results obtained at the university are utilized in society”² (cf. Bohlin & Bergman, 2019, p. 9). As the title suggests, however, despite their best intentions few researchers are able to find the time to engage in communication beyond academia.

Academia is also confronted by an increasingly critical and informed public in terms of what research should be pursued and ethical applications of results. The emergence of digital genres concerned with science “edutainment” and the hybridization of existing genres via social media (Mauranen, 2013) have become features of academics’ writing repertoires. McGrath (2016) for example, investigated the collaborative construction via blog of a research article in pure mathematics, and Luzón in multiple

¹ “I want but I don’t have time” (Our translation).

² Our translation. Original quote: ” verka för att forskningsresultat tillkomna vid högskolan kommer till nytta”

publications (2013a; 2013b; 2017) has revealed blogs as a space where genres are recontextualized for different communicative purposes and diverse audiences. As a result, scientists and academics have been under increasing demands to disseminate their work more publicly, what in Sweden has been called “the third requirement”³, placing scientific communication at the forefront. Interestingly, the results of the survey conducted by Vetenskap & Allmänheten, in which 3699 researchers participated, was that “most researchers will devote themselves to communication with society to a higher degree, but are hindered in their efforts by both internal and external constraints, such as the lack of “adequate knowledge and training in communication”, and “which financial resources should support communication activities” (Bohlin & Bergman, 2019, p. 9)⁴. As academia is increasingly confronted with the need to disseminate knowledge in forms that make it more democratically accessible and promote its impact in society, it is crucial to examine *and foster* scientists’ ability to tackle new/challenging communicative situations. It is also important that these initiatives are grounded in scientific evidence about what works.

Despite the fact that writing well is crucial for publication and hence a successful academic career, scientists’ communicative skills are often untrained, painstakingly absorbed through practice, and frequently inadequate to meet the demands of scientific knowledge dissemination of modern universities. Although this is an important mandate, communicative abilities are weak and undervalued in the training of future scientists. Writing is central for a successful career and institutional excellence (Carli, Tagliaventi & Cutolo, 2018), yet, research shows that scientists lack adequate training in writing and communication (Emerson, 2017). For emergent scientists, the pathway towards writing expertise is typically implicit and unstructured, depending on the affordances of their immediate research context and the availability of supportive colleagues and supervisors (Dysthe, 2002; Florence & Yore, 2004)—a situation that often results in anxiety and fear (Aitchinson, Catterall, Ross & Burgin, 2012). In Sweden, the media and professional outlets have emphasized that writing skills are often poorly developed among doctoral students and junior researchers (cf. Ilar, 2019).

Universities in Sweden have approached the problem through their own initiatives, ranging from the creation of academic writing centers to workshops and science festivals, to the recruitment of “writers in residence” (Östlund, 2017). While none of these initiatives are inherently ineffective, they are not often based on current research on the development of academic/scientific writing expertise, for instance from applied linguistics or cognitive science. Additionally, this kind of initiative tends to place the responsibility for the development of communicative skills on the individual researcher, thereby shifting the focus from the lack of a systematic, research-based and university-wide attention to the development of writing and communication in science (Chalmers is an exception in this respect, having had a division for language and communication for more than 20 years that employs teachers/researchers in academic and technical

³ Our translation. “Tredje uppgiften”

⁴ Our translation. Original quote, in full: “Som helhet visar enkäten en bild där forskare vill ägna sig åt kommunikation med det omgivande samhället i högre grad än idag, men hindras av både inre anledningar; som att de saknar kunskap och utbildning i kommunikation, och yttre; som att det idag är oklart vilka resurser som ska finansiera kommunikationsaktiviteter.

writing who work in close collaboration and in integration with a number of programs). In addition, initiatives towards the development of communicative skills in scientists should be grounded in an explicit description of, or at least a reflection on, what kind of role as “public intellectual” (Said, 1995) institutions expect scientists to take (and how to support them in their professional development). As Wadstein MacLeod (2019) points out, building a public “pedagogue” persona requires an investment in time, energy and resources that few scientists can afford.

This situation provides the background for this project, which in 2019 was awarded funding within the GENIE initiative for equality at Chalmers University of Technology. The overall aim of the project is to gain an in-depth understanding of scientists’ communication outside of academia:

- 1) What kind of writing scientists are doing, beyond article publication; and
- 2) How they think around these writing tasks: their metacognition when writing open science

The project runs for two years and has two phases: the first phase entails mapping out the types of publications that scientists at Chalmers engage in, including topics, collaborations, genres and possibly languages; the second phase investigates in depth these practices through interviews with relevant “cases” identified in the first phase. This report documents the preliminary findings of the first phase. The overarching aim of this project is to foreground scientists’ own perspective about communication of science, providing important insights about challenges and effective practices, and offering a research basis for the development of educational interventions to train future scientists to disseminate their knowledge clearly, effectively, and creatively.

Method

The first phase of this project, whose results are reported here, aims to identify and describe the type of non-academic written genres that scientists are currently producing. The starting point was the scientific communication output available through Chalmers' research database, which is publicly accessible. Currently, this database includes considerable output in relevant categories such as magazine articles (2,374 as of May 2020) and newspaper articles (70). We chose to include only publications from 2015-2019, in order to have a recent picture.

The objective is to compile a general descriptive map of these texts, applying the rhetorical analysis methods used in genre studies (Swales, 1990) to identify topic, purpose, and audience.

Chalmers research

Research.chalmers.se is Chalmers current research information system (CRIS), a database to store, manage and exchange metadata for research activity connected to Chalmers. In research.chalmers.se anyone can find information about research at Chalmers, projects, persons and publications.

Chalmers Library registers all scientific publications that are published in journals indexed by the citations databases Scopus and/or Web of Science. They are prioritized since they are used in bibliometric analyses and follow ups, at Chalmers as well as by national and international organizations. *Thinking Outside the Box* uses metadata from magazine articles and newspaper articles. Those are publication types that are registered by the authors themselves. As they are registered voluntarily, it is difficult to estimate how well this publication type is covered by research.chalmers.se.

Co-authorship analysis and network graphs

Co-authorship analysis is a method used within the field of bibliometrics to study research fields. Who are the key actors of the research field? Are there actors who are more influential than others? Actors who link different groups of authors together (bridges)? Are there clusters of authors within the networks? What are these groups of authors writing about? Are there authors who write interdisciplinary publications, i.e. with authors from other parts of the network? Those are questions typically answered by co-authorship analysis.

Co-authorship networks are visualized as graphs. Graphs are mathematical models of things (nodes) and their relationship with one another (edges). In co-authorship networks, authors are nodes and they are linked by co-authored publications (edges). Centrality measures, derived from graph theory, will indicate which authors have collaborated the most, and who are the most influential actors of the network (Powell, 2015, p. 79-80). Authors that have a high degree of centrality collaborate more in relation to other authors in the network. Co-authorship networks have been visualized for the Department of Architecture and Civil Engineering (ACE), and for the Department of Space, Earth, Environment (SEE)

using publications metadata from research.chalmers.se for publications published 2015 - 2019. The networks were visualized using the visualization and exploration software Gephi (Bastian, Heymann & Jacomy, 2009).

Qualitative analysis of the data

The data collected under the database categories *Magazine* and *Newspaper articles* was analyzed qualitatively to identify the most common genres and topics. This qualitative analysis adopted primarily a content analysis focus (Schreier, 2012; Cho & Lee, 2014) in combination with preliminary genre analysis, to identify intended audience and communicative purpose of the texts.

Content analysis started as a quantitative methodology, but in recent years has been increasingly used qualitatively to describe the main topics and content of a variety of oral and written data sources. In this project, we adopted qualitative content analysis as a method for “systematically describing the meaning of qualitative material” (Schreier, 2012, p. 1) to identify the main topics of the publications in our dataset and identify preliminary categories and areas of focus on the basis of this content. Qualitative content analysis has been successfully used to analyze newspaper and magazine articles in the past. It adopts a systematic process of classification based on the content of data sources. In our case, we adopted an inductive approach, deriving the classification progressively from the data, primarily by looking at manifest characteristics of texts (title and other signposting, abstracts, type of publication venue) and to an extent to latent meaning, which require a preliminary interpretation (area of interest, type of content presented) (Cho & Lee, 2014). Similar to other constant-comparative methods of qualitative analysis, content analysis requires a systematic process and a comparison of categories, but its primary aim is to describe the meaning of materials in a systematic way in response to research questions (rather than identifying relationships, as in grounded theory), and extract categories from the data. Since our research question at this stage is “what kinds of writing scientists are doing, beyond scientific publication?” qualitative content analysis was an ideal first step in the analysis of our data.

In addition to content analysis, we applied some of the principles of Genre analysis (cf. Swales, 1990), mostly to understand the socio-rhetorical dimensions of the texts in our data set, beyond topic and content. Genre analysis is a method stemming from genre studies, a major area of in applied linguistics in the past 30 years or so, which has generated some of the most successful pedagogies of academic writing. Similar to discourse analysis, it is based on an approach to the study of language that takes into account the social and contextual dimensions around the linguistic “act”. In brief, genre analysis aims to inductively identify recurrent types of communication that target a specific purpose and audience. While formal aspects of a text tend to become characteristics of a genre (including a certain register), these are by no means fixed and thereby do not necessarily indicate a genre, which is rather better characterized in terms of recurrent rhetorical moves that help to fulfil the genre’s social motive (Miller, 1984). Note that the idea of “recurrence” as the basis for genre characterization is fundamentally a social idea: while each text is unique, and therefore different, what recurs is the social occurrence which needs to be familiar *both* for the writer and the intended readers/audience: “What recurs is not a material situation (a real,

objective, factual event) but our construal of a type. The typified situation, including typifications of participants, underlies typification in rhetoric. Successful communication would require that the participants share common types; this is possible insofar as types are socially created" (Miller, p. 158). While the primary purpose of this study is not to identify and classify genres of "public science", three pre-requisites for genre (following Miller, 1984) were taken into account in the preliminary analysis of the texts in our dataset: 1) the presence of systematic similarities in content and form; 2) the fact that the text fulfils a socially recognized purpose *and* situation, shared by author and readers; and 3) the text represents a form of social action rather than being produced to fulfil requirements for policy or law.

This first-stage content/genre analysis for instance highlighted that under the same category of text many possible types of texts could be included, with the debate article as a possible contender for the definition of genre. However, this will need to be verified in further analysis.

Types of publication, audience, and topics

The project began with an analysis of the publication categories listed in Chalmers' publication database: Research@Chalmers.se. Two categories were considered relevant and contained a large enough data set: *Magazine articles* and *Articles in Newspaper*. These categories overlap, and newspaper articles were categorized as magazine articles for the first couple of years included in this report. In total, 506 publications dated 2015-2019 were examined.

A few types of publications are easily distinguishable. Four types of easily distinguished and common publications are presented in table 1.

| Type of publication | Number of publications |
|---|------------------------|
| Debate articles | 113 |
| Editorials in newspapers | 30 |
| Editorials in scientific journals or in conference proceedings | 21 |
| Articles communicating research or current understanding to professionals | 58 |

Table 1: Four easily distinguishable and common types of publications within the categories magazine articles and newspaper articles from 2015-2019

As shown in table 1, the most common type of publication is debate articles, with 113 publications. Responses to debate articles, in which the authors did not initiate the debate but respond to someone else's debate article, are included in this type. Some other articles are similar to debate articles, for example when a newspaper has invited a researcher to write about a topic and the researcher has written a text that is in many ways similar to a debate article, with the clear intention to influence the audience by presenting an argument or point of view on the topic. Those articles are however not categorized as debate articles in this report. The majority of the debate articles are published in newspapers. For example, Anna-Johanna Klasander, Claes Caldenby, Meta Berghauser Pont and Ola Nylander wrote a debate article about urban design in Gothenburg *Göteborgs-Posten* in January 2018. In the same newspaper, Christian Azar from Space, Earth and Environment wrote another debate article together with Thomas Sterner from University of Gothenburg about fossil fuels in 2018. *Göteborgs-Posten*, *Dagens Nyheter* and *Svenska Dagbladet* are common newspapers in our data, where many of the

debate articles have been published. There are however also debate articles published in magazines intended for professionals, mostly architects. For example, Lars Marcus wrote an article about sustainability and architecture in the architecture magazine *Arkitekten* in December 2018. Another example, not within architecture, is a debate article in the magazine *NyTeknik*, a magazine intended for engineers and similar, where Per-Olof Arnäs and Christian Sandström from the department Technology Management and Economics argue that we have to train the engineers of the future in a new way. This shows that even though the majority of debate articles are connected to Architecture and Civil Engineering (40 debate articles) or to Space, Earth and Environment (56 debate articles), scientists from other departments also write debate articles sometimes.

References to the examples:

Klasander, A., Caldenby, C., Berghauer Pont, M., & Nylander, O. (2018). *Tät blandstad passar inte överallt i Göteborg*. gp.se. Retrieved from <http://www.gp.se/debatt/t%C3%A4t-blandstad-passar-inte-%C3%B6verallt-i-g%C3%B6teborg-1.5010509>.

Azar, C., & Sterner, T. (2018). *Ju förr vi blir fossilfria desto bättre för alla*. gp.se. Retrieved from <http://www.gp.se/debatt/ju-f%C3%B6rr-vi-blir-fossilfria-desto-b%C3%A4ttr%C3%A4re-f%C3%B6r-alla-1.7705515>.

Marcus, L. (2018). *"Vi har missat hållbarhetståget" - Arkitekten*.se. Arkitekten.se. Retrieved from <https://arkitekten.se/debatt/vi-har-missat-hallbarhetstagnet/>.

Arnäs, P., & Sandström, C. (2019). *"Vi måste utbilda framtidens ingenjörer på ett nytt sätt"*. Ny Teknik. Retrieved from <https://www.nyteknik.se/opinion/vi-maste-utbilda-framtidens-ingenjorer-pa-ett-nytt-satt-6960888>.

Some scientists, for example Claes Caldenby, Lars Marcus, Christian Azar and Charlotta Thodelius, have contributed to many debate articles. Overall, 52 different scientists have contributed to debate articles. Another interesting observation is that scientists seem to stay fairly close to topics related to their research. In addition, almost all debate articles are connected to only one department in the database, suggesting that it is not very common to engage in this type of publications across departments and research fields.

As opposed to debate articles, the editorials in newspapers are all written by the same scientist, Tomas Kåberger, and published in the same newspaper: *ETC* or the local version *ETC Göteborg*. A common theme is the climate crisis and different topics related to it, which is not very surprising as this scientist works at the department Space, Earth and Environment. One example is an editorial from 2017 about the development of renewable energy sources, saying that Donald Trump cannot stop that development.

Reference to example:

Kåberger, T. (2017). *"Trump kan inte stoppa den förnybara energiutvecklingen"*. ETC Göteborg. Retrieved from <https://goteborg.etc.se/ledare/trump-kan-inte-stoppa-den-fornybara-energiutvecklingen>.

The editorials in scientific journals or conference proceedings are instead written by a variety of scientists from many different departments at Chalmers. For example, Magnus Gustafsson at the department of Communication and Learning in Science co-wrote an editorial in a special conference issue of the *Journal of Academic Writing* in 2016. Tünde Fülöp from the physics department has co-authored an editorial in the *Journal of Plasma Physics*, in a special issue about “Energetic electrons in space and laboratory plasmas”.

References to examples:

Petric, B., & Gustafsson, M. (2016). Editorial: Selected Papers from the 8th Conference of the European Association for the Teaching of Academic Writing, Tallinn University of Technology, Estonia, June 2015. *Journal of Academic Writing*, 6(1), ii-vi. <https://doi.org/10.18552/joaw.v6i1.373>

Fülöp, T., & Robinson, A. (2016). Special issue: Energetic electrons in space and laboratory plasmas. *Journal of Plasma Physics*, 82(2), 471820201. <https://doi.org/10.1017/S0022377816000337>

Finally, the articles communicating research or current understanding (state of the art) to professionals are mostly on topics related to architecture or civil engineering and published in trade journals such as *Bygg & Teknik* and *Tidningen Arkitekten*. For example, Liane Thuvander and Paula Femenias co-wrote an article in *Bygg & Teknik* together with two people from RISE in 2015, in which they communicated the results of an interview study about sustainable renovation.

Reference to example:

Femenias, P., Thuvander, L., Norling Mjörnell, K., & Lane, A. (2015). Koll på hållbar renovering. *Bygg Och Teknik*, 2015(2), 30-34.

In addition to these types of publications, the categories magazine articles and newspaper articles also include an assortment of various texts: texts in newspapers that are not debate articles or editorials, other types of texts in professional journals (most often about architecture), a few book reviews, a few blog posts, articles about boats and maritime science in a lifestyle magazine, a few interviews with other scientists, a few reports of various types, and finally publications in scientific journals that are neither peer-reviewed scientific articles nor editorials.

The next step in the analysis was to identify the audience of the texts categorize under *Magazine* and *Newspaper articles*. Who is the potential intended reader of these communications?

| Intended audience | Number of publications |
|--------------------------|-------------------------------|
| Scientists | 153 |
| Professionals | 135 |
| General public | 162 |

Table 2: Number of publications intended for different audiences. Note that some publications were classified as intended for several audiences and that some were not classified at all, as it was unclear who they were intended for.

We identified three main categories of audiences: scientists, professionals and the general public. The publications intended for scientists are to a large extent publications in scientific journals that are non-peer-reviewed scientific articles. The publications intended for professionals are often communicating research or current understanding, often within architecture or civil engineering. An example from the department Architecture and Civil engineering is an article about a research project about green roofs (i.e. roofs with plants on them) by Angela Sasic Kalagasidis, Kaj Pettersson and Pär Johansson in the trade magazine *Bygg & Teknik*. They describe their project and its potential use. Other publications intended for professionals range from articles about the history of architecture or a building to articles about properties of different materials used in construction. A common purpose seems to be to disseminate knowledge and affect practice, but which professionals are targeted varies, as suggested by the broad range of topics. There are also articles that do not relate to architecture or civil engineering. Interestingly, the department Space, Earth and Environment have only a few publications intended for professionals. One of the few examples is an article in *Land Lantbruk* written by Fredrik Hedenus and Stefan Wirsenius where they respond to a debate article about climate taxes and biodiversity. The journal is published by the Federation of Swedish Farmers. Many of the publications included in the last category, general public, are debate articles, but not all. These texts are published in places where they can be read by anyone, for example in newspapers, and we can presume that they address laypeople as well as policymakers, professionals, or anyone interested in the topic. The debate articles published in *Göteborgs-Posten* mentioned earlier in this report are examples of this type of publication. As shown in table 2, all three identified audiences were common.

References to examples:

Hedenus, F., & Wirsenius, S. (2017). "*En klimatskatt kan främja biologisk mångfald*". Land Lantbruk.

Retrieved from <https://www.landlantbruk.se/debatt/en-klimatskatt-kan-framja-biologisk-mangfald/>

Johansson, P., Sasic Kalagasidis, A., & Pettersson K., Krajnovic, S., & Kjellström, E. (2016). [Tak i urbana miljöer för att minska risken för översvämning vid skyfall](#). Bygg Och Teknik, 2016(4), 48-50.

A few common themes emerged after analyzing the topic of each publication. For example, the aforementioned debate article about urban design as well as the article communicating the results of a study on sustainable renovation were both categorized into the theme "Architecture, Civil engineering, Urban design, and similar". Similarly, the debate article about fossil fuels was categorized into "Global warming, Renewable energy resources and similar". Some publications combine topics from different themes, for example a debate article written by Fredrik Hedenus and Stefan Wirsenius about meat production being positive both for the environment and health. This publication is therefore included both in the global warming theme and the theme "Medical Science, Healthcare, Nutrition and similar". Two themes, related to architecture and global warming, were far more common than any other.

In table 3, the most common themes are presented.

Reference to example:

Hedenus, F., & Wirsenius, S. (2019). "*Mindre kött är bra för både miljö och hälsa*" | SvD. SvD.se. Retrieved from <https://www.svd.se/mindre-kott-ar-bra-for-bade-miljo-och-halsa>.

| Themes / topics | Number of publications | Comment |
|--|------------------------|---|
| Architecture, Civil engineering, Urban Design, and similar | 133 | Many about architecture in professional journals but also many about urban design (44 publications), whereof 29 debate articles |
| Global warming, Renewable energy sources and similar | 116 | Many debate articles and editorials in newspapers, but also other types |
| Medical Science, Healthcare, Nutrition and similar | 34 | Most of them similar to scientific articles |
| Biology, Molecular Biology, Biophysics and similar | 30 | Most of them similar to scientific articles |
| The History of Architecture, Technology, Chemistry, or similar | 29 | A variety of publications intended for different audiences |
| Chemistry or similar | 23 | Mostly various types of publications intended for scientists |

Table 3: Most common themes/topics and description of the publications within these topics.

An interesting observation is that, similarly to what we observed about intended audience, publications with topics related to architecture and civil engineering were often intended for professionals but sometimes for anyone, while publications with topics related to global warming often were debate articles intended for the general public. The remaining publications cover a broad variety of topics. For example, there are 11 publications that to some extent discuss life as a scientist rather than science, or about both. For example, Pernilla Wittung Stafshede (Biology and Biological Engineering) has written blogposts about life as a female scientist, including one titled “Is the gender gap solved in liberal Sweden” at *stemwomen.net* where she uses both personal anecdotes and research to argue that gender biases still exist in academia, even in Sweden. This category also includes a series of interviews with scientists by Robert Cumming (Space, Earth and Environment) in a popular science magazine about astronomy. The interviews are both about astronomy and about the personal “pathways” of the scientists. For example, one scientist explains how the pathway to science stemmed from a fascination with Star Wars as a child.

References to examples:

Wittung Stafshede, P. (2016). Is the Gender Gap Solved in Liberal Sweden? [Blog]. Retrieved from <http://www.stemwomen.net/is-the-gender-gap-solved-in-liberal-sweden/>

Cumming, R. (2017). Sverige borde leda inom internationell rymdpolitik. *Populär Astronomi*, 2017(1), 38-40.

Interestingly, two debate articles are about scientists writing debate articles. In one of these articles, Jan Petter Hansen and Fredrik Hedenus defend their colleague Stefan Wirsenius (Space, Earth and Environment) and criticize interest organizations for accusing him of inaccurate conclusions that can be drawn from his research, without examining the methods and results of the research. The other debate article of this type is written by Christian Gadolin and Erik Eriksson and tries to explain why scientists often do not engage in the public debate. They have three explanations: (1) that the debate climate is such that shorts texts trying to convince are preferred over longer and more nuanced texts, which is what scientists are used to; (2) a lack of interest from nationwide media in “unknown” researchers; and (3) that academia itself does not encourage researchers to engage in the public debate.

References to examples:

Hansen, J.P., & Hedenus, F. (2019). "Argumentera i sak – förtal av forskare är ovärdigt". Göteborgs-Posten. Retrieved from <https://www.gp.se/debatt/argumentera-i-sak-f%C3%B6rtal-av-forskare-%C3%A4r-ov%C3%A4rdigt-1.13474301>

Gadolin, C., & Eriksson, E. (2019). "Därför avstår forskarna från offentlig debatt". Göteborgs-Posten. Retrieved from <https://www.gp.se/debatt/d%C3%A4rf%C3%B6r-avst%C3%A5r-forskarna-fr%C3%A5n-offentlig-debatt-1.15834906>

To summarize, it is clear from our findings that the two categories of *Magazine articles* and *Newspaper article* are very broad, encompassing not only a great variety of topics but also an equally great variety types of publication and intended audience. For example, some publications such as the editorial are very similar to peer reviewed scientific articles (and can hardly qualify as public communication of science, but rather correspond to an established academic genre), while some publications are definitely addressed to a general public.

Overall, it is clear that these categories also belie a wide variety of social practices of communication to which researchers participate, with different purposes and patterns of collaboration (both within their discipline and across disciplines). As such, these social practices may require researchers to be able to present themselves with different “public intellectual” personas (Said, 1995), from the “expert” to the “educator”. The construction of such a persona in a text requires advanced writing expertise, scientific authority, and time. Not surprising, the researchers who seem most engaged in publication practices “beyond academia” are established, tenured researchers, with an expert mastery of Swedish.

Another consideration is whether these publications could be categorized into recognizable genres. As pointed out by genre analysis (Swales, 1990), genres are types of communicative events that serve a clear

communicative purpose and are recognized as such by a discourse community. In addition, especially in the rhetorical tradition (Miller, 1984), a type of communication can be called a “genre” only if there is a social recognition of its communicative purpose, its “exigence”. In this perspective, the two categories analyzed in this report—*Magazine articles and Newspaper articles*—are clearly not genres. However, some sub-types within these categories may qualify as genres. One such contender is the (scientific) debate article: despite a relatively broad audience, it is a recurrent type of communicative act whose social exigence seems to be quite well understood, and this sub-category may therefore be worth further scrutiny from a genre analysis perspective. Another contender is the magazine article in professional publications (especially in architecture): in this case, the discourse community could be relatively established (experts in the area with specific technical knowledge and interest, operating both within and outside academia) and the purpose (informing about innovative/state of the art scientific knowledge) is also potentially mutually recognized by writers and readers.

Departments and People

As the previous section suggests, some departments at Chalmers seem particularly active in relation to communication of science beyond academia, at least when analyzing the publications under *Magazine* and *Newspaper articles*: Architecture and Civil Engineering, and Space, Earth and Environment, as seen in figure 1.

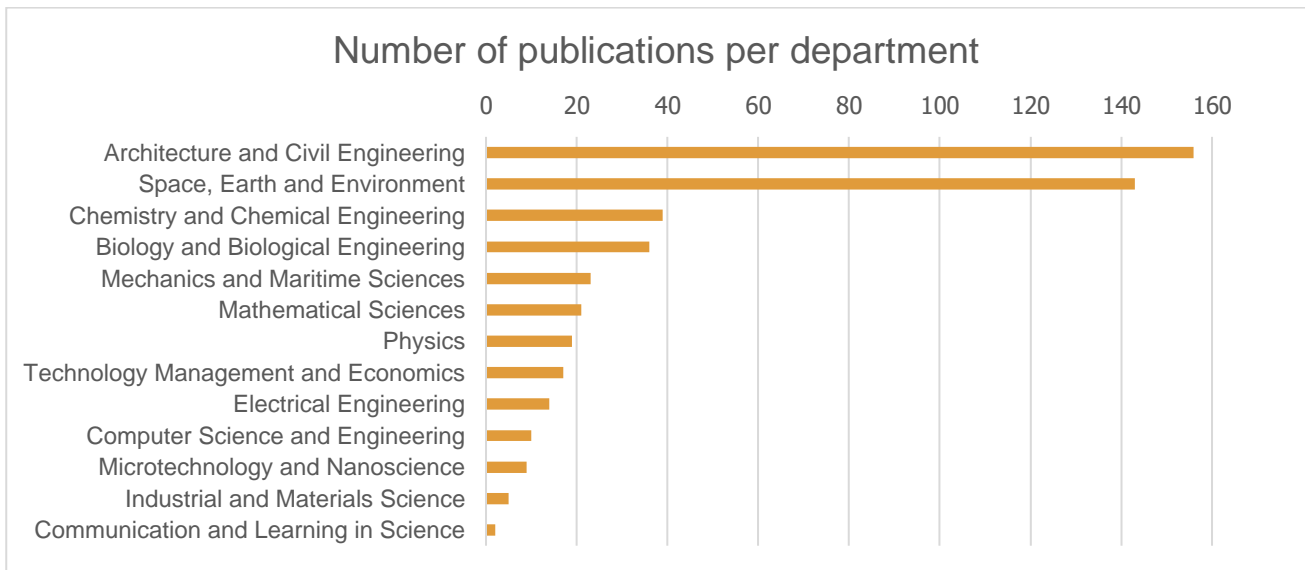


Figure 1: Number of publications per department

At the same time, some scientists in these two departments engage far more in this type of publications, bringing up the total number of publications per department. The median number of publications per author in our data set is 1, but the average is 2.2 publications. 15 scientists have contributed to more than 1 percent of the publications each, i.e. at least 8 publications (see figure 2). Note that some of these scientists have co-authored publications. Collaborations are addressed later in this report.

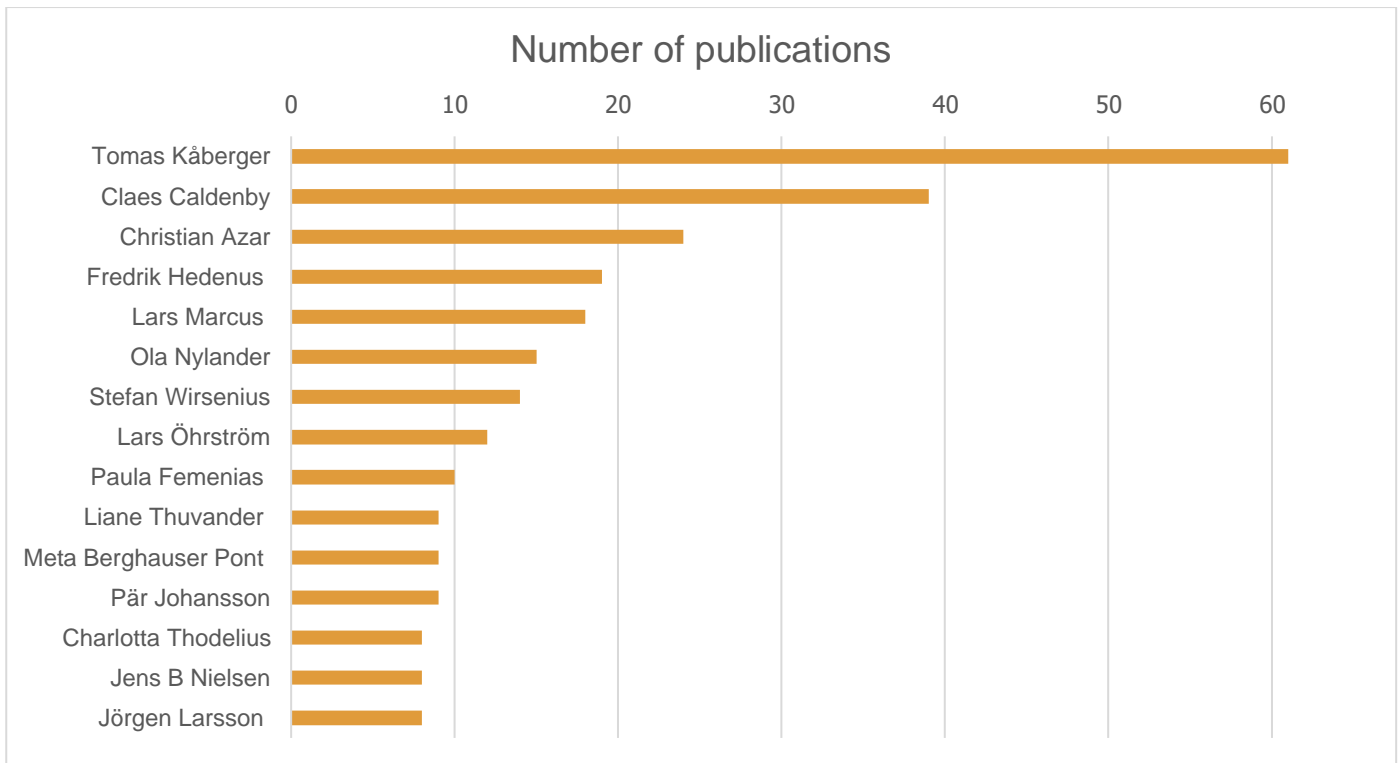


Figure 2: Number of publications per scientist for authors who contributed to at least 1 percent of the publications in our data

The scientists with the highest number of publications have mostly written single authored publications. For example, almost all of Tomas Kåberger’s publications are single authored. One reason for his high number of publications is his affiliation with the newspaper ETC, in which he has published 30 editorials and also some debate articles. Note that his publications make up almost half of the publications by scientists from the department Space, Earth and Environment (Fig. 1). A similar pattern of mostly single authored articles can be seen for two other scientists in figure 2: Claes Caldenby (Architecture and Civil engineering) and Christian Azar (Space Earth and Environment). It is interesting to note that also among the top contributors in our data it is possible to trace the pattern of themes described in the previous section of this report: scientists from Space Earth and environment tend to write debate articles related to global warming, and scientists from Architecture and Civil Engineering tend to write articles published in magazines for professionals. Caldenby and Azar both fit into this pattern, while Kåberger only partly does.

It is important to note also that several of the most productive authors have written many of their publications in collaboration with others. Fredrik Hedenus, Stefan Wirsenius, and Lars Marcus are examples of scientists who have both many single authored and many co-authored publications; Hedenus and Wirsenius in debate articles on topics related to global warming and Marcus in debate articles about urban design. Marcus has co-authored many debate articles with another scientist in also appearing in the list in Fig. 2: Meta Berghauser Pont. The clearest example of collaboration in this type of publication is the one between Paula Femenias and Liane Thuvander, who have written most of their

publications together, typically about renovation in professional magazines. Pär Johansson and some other scientists have also co-authored with Femenias and Thuvander.

Another notable point is that most scientists in Figure 2 completed their PhD a relatively long time ago and are presumed to be established academics. The exception is Charlotta Thodelius from Architecture and Civil Engineering. Thodelius defended her doctoral thesis in 2018, suggesting that she engaged in communication beyond academia already as a PhD student, a practice that seems very uncommon in our data. She has also co-authored almost all her publications with people outside of Chalmers.

Finally, Lars Öhrström at Chemistry and Chemical Engineering is the scientist with the highest number of publications in these categories outside Architecture and Civil Engineering or Space Earth and Environment. All his publications are single authored, but the types of publication vary. He has published in *Science*, *Nature Chemistry* and *Kemivärlden*, but also in a newsletter for chemistry teachers. Many of his publications seem to have an educational intent, rather than contributing to a debate.

As can be seen in figure 2, the gender distribution for publications in *Magazine article* and *Newspaper article* reflects the gender distribution at Chalmers University of Technology, with a clear over-representation of male faculty. Accounting for differences among departments and academic rank, the percentage of female faculty in tenured positions ranges between 17% to 33% ([Genie Gender Report 2018 Part 1](#)). This proportion seems to correspond to the gender distribution among the authors in our data, with 75% men and 25% women (see figure 3)

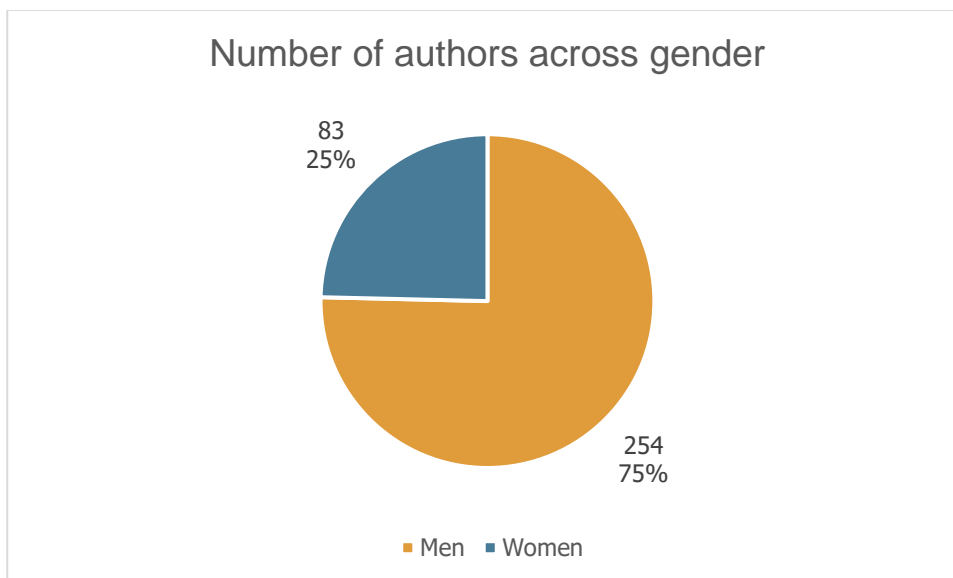


Figure 3: Number of authors in our data across gender. Note that gender is assumed from the authors' profiles and does not denote their preferred gender identification. Four scientists were excluded as we could not deduce gender from their profiles.

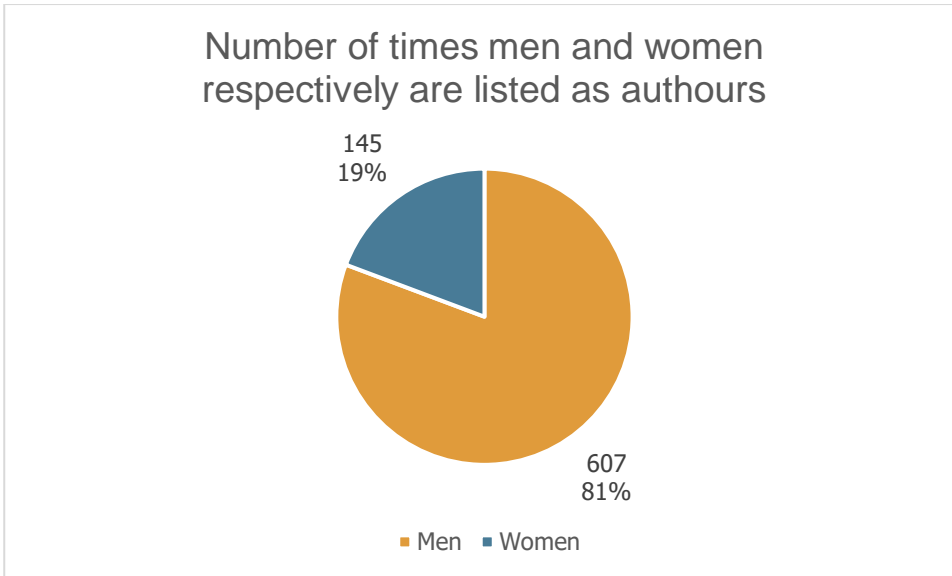


Figure 4: Number of times men and women respectively are listed as authors. Tomas Kåberger is included 61 times because of his long-term editorial engagement (skewing the data slightly). The figures without Kåberger result to 145 (21%) total for women, and 546 (79%) for men.

The difference is however slightly larger for the number of times men and women respectively are listed as authors, suggesting that men on average contribute to more publications of this type than women. In this analysis, Tomas Kåberger was for example included 61 times. As can be seen in figure 4, the percentage of men is 81 and of women 19.

A closer look at two departments

Our analysis of popular communication texts indicates that two departments at Chalmers are particularly active, worth of closer inspection: Architecture and Civil Engineering (ACE), and Space, Earth and Environment (SEE). The communicative production “beyond academia” of these two departments is presented here.

First of all, it needs to be underscored that while both these two departments are particularly productive, each of them presents a very unique profile in terms of topic, collaborations, and types of texts produced. This uniqueness is presumably tied to the nature of the scientific work carried out in these departments, including the “local culture” of ontologies, epistemologies, and values.

These different profiles also reflect the increasing degree and complexity of interdisciplinarity in scientific work. It has been argued that discipline should no longer be seen as the central way of understanding academic work (Manathunga & Brew, 2014) in light of the growing recognition that many “real world” problems require interdisciplinary solutions. Indeed, there has been a significant shift from knowledge constructed and defined within universities in clearly demarcated disciplinary areas, towards knowledge influenced by governmental, economic and public agendas (Brew & Lucas, 2009). Increasingly, engineers from different backgrounds work across the globe to solve environmental and social problems, and researchers produce work which has an impact on industrial applications and organizational culture. The analysis of the public science production of these two departments illustrates in part this new academic reality.

Co-authorship analysis – Architecture and Civil Engineering

The co-authorship graphs presented below represent authors of *Magazine* and *Newspaper articles* registered in research.chalmers.se in the period 2015-2019. All publications are affiliated to Chalmers, but the individual authors may have any affiliation (any department at Chalmers, as well as any organization other than Chalmers). The first graph is based on publications affiliated to the department of ACE and the second graph represents publications affiliated to the department of SEE. Each node represents an author and a line (edge) between two authors indicates that they have co-authored at least one publication. Since this graph relies on co-authorship, only authors who have collaborated on at least one publication are included. The size of the nodes is determined by the network statistics called “degree centrality”. An author with high degree centrality is well connected to the other authors of the network, through direct or indirect relations. The thickness of the edges is determined by number of co-authored publications, i.e. authors who have co-authored many publications have a thick line between them.

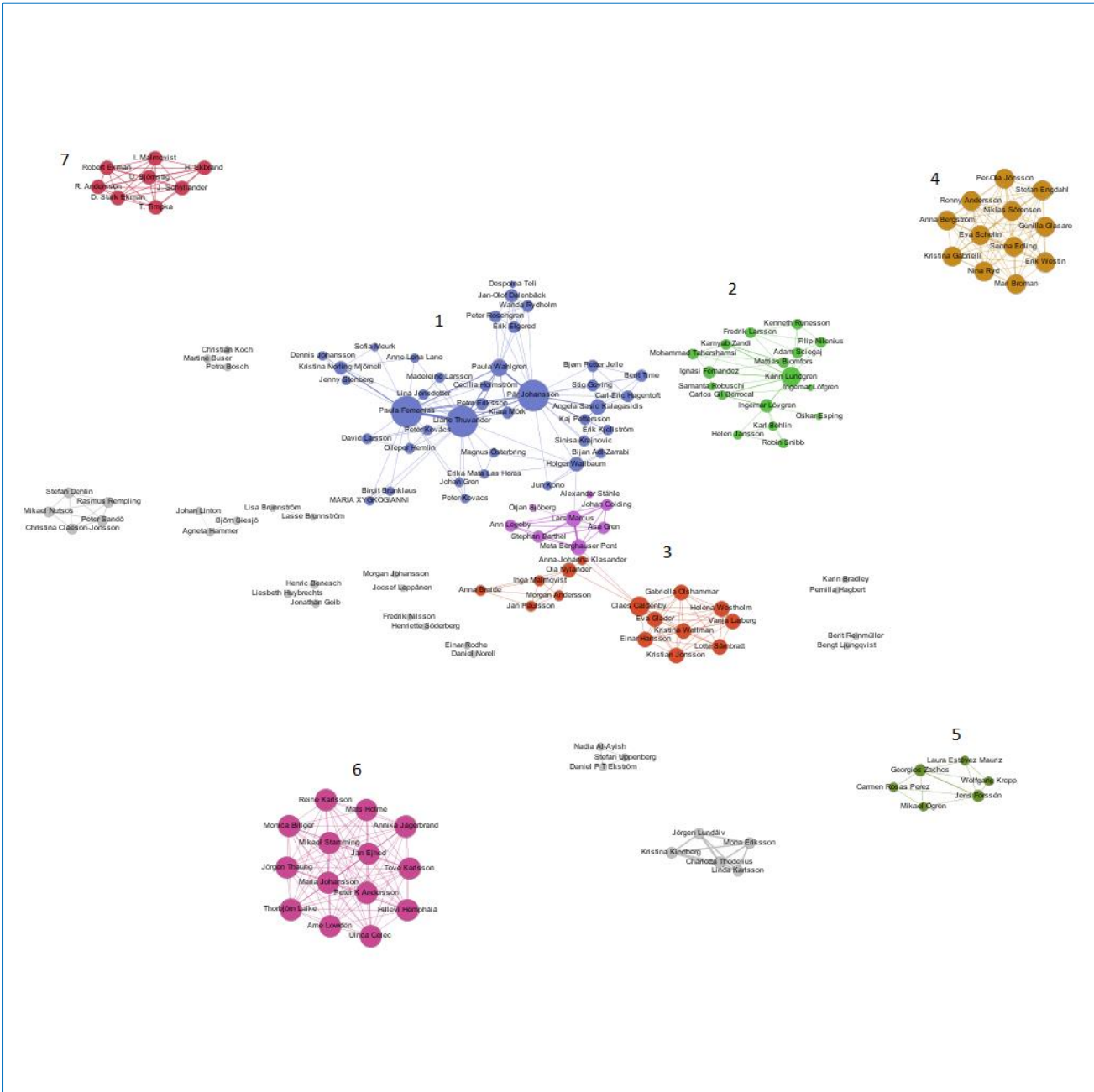


Figure 5. Co-Authorship Network ACE

The graph consists of clusters with few bridges between them, almost like an archipelago. A few clusters are based on one single publication (clusters 4 and 6), while others are based on two or more co-authored publications. Examples of authors in the network that have high degree centrality are Liane Thuvander, Pär Johansson, Paula Fermenais and Karin Lundgren. They happen to also be among the most productive authors of the network. The most productive author in this network, according to research.chalmers.se is Claes Caldenby (39 publications). However, since a majority of Caldenby’s publications are single authored, that does not affect the size of his node.

One publication from each of the larger clusters is listed below. Notably, a significant share of ACE publications is not published in journals indexed by Scopus and Web of Science. Rather, a considerable

amount of publication output in ACE appears in newspapers (such as *Göteborgs-posten*) where topics of local relevance such as city development and urban planning are debated; trade magazines (*Arkitektur*, *Arkitekten*, *Baumeister*, *Bygg & Teknik*, *Betong* e.g.), reaching primarily professionals; humanist magazines such as *Arche* and *Glänta*, that are interdisciplinary in its nature and reach intellectuals from different research disciplines and professions. With a few exceptions (e.g. *Baumeister*), these types of publications are written in Swedish. This practice suggests an underlying publishing culture at ACE, possibly tied to conceptualization of the discipline itself and its role within society.

Area 1 (the blue cluster) writes about sustainable renovations (recycling, sustainable materials, solar panels, roof renovation). These authors have one major publication channel, namely the trade magazine *Bygg & Teknik*. This magazine can target anyone interested in construction, but professionals are probably the primary target group.

Area 1 and 3 (the purple and red clusters) are linked together through the following publication:

Marcus, L., & Wallbaum, H. (2019). Skatteväxla från arbete till mark effektivare än en plastpåseskatt. *Dagens Nyheter* (DN).

Area 3 includes researchers who write about architecture and city development. Notably, themes covered here are typically of a more local character; for example, the development of Gothenburg is debated in *Göteborgs-posten*.

Area 2 (the green cluster) published primarily in the trade magazine *Bygg & Teknik* (see area 1).

Examples of publications from each area:

Area 1

Femenias, P., Wahlgren, P., Johansson, P., Thuvander, L., & Eriksson, P. (2019). Om-renovering – möjligheter för energieffektivisering när äldre flerbostadshus renoveras en andra gång. *Bygg Och Teknik*, 2019(2), 24–28.

Area 2

Sciegaj, A., Lundgren, K., Larsson, F., Nilenius, F., & Runesson, K. (2018). Ny metod för sprickmodellering i armerad betong. *Bygg & Teknik*, 110(7), 46–48.

Area 3 (red and purple)

Berghauser Pont, M., Caldenby, C., Klasander, A.-J., & Nylander, O. (2018). Tät blandstad passar inte överallt i Göteborg. *Göteborgs-Posten*. (red)

Marcus, L., Berghauser Pont, M., Barthel, S., Colding, J., Legeby, A., & Gren, Å. (2016). Nytt miljonprogram – unik chans att lösa flera frågor. *Dagens Nyheter*. (purple)

Area 4 (based on one publication)

Ryd, N., Schelin, E., Gabrielli, K., Andersson, R., Westin, E., Bergström, A., Edling, S., Engdahl, S., Broman, M., Jönsson, P.-O., Sörensen, N., & Glasare, G. (2016). Forskning avgörande för samhällsbyggandet. Dagens Samhälle.

Area 5

Forssén, J., Rosas Perez, C., Zachos, G., & Ögren, M. (2019). Utmaning med lågfrekvent buller inomhus vid stadsförtätning. Bygg & Teknik, 3.

Area 6 (based on one publication)

Celec, U., Stamma, M., Andersson, P. K., Holme, M., Laike, T., Jägerbrand, A., Thaug, J., Lowden, A., Hemphälä, H., Billger, M., Johansson, M., Karlsson, R., Ejhed, J., & Karlsson, T. (2015). Bättre ljus i skolan minskar barnens stress. NyTeknik, Debatt. Publicerad 23 Juni 2015 06:12.

Co-authorship analysis - Space Earth and Environment

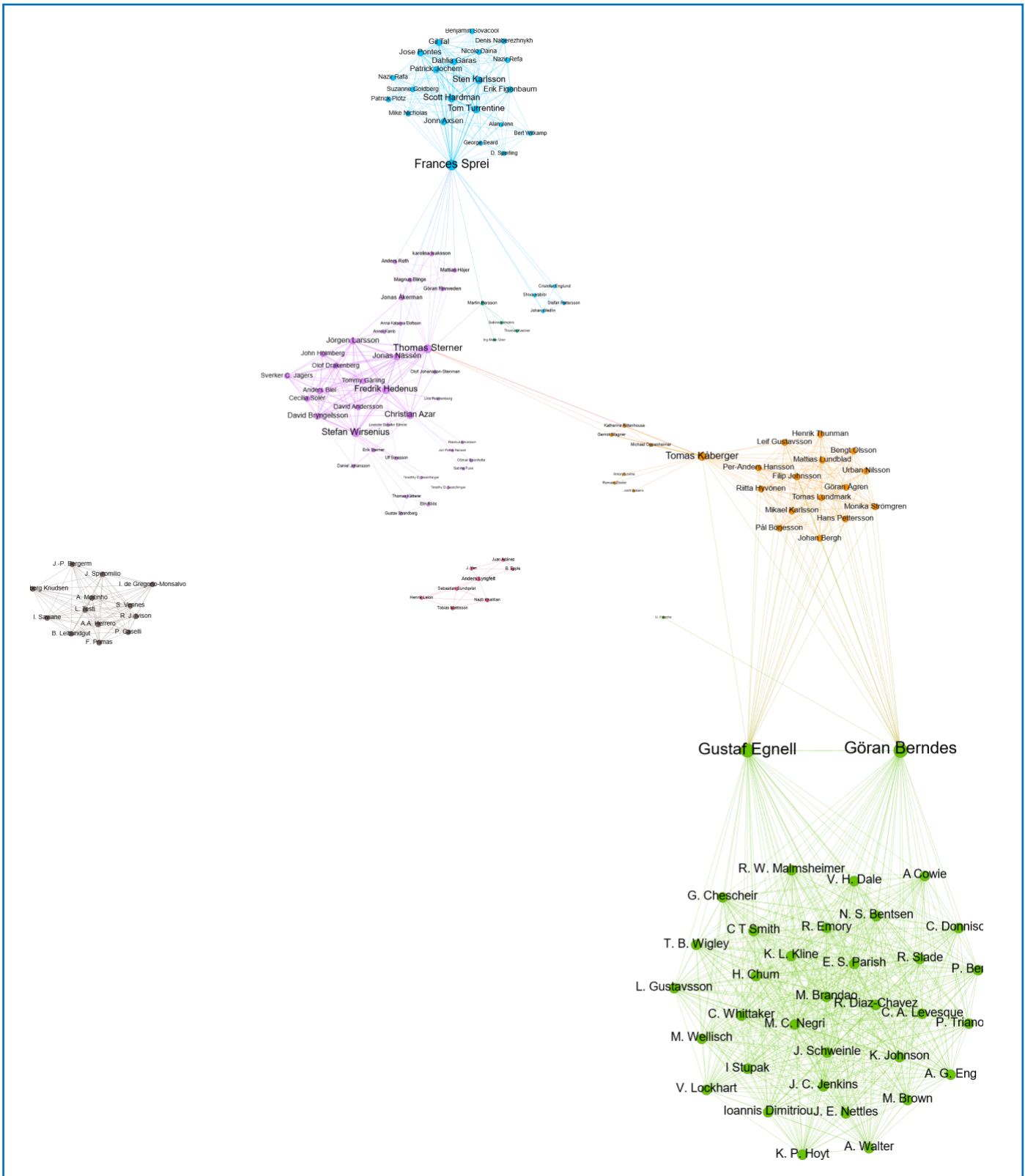


Figure 2. Co-Authorship Network SEE

Figure 2 shows co-authorship in newspaper- and magazine articles affiliated to the Department of SEE 2015-2019. Compared to previous graph, this graph is denser, with only a couple of clusters not

connected to the main graph. Interesting to note is that the main graph, in which all clusters are connected to each other, consists of authors primarily affiliated to the Division of Physical Resource Theory at SEE, and their collaborators from other organizations (institutes, universities, companies).

Topics identified were energy systems analysis, carbon capture and storage, climate change, biofuel energy, sustainable transport, agriculture, consumption and air travel.

Fredrik Hedenus, Frances Sprei and Martin Eriksson link the blue and the purple clusters together through their co-authored debate article “Forskare: Flygdebattörerna borde kliva upp ur sina skyttegravar” (“*Researchers: Flight debaters should step out of their trenches*”) (DN, 2018-02-20).

One debate issue identified in the publications written by authors belonging to the purple cluster is carbon dioxide tax. One example is:

Hedenus, F. (2017). Lösningen stavas koldioxidskatt. *Arbetaren*, 29 november.

Which translates “The solution is spelled carbon dioxide tax”, published in the left-oriented magazine *Arbetaren*. *Arbetaren* is, owned by the union “SAC-syndikalisterna”. [SAC syndicalists]. (<https://www.arbetaren.se/>, 2020-06-29)

Tomas Sterner (professor in environmental economics at Gothenburg University) and Tomas Kåberger link the purple and orange clusters together through the following text published in *Nature*:

Sterner, T., Kåberger, T., Wagner, G., Oppenheimer, M., Rittenhouse, K., & Kåberger, T. (2015). Energy policy: Push Renewables to spur carbon pricing. *Nature*, 525(7567), 27–29. <https://doi.org/10.1038/525027a>

A majority of the authors belonging to the blue cluster are not affiliated to Chalmers: John Axsen (Simon Fraser University), George Beard (TRL limited), Erik Figenbaum (Transportøkonomisk institutt - TØI), Scott Hardman (University of California), Alan Jenn (University of California), D Sperling (affiliation unknown), Tom Turrentine (University of California) and Bert Witkamp (affiliation unknown). This group of authors have co-authored *International EV Policy Council Policy Briefs* (<https://phev.ucdavis.edu/international-ev-policy-council-policy-briefs/>), addressing international and national policy makers in relation to questions about the plug-in hybrid and electrical vehicles’ market. The Plug-in Hybrid & Electric Vehicle (PH&EV) Research Center, where these briefs are published, is part of the Institute of Transportation Studies at the University of California.

The same can be found for the green cluster and in that case, most of the authors were collaborators on one publication⁵:

Dale, V. H., Kline, K. L., Parish, E. S., Cowie, A., Emory, R., Malmsheimer, R. W., Slade, R., Smith, C. T., Wigley, T. B., Bentsen, N. S., Berndes, G., Bernier, P., Brandao, M., Chum, H., Diaz-Chavez, R., Egnell, G., Gustavsson, L., Schweinle, J., Stupak, I., ... Wellisch, M. (2017). Status and prospects for renewable energy using wood pellets from the southeastern United States. *GCB Bioenergy*, 9(8), 1296–1305.
<https://doi.org/10.1111/gcbb.12445>

The graph was shown to a researcher connected to the SEE department, who acted as our expert informant and helped us interpret the graph, identifying topics and influential actors. His experience was that the researchers at the Division of Physical Resource Theory are both encouraged and enabled to write in publication channels that have target audiences outside of the research community, such as newspapers and magazines, and therefore this graph well represents a local culture of outreach.

Examples of publications for each cluster:

Blue cluster

Hardman, S., Turrentine, T., Daina, N., Figenbaum, E., Garas, D., Jochem, P., Karlsson, S., Naberezhnykh, D., Pontes, J., Refa, N., Sovacool, B., Sprei, F., & Tal, G. (2017). *Driving the Market for Plug-in Vehicles - Understanding Reoccurring Incentives*. UC Davis, International EV Policy Council.

Purple cluster

Andersson, D., Azar, C., Biel, A., Bryngelsson, D., Drakenberg, O., Gärling, T., Hedenus, F., Holmberg, J., Jagers, S. C., Larsson, J., Nässén, J., Solér, C., Sterner, T., & Wirsenius, S. (2015). Nu krävs kraftfulla åtgärder mot nötkött och flygresor. *Dagens Nyheter*, 2015-02–27.

⁵ The following organizations collaborated on this publication: Argonne National Laboratory, Agriculture et Agroalimentaire Canada, Canadian Forest Service, ENVIVA LP, Imperial College London, Innovative Natural Resource Solutions LLC, Instytut Uprawy Nawożenia i Gleboznawstwa Państwowy Instytut Badawczy, Linnaeus University, National Council for Air and Stream Improvement, National Renewable Energy Laboratory, North Carolina State University, that publication: Oak Ridge National Laboratory, Resource Management Service L.L.C., Rothamsted Research, University of New England, Weyerhaeuser NR Company, State University of New York College of Environmental Science and Forestry, Sustainable Forestry Initiative Inc., Imperial College London, University of Toronto, National Council for Air and Stream Improvement, University of Copenhagen, Canadian Forest Service, Instytut Uprawy Nawożenia i Gleboznawstwa Państwowy Instytut Badawczy, National Renewable Energy Laboratory, Swedish University of Agricultural Sciences, Linnaeus University, Thünen Institute of International Forestry and Forest Economics, United States Department of Energy, Sustainable Forestry Initiative Inc., Universidade Estadual de Campinas, University of Copenhagen, University of New England, University of Southampton, Rothamsted Research, University of the Sunshine Coast, North Carolina State University, University of Southampton, United States Department of Energy, University of Tennessee, University of Toronto, Weyerhaeuser NR Company. ENVIVA LP, Innovative Natural Resource Solutions, LLC, Resource Management Service L.L.C., Argonne National Laboratory, Weyerhaeuser NR Company, Agriculture et Agroalimentaire Canada

Hedenus, F., & Einarsson, R. (2017). Nej, man behöver inte djuren för att få mat. *Aftonbladet*, 18 December.

Orange cluster

Berndes, G., Bergh, J., Börjesson, P., Egnell, G., Gustavsson, L., Hansson, P.-A., Hyvönen, R., Johnsson, F., Karlsson, M., Kåberger, T., Lundblad, M., Lundmark, T., Nilsson, U., Olsson, B., Pettersson, H., Strömgren, M., Thunman, H., & Ågren, G. (2017). Skoglig bioenergi central i klimatarbetet. *Dagens Nyheter*.

Sterner, T., Kåberger, T., Wagner, G., Oppenheimer, M., Rittenhouse, K., & Kåberger, T. (2015). Energy policy: Push Renewables to spur carbon pricing. *Nature*, 525(7567), 27–29.

<https://doi.org/10.1038/525027a>

Green cluster

Dale, V. H., Kline, K. L., Parish, E. S., Cowie, A., Emory, R., Malmshamer, R. W., Slade, R., Smith, C. T., Wigley, T. B., Bentsen, N. S., Berndes, G., Bernier, P., Brandao, M., Chum, H., Diaz-Chavez, R., Egnell, G., Gustavsson, L., Schweinle, J., Stupak, I., ... Wellisch, M. (2017). Status and prospects for renewable energy using wood pellets from the southeastern United States. *GCB Bioenergy*, 9(8), 1296–1305.

<https://doi.org/10.1111/gcbb.12445>

Berndes, G., Bergh, J., Börjesson, P., Egnell, G., Gustavsson, L., Hansson, P.-A., Hyvönen, R., Johnsson, F., Karlsson, M., Kåberger, T., Lundblad, M., Lundmark, T., Nilsson, U., Olsson, B., Pettersson, H., Strömgren, M., Thunman, H., & Ågren, G. (2017). Skoglig bioenergi central i klimatarbetet. *Dagens Nyheter*.

Pink cluster (one publication)

Sundqvist, S., Khalilian, N., Leion, H., Mattisson, T., & Lyngfelt, A. (2017). Manganese ores as oxygen carriers for chemical-looping combustion (CLC) and chemical-looping with oxygen uncoupling (CLOU). *Journal of Environmental Chemical Engineering*, 5(3), 2552–2563.

<https://doi.org/10.1016/j.jece.2017.05.007>

Grey cluster (one publication)

Primas, F., Ivison, R. J., Bergerm, J.-P., Caselli, P., de Gregorio-Monsalvo, I., Herrero, A. A., Knudsen, K. K., Leibundgut, B., Moitinho, A., Saviane, I., Spyromilio, J., Testi, L., & Vennes, S. (2015). Shaping ESO2020+ Together: Feedback from the Community Poll. *The Messenger*, 161, 6–14.

Conclusion

Although we limited our data to the most recent years (2015-2019) and used as database a publicly available repository where scientists themselves report their own publications, [Research.chalmers.se](https://research.chalmers.se), our report reveals a considerable variety of publications, practices, and topics. This variety of practices is perhaps more evident across disciplinary areas, rather than within one single department, suggesting that practices of “public science” communication are both contextual and disciplinary, tied to the situated “culture” of scholarship and community engagement (Renwick, Manathunga & Keamy, 2020) that is fostered within different university departments. For example, the boundary between academia and the profession (or society) may be more fluid and porous for scholars working in architecture and civil engineering, who in our dataset seem to publish regularly in professional publications. Similarly, the epistemological mandates and the goals of scholarship with an environmental focus may result in a culture of public engagement, and scientists working in these areas, such as some of the researchers at SEE, may consider the dissemination of their scientific knowledge and the engagement in public debate as a natural dimension of their academic persona (much as the public pedagogue described by Said, 1995).

Some authors stand out as particularly engaged in this type of communication, mostly in the two most productive departments. Questions that emerge –potentially interesting to address in the next stage of this project— include: Why do they choose to engage so much in this kind of publication when it is clear that it has less academic “prestige” than high-impact publication? What motivates them? How do they perceive the aim of scholarship and as such the role of a scientist? And, more concretely in relation to metacognition: what do they think about when they plan, write, and evaluate their writing “beyond academia”, with genres and audiences that are not tied to scientific publication?

The collaborative dimension of writing beyond academia was highlighted by the use of network analysis. This methodology showed that situated cultures of science may also reflect on different collaborative practices, and we could see different patterns of collaboration within the different departments. Interestingly, the most productive authors are not the ones that collaborate the most. The co-authorship analysis shows how the authors of the two departments ACE and SEE collaborate, but it seems that a well-established pen (an established, tenured academic) rather writes alone, and is established enough to do so. Looking at authorship from a practical perspective, it may be worth investigating and perhaps promoting collaborative practices, especially for junior scholars who may not have the confidence to assume an authoritative persona, but instead may feel more comfortable writing with one voice: “Researchers at Chalmers...”.

The use of network analysis—a bibliometric method—in combination with qualitative methodologies typically used in social science and applied linguistics brings up another point. Typically, bibliometrics is linked to research measurement, evaluation, and competition for funds. As Linton (2019, p. 7) points out,

bibliometrics are too often used as a (grossly unsuccessful) “structure of incentives within research”⁶, detracting from the crucial role that communication covers in the advancement of scientific knowledge: each new result is a story that culminates in a text. This report hopefully shows that bibliometric methods can also be used as explorative tools to study research fields. Methods such as co-authorship analysis may give insights into the structure of a research field, and collaboration patterns may be observed. It is interesting to note that in our dataset, the most collaborative researchers are not necessarily the most productive nor the most cited authors of the fields. A researcher who is not well cited could be a “socially important figure” in the network, collaborating with individuals from different divisions and sub-fields (increasing interdisciplinarity), even bridging individuals and clusters of authors together. Thus, social network analysis can reveal something about social practices of communication adding a new dimension to traditional “evaluative” bibliometrics.

This report shows that dissemination of science is carried out to a rather considerable extent by many scientists, but that the value of these publications may depend on the situated (inter)disciplinary culture and goals. In terms of policies for promotion and tenure, it is thus important to take into account the variety of practices that researchers actually engage in, since not the same type of communication works for all disciplinary orientations (Schimanski & Alperin, 2018). In our data, for example, the Division of Physical Resource Theory (at SEE) is the most active division at Chalmers when it comes to publishing in magazine and newspaper articles. This may be due to internal, situated values that reflect the research orientation of that division, possibly to the same extent as scientific publications. The inter-disciplinary and global relevance of certain research topics may naturally lead to more public science engagement and international collaboration. In the SEE co-authorship graph, we found examples of international collaboration, primarily between researchers from Chalmers and the University of California addressing questions about plug-in hybrid and electric vehicles, reaching international policymakers. At the same time, while at SEE that division is the most active in outreach, at ACE a more even spread could be observed among the divisions, posing again questions such as what genres are written, for whom, who as the time and affordance to disseminate knowledge, and what kind of collaborative practices are available. It may also suggest a local disciplinary culture that holds in high regard engagement in society and communication of science with local relevance. Interestingly, overall in our data, the level of internationalization is low compared to scientific publishing (in peer review journals), with Swedish being the dominating language. Thus, another interesting question that emerges is what motivates researchers to be active in public communication of science (political engagement, personal values, conceptualizations of scholarship etc.).

We conclude by picking up some questions and points of reflection presented in the introduction to this report. Fundamentally, as universities face a shift towards global, digital and socially engaged forms of education, key questions that need to be addressed are: What kind of public intellectual (Said, 1995) should universities foster? How do we define or re-define scholarship (Boyer, 1990, 1996), including its

⁶ Our translation. Original: “den helt misslyckade incitamentstrukturen inom forskningen” (Linton, 2019, p7).

desired outcomes? Who benefits from these outcomes, and at what cost? And, more practically, how do we give an equal opportunity to *all* future scientists to access resources and training that will allow them to participate in various outlets of science communication with confidence, creativity, and style? Our report shows that many scientists, actually, “hinner” (have time for), but that engagement in public communication of science is mostly tied to individual motivation (including personal political engagement), academic status, and the existence of a supportive departmental culture where this kind of activity is valued. To quote Katarina Wadstein Macleod (2019, p. 25), author of a chapter in the book *Kampen om kunskap*, as she reflects on possible public personas that scientists can adopt when communicating beyond academia “I båda fallen är det någon som vid sidan av sin forskning, undervisningsbeting och administration har tid, kraft och möjlighet att ägna till åt att skapa en offentlig persona. Det är en mer uppnåelig roll än forskaren gestaltad i film och konst. Likväl är det en roll som är få forskare förunnad...”⁷ (Wadstein McLeod, 2019, p. 25).

⁷ “In both cases, it is someone who, in addition to their research, teaching duties, and administrative service, has the time, energy and opportunity to dedicate to the creation of a public persona. It is a more achievable role than the researcher portrayed in film and art. Nevertheless, this is a role that few researchers can afford to create”. (Our translation).

References

- Aitchison, C., Catterall, J., Ross, P., & Burgin, S. (2012). 'Tough love and tears': Learning doctoral writing in the sciences. *Higher Education Research and Development*, 31(4), 435-447.
- Bastian M., Heymann S., Jacomy M. (2009). Gephi: an open source software for exploring and manipulating networks. International AAAI Conference on Weblogs and Social Media.
- Bohlin, G. & Bergman, M. (2019), *Jag vill, men hinner inte! – forskares syn på kommunikation och öppen vetenskap. Nationell enkätundersökning 2019. (VA-rapport 2019:8)*. Retrieved from Vetenskap & Allmänhet website: <https://v-a.se/2019/09/jag-vill-men-hinner-inte-forskares-syn-pa-kommunikation-och-oppen-vetenskap/>
- Boyer, E. L. (1990). *Scholarship reconsidered: Priorities of the professoriate*. Princeton University Press, 3175 Princeton Pike, Lawrenceville, NJ 08648.
- Boyer, E. L. (1996). The scholarship of engagement. *Bulletin of the American Academy of Arts and Sciences*, 49(7), 18-33.
- Brechensbauer, A., Grafström, M., Jonsson, A., & Klintman, M. (2019). *Kampen om kunskap: Akademi och praktik*. Stockholm, Sweden: Santérus Förlag.
- Brew, A. & Lucas, L. (2009). *Academic research and researchers*. London: Open University Press/SRHE.
- Carli, G., Tagliaventi, M. R., & Cutolo, D. (2018). One size does not fit all: the influence of individual and contextual factors on research excellence in academia. *Studies in Higher Education*, 44, 1912–1930. <https://doi.org/10.1080/03075079.2018.1466873>
- Cho, J. Y., & Lee, E. (2014). Reducing confusion about grounded theory and qualitative content analysis: Similarities and differences. *The Qualitative Report*, 19(32), 1-20.
- Dysthe, O. (2002). Professors as mediators of academic text cultures. *Written Communication*, 19(4), 493-544.
- Emerson, L. (2017). *The forgotten tribe: Scientists as writers*. Fort Collins: University Press of Colorado.
- Florence, M. K., & Yore, L. D. (2004). Learning to write like a scientist: Coauthoring as an enculturation task. *Journal of Research in Science Teaching*, 41(6), 637-668.
- Ilar, A. (2019, May 7). Prioritera kommunikation redan under forskarutbildningen. *Curie*. Retrieved from <https://www.tidningencurie.se/debatt/prioritera-kommunikation-redan-under-forskarutbildningen/>
- Linton, M. (2019). Text och stil: Om konsten att berätta med vetenskap. *Natur och Kultur*.
- Luzón, M. J. (2013a). Public communication of science in blogs: Recontextualising scientific discourse for a diversified audience. *Written Communication*, 30 (4), 428-457.
- Luzón, M. J. (2013b). "This is an erroneous argument": Conflict in academic blog discussions. *Discourse, Context & Media*, 2(2), 111-119.
- Luzón, M. J. (2017). Connecting genres and languages in online scholarly communication: An analysis of research group blogs. *Written communication*, 34(4), 441-471.
- Manathunga, C. & Brew, A. (2014). Beyond Tribes and territories: New metaphors for new times. In P. Trolwer, M. Saunders & V. Bamber (Eds.). *Tribes and Territories in the 21st Century: Rethinking the significance of disciplines in higher education*. London: Routledge.
- Mauranen, A. (2013). Hybridism, edutainment and doubt: Science blogging finding its feet. *Nordic Journal of English Studies* 13(1), 7-36.

- McGrath, L. (2016). Open-access writing: An investigation into the online drafting and revision of a research article in pure mathematics. *English for Specific Purposes*, 43, 25-36.
- Miller, C. R. (1984). Genre as social action. *Quarterly journal of speech*, 70(2), 151-167.
- Persson, O., R. Danell, J. Wiborg Schneider. 2009. How to use Bibexcel for various types of bibliometric analysis. In *Celebrating scholarly communication studies: A Festschrift for Olle Persson at his 60th Birthday*, ed. F. Åström, R. Danell, B. Larsen, J. Schneider, p 9–24.
- Leuven, Belgium: International Society for Scientometrics and Informetrics.
- Powell, James. *A Librarian's Guide to Graphs, Data and the Semantic Web*, Elsevier Science & Technology, 2015. ProQuest Ebook Central, <https://ebookcentral.proquest.com/lib/chalmers/detail.action?docID=2086742>.
- Renwick, K., Selkrig, M., Manathunga, C., & Keamy, R. "Kim." (2020). Community engagement is ... : revisiting Boyer's model of scholarship. *Higher Education Research & Development*, 1–15. doi:10.1080/07294360.2020.1712680
- Said, E., S. (1995). *Representation of the Intellectual*. New York: Random House Inc.
- Schreier, M. (2012). *Qualitative Content Analysis in Practice*. Thousand Oaks, CA: Sage.
- Schimanski, L. A., & Alperin, J. P. (2018). The evaluation of scholarship in academic promotion and tenure processes: Past, present, and future. *F1000Research*, 7, 1605. doi:10.12688/f1000research.16493.1
- Swales, J. (1990). *Genre analysis: English in academic and research settings*. Cambridge University Press.
- Wadstein MacLeod, K. (2019). Galna genier och mångfaldens möjligheter. In Brechensbauer, A., Grafström, M., Jonsson, A., & Klintman M. (Eds.), *Kampen om kunskap: Akademi och praktik*. Stockholm: Santerus Förlag
- Östlund, H. (2017, November 16). Han ska väcka forskarnas språk. *Curie*. Retrieved from <https://www.tidningencurie.se/nyheter/2017/11/16/han-ska-vacka-forskarnas-sprak/>