ERUA
European Reform University Alliance

Co-funded by the Erasmus+ Programme of the European Union

D 2.2.1.3

Analysis of Conditions and Strategies of Success for Research in the SSH

Publication patterns in Horizon 2020

Table of Contents

Document Information

Grant Agreement	101004053
Project Title	European Reform University Alliance
Project Acronym	ERUA
Project Start Date	01 November 2020
Related Work Package	WP 2 – Re-Imagining Higher Education and Research
Related Tasks	Deliverable 2.2.1.3
Lead Beneficiary	Roskilde University
Submission Date	1 November 2022
Dissemination Level	Public
Authors	P8: …….; RUC: ……..; UKon: ……..; UAegean: ……; NBU: ……;

1. Introduction

The idea of research interdisciplinarity is crucial to the ERUA-project: One of the goals is to be a European hub for interdisciplinary research with the social science and humanities as a reference: According to the mission constituting the basis of ERUA, research should focus on problems and challenges, which demands the utilization of an interdisciplinary mindset, and all universities in the alliance have a strong interdisciplinary research profile. Frodeman (2017, p. 8) argues that interdisciplinarity in a wide sense seeks to solve political, democratic and technocratic problems by bridging academia and the rest of society. In addition, through interdisciplinary approaches, research can address real life problems which most often do not adhere to the epistemic constructs of academic disciplines, and furthermore, researchers are more likely to have discipline-specific epistemic knowledge complemented by other perspectives. However, although for many institutions, interdisciplinarity is desirable, it has also been associated with numerous challenges: For one, interdisciplinary research collaborations face the challenge of language, i.e., it might be difficult to bridge disciplinary divides in order to establish a common theoretical and empirical understanding of a research phenomenon, question or problem (Bul & Oughton, 2006). Likewise, a significant risk of including multiple disciplines in a single research project is made up by what has been referred to as ‘organisational silos’ in administration and management literature (Bento et al., 2020), i.e., the splitting up of projects into isolated units of results, people, data, practices – in this case based on disciplines. If this happens, some of the merit of interdisciplinary research is lost. In this report, we seek to assess interdisciplinary research projects funded by the EU to learn more about their patterns of publication and their build up when compared to non-interdisciplinary projects.

1. Data

1.1. Why EU project data?

In this report, we draw on accumulated data covering projects and associated publications from Horizon 2020, the research funding programme of the European Union in the years 2014-2020, which had a budget of nearly € 80 billion (European Commission, n.d.-a). There are several reasons that this data is useful to our research interest: First, the data is openly

available for download through the CORDIS database.[1] Secondly, the context of the projects and publications in the data is internationally anchored in the EU, which all member universities in ERUA are members of. In addition, the European context entails that our data is not specific to a single national or regional context, which might give rise to questions of generalizability across borders. Finally, we see the EU Horizon 2020 programme as an optimal case for analysis of ERUA: the programme was inherently problem- oriented, as it emphasized using research as a means of tackling societal challenges, and a specific goal was to enhance opportunities for innovation and to enable collaboration of public and private sectors to create innovation (European Commission, n.d.-b). Likewise, it was an explicit ambition to include external collaboration in projects. Thus, we see many of the core values and the mission of ERUA mirrored in the Horizon 2020 program, and it provides an optimal case for enquiry into patterns of publication of interdisciplinary research.

1.2. Data sources

We draw on data from the CORDIS EU Research Results database. This database covers projects and associated results of EU-funded projects from the 1990's until now, although we limit the enquiry to Horizon 2020 projects. We use the *EuroSciVoc* (European Science Vocabulary) taxonomy of fields of sciences (Publications Office of the EU, n.d.) to identify interdisciplinary projects. This method, managed by the European Union, is a semi-automated process based on natural language processing methodology. The method is used by CORDIS which in addition to data covering all EU-funded projects also contains their associated publications. Thus, we obtain data on all articles, books, theses, conference proceedings and other publications related to each funded project.

Our data comprises project information on funding, participants, external collaborators, scientific fields, research descriptions as well as publication data. In addition to this data, we draw on various external sources of metadata on publication outlets, which we link to the EU data via the ISSN of each publication. In the data, several ISSN values were missing, which is problematic, seeing as our analysis is based on the option to link publications with metrics and indicators from external data sources. To maximize the number of valid cases, we used

[1] See https://cordis.europa.eu/

various methods of imputation. First, we used DOI values of publications to match ISSNs using the Crossref API. Likewise, we used journal names to obtain potential matches.

Our initial data comprised all 35,349 Horizon 2020 projects. Out of these, 34,218 were included in the analysis, as some projects were dismissed based on missing EuroSciVoc codes or lack of unique IDs. The data on publications comprises all 154,969 publications associated with the included Horizon 2020 projects. For the sake of simplicity, in this analysis, we only use peer-reviewed articles, seeing as they are easier to compare based on various sources of metadata, and because they are assessed by actors external to each project. Thus, in total, 154,969 unique publications are included. Out of the included Horizon 2020 projects, only 14,934 had published articles, and thus, the remaining were dropped in the analysis of publication patterns. In general, we also restrict the analysis to only include projects that have published more than 3 articles to ensure that they are not recently started projects.

In addition to the EU project and publication data, we used the following other data sources:

BFI – The Danish Bibliometric Research Indicator: We draw on data from the Danish BRI, a national research evaluation system used to allocate research funding to public universities based on their performance. BFI indexes journals as either level 1, 2 or 3, with 1 being *normal*, 2 being *high* and 3 being *excellent* (level 3 is used extremely rarely and no social science or humanities journals are indexed at this level). More specifically, to be indexed as level 2, a journal ought to be considered an international leader in the specific research subject, and the cumulative share of international research production in journals classified as level 2 should not exceed 17.5 – 22.5 %. What makes BFI useful for studying publication patterns is that the indexing of journals is carried out by subject-specific expert councils made up of 6-8 researchers, and it is thus based on a subjective assessment of individual journals within their respective subjects – i.e., it is useful to use across subjects, seeing as it accounts for subject specific differences i.e., in citation styles. Likewise, the categorization of journals into different subjects is based on subjective human judgements based on thorough academic discussions, which makes the results of patterns of subjects more robust[2].

[2] https://kub.ku.dk/biblioteker/frederiksberg/forskdok/forskdok/bfi/

CWTS Journal Indicators: Additionally, we draw on data from the CWTS Leiden Ranking which offers various data variables on the international ranking and performance of journals. To identify subjects of publications, we utilize the ASJC (All Science Journal Classifications) codes included in this data. These codes cover the specific subjects of sciences (i.e., oncology, social psychology, condensed matter physics, etc.). Based on these, we created three supergroups: health/life science, social sciences and humanities, natural/physical science, and multidisciplinary sciences[3].

Directory of Open Access Journals: To identify open access journals, we draw on data from DOA, which indexes all open access journals.

Scimago Journal & Country Rank: To examine the journal ranking of publications, we finally draw on Scimago Journal & Country Rank, which includes various measures of performance and ranking for journals. This data source offers subject-specific rankings, which is well suited to provide a more nuanced view of publication patterns of research projects.

1.3. EuroSciVoc - Identifying interdisciplinary projects

We draw on EuroSciVoc to identify interdisciplinary research projects in Horizon 2020. More specifically, projects are coded as interdisciplinary if they feature one or more ‘super disciplines’, i.e., both natural and social sciences or both engineering and humanities. We are aware that projects can be interdisciplinary within a single super discipline, i.e., covering both economic and sociological aspects or both physical and chemical subjects, but we limit ourselves to the study of interdisciplinarity as collaborations ‘between faculties’. We code this into a categorial variable covering whether the project is monodisciplinary, interdisciplinary (2 super disciplines) or multidisciplinary (more than 2 disciplines). Table 1 shows the included super disciplines and the number of projects that feature the particular discipline.

[3] Some journals are coded as ’multidisciplinary’ at the most specific level (i.e., Nature, Science, PLoS ONE)

Type	Number of projects
Engineering and technology	14143 (41.33%)
Medical and health	9223 (26.95%)
Natural	24131 (70.52%)
Social	11907 (34.8%)
Humanities	3152 (9.21%)
Agricultural	2566 (7.5%)

Table 1: Overview of number of projects including different disciplines

2. Analysis

2.1. Descriptive introduction

Before proceeding to the presentation of publication patterns of Horizon 2020 projects, we present a few descriptive insights into the development of interdisciplinarity. Figure 1 shows the share of Horizon 2020 by start year based on whether they include 1, 2, or more than 2 super disciplines, i.e., if they are mono-, inter-, or multidisciplinary. As shown, the share of multidisciplinary projects has been decreasing somewhat steadily since 2014. However, the largest share of projects in general across years is made up by interdisciplinary projects.

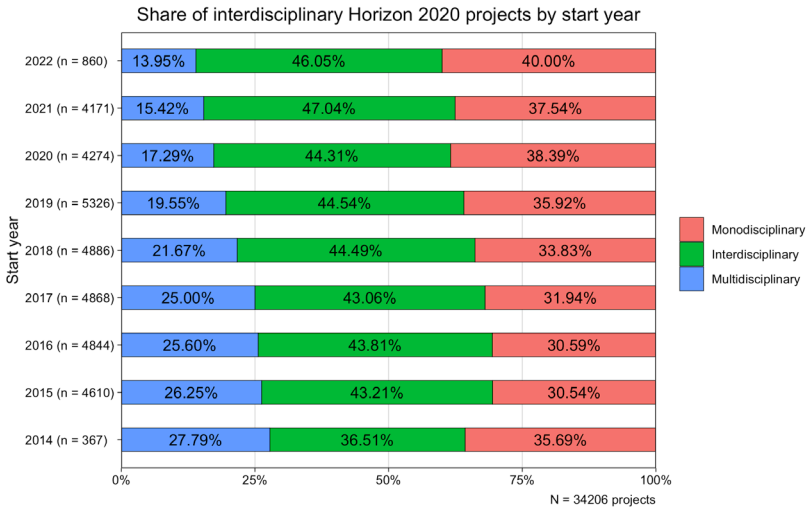

Figure 1: Share of interdisciplinary Horizon 2020 projects by start year

The inclusion of different disciplines in inter- and multidisciplinary projects can take many forms. In Figure 2, we show the share of projects that include both SSH and STEM disciplines by start year. As shown, the share of projects including both STEM and SSH disciplines has also steadily declined by start year. However, for both Figure 1 and Figure 2, we cannot conclude that generally, the EU is funding a decreasing number of inter- and multidisciplinary project. This conclusion would need to draw on an analysis of data covering a longer time period and more funding programmes – in this data, the decrease might, for example, be the result of various funding schemes being used at different points in the programme.

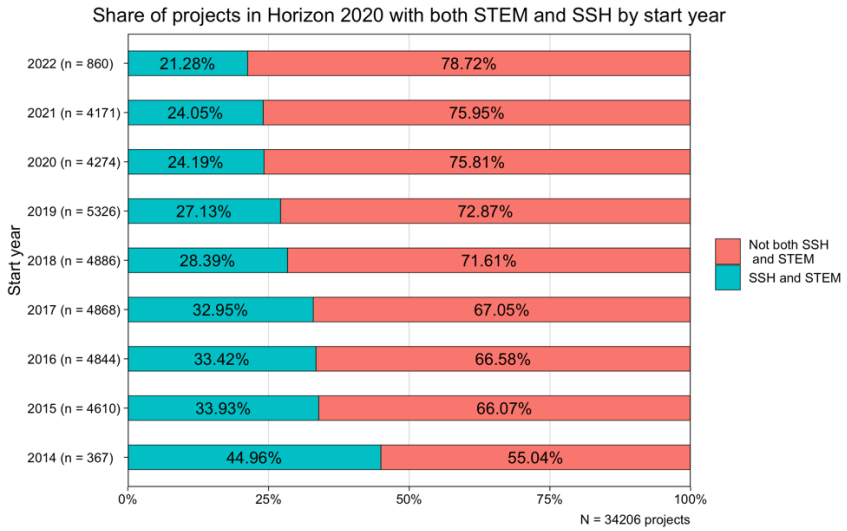

Figure 2: Share of projects in Horizon 2020 with both STEM and SSH by start year

The figure below shows the total number of projects including different disciplines. As shown, almost ¾ of all projects include natural science disciplines.

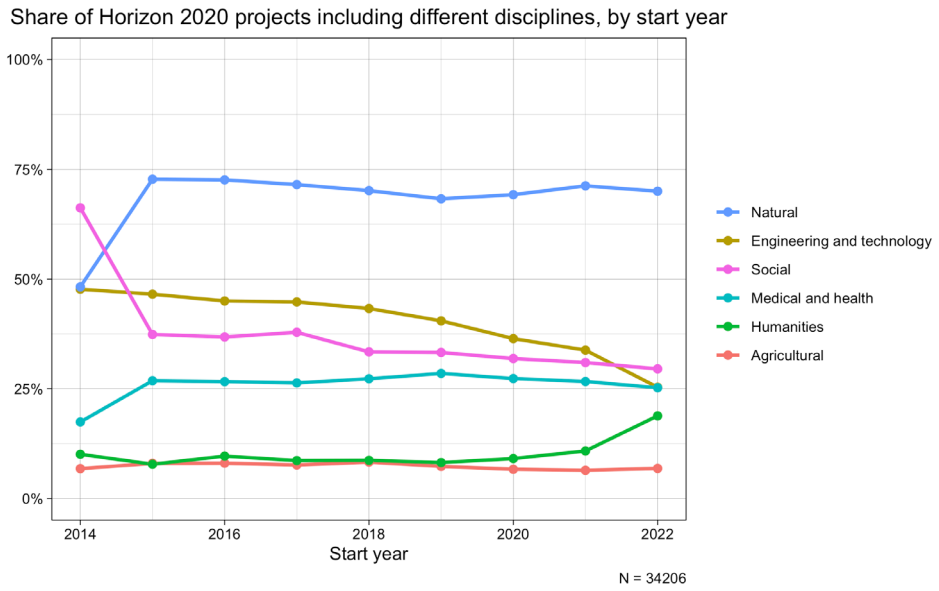

Figure 3: Share of Horizon 2020 projects including different disciplines, by start year

We limit this analysis to publications of articles. However, the visualization of the share of publication types in the various project types in Figure 4 shows that, the share of publications that are articles is in general higher in monodisciplinary projects, whereas in inter- and multidisciplinary projects, conference proceedings make up a higher share of total publications.

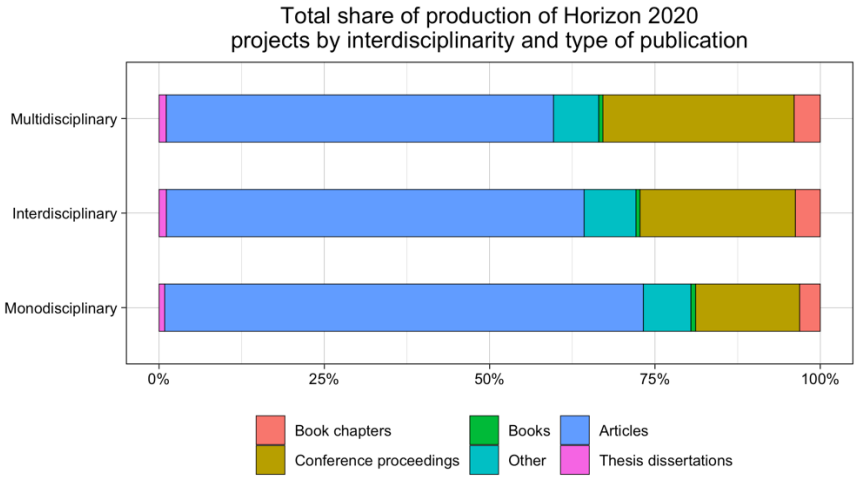

Figure 4: Total share of production of Horizon 2020 projects by interdisciplinarity and type of publication

In Figure 5, we show the average number of participants and participating members (institutions) for projects based on their degree of interdisciplinarity. As shown, multidisciplinary and interdisciplinary projects have a higher degree of both members and countries participating when compared to monodisciplinary projects. This makes sense, seeing as working across disciplines is likely to imply the involvement of several institutions from several disciplines. This might mean that more actors are involved, and thus more perspectives are added to the view of the problem – however, it might also prove difficult in terms of collaboration. However, one reason that these types of projects feature more countries and participants might be that they are simply larger, i.e., in terms of the amount of funding they receive. In Figure 6, we show the total cost of projects based on their interdisciplinary status in 1000 €. As shown, although multidisciplinary and monodisciplinary projects are typically somewhat more costly, the difference is not striking.

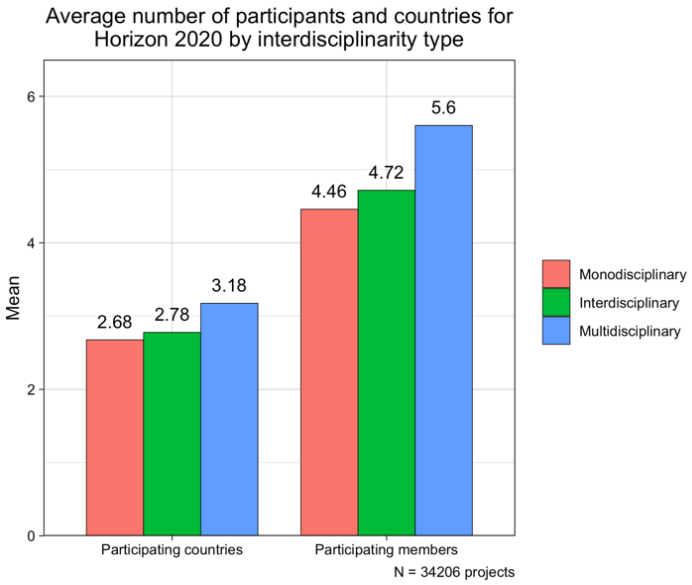

Figure 5: Average number of participants and countries for Horizon 2020 by interdisciplinarity type

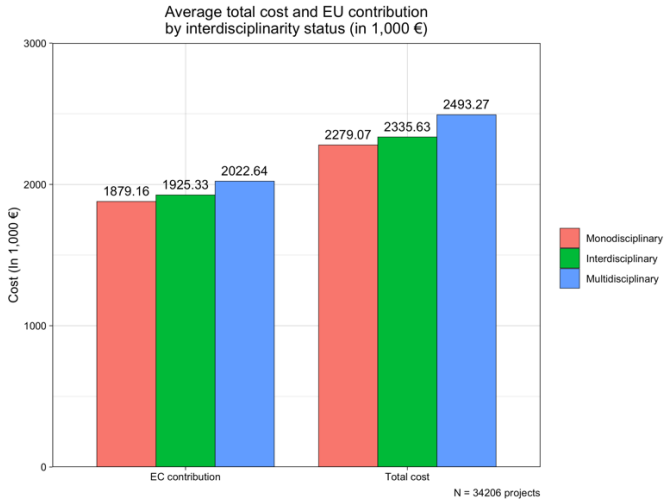

Figure 6: Average total cost and EU contribution by interdisciplinarity status (in 1,000 €)

In EU research policy, 'open science' is strongly emphasized as a policy priority, and publication in open access outlets is explicitly encouraged[4]. The intersection of interdisciplinary research and open access in science is also key to the ERUA project, as open access is seen as a means to pursue excellence in research. Likewise, interdisciplinarity and open access constitute two trends that are both oriented towards alternative modes of producing scientific knowledge.

In Figure 7, we compare the average open access publication share for projects based on their interdisciplinarity type. For a journal to be classified as Open Access, it ought to be classified in DOAJ, and this registry of open access journals contains various types of journals with different degrees of open access status. As the figure shows, there is no clear correlation between the interdisciplinarity of a project and the degree to which the project publishes in open access journals.

[4] https://research-and-innovation.ec.europa.eu/strategy/strategy-2020-2024/our-digital-future/open-science_en

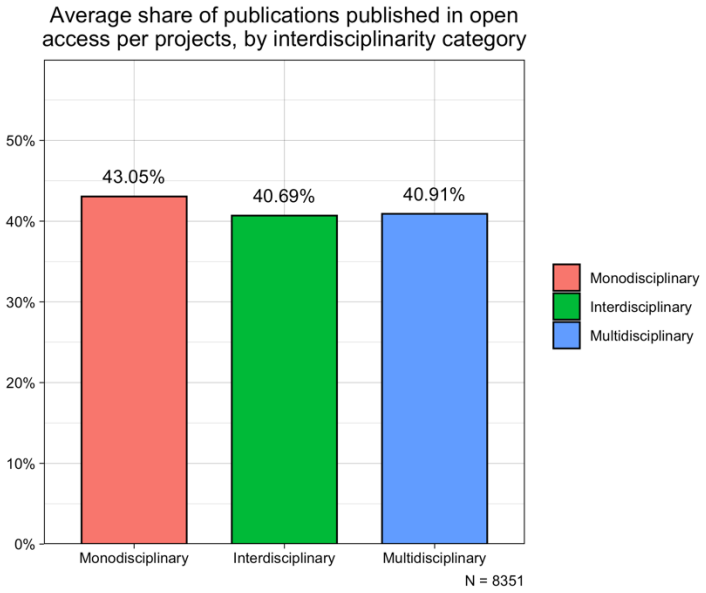

Figure 7: Average share of publications published in open access per projects, by interdisciplinarity category

In this section, we examine the publication patterns of interdisciplinary Horizon 2020 projects. Our main interest concerns whether these projects publish interdisciplinarity, i.e., if the journals they publish in have a larger distribution of subjects, but we are also interested in the ranking patterns of publications. In our data, those publications that have valid ISSNs and which we can connect to journals via their ISSN, cover 12,199 journals in total. Table 1 shows the most frequent journals for both interdisciplinary and monodisciplinary projects.

Type	Number of projects
Nature Communications (N = 3675)	Monthly Notices of The Royal Astronomical Society (N = 3694)
Physical Review B (N = 2146)	Physical Review B (N = 2623)
IFAC-PapersOnLine (N = 1368)	Nature Communications (N = 2241)
Monthly Notices of The Royal Astronomical Society (N = 1079)	Elife (N = 1325)
Acs Nano (N = 895)	Ifac-Papersonline (N = 853)
PLoS One (N = 886)	Physical Review D (N = 805)
Elife (N = 851)	Journal of The American Chemical Society (N = 604)
Nanomaterials (N = 760)	The Astrophysical Journal (N = 596)
Science Advances (N = 736)	Science Advances (N = 555)

Figure 8: Most frequent journals in the data

Figure 9 shows the average share of publications published in interdisciplinary journals by type of project. As shown, there seems to be a slight correlation between the disciplinary nature of a project and the extent to which it is published in interdisciplinary journals – especially in light of the generally low degree of interdisciplinary publishing in the dataset as a whole.

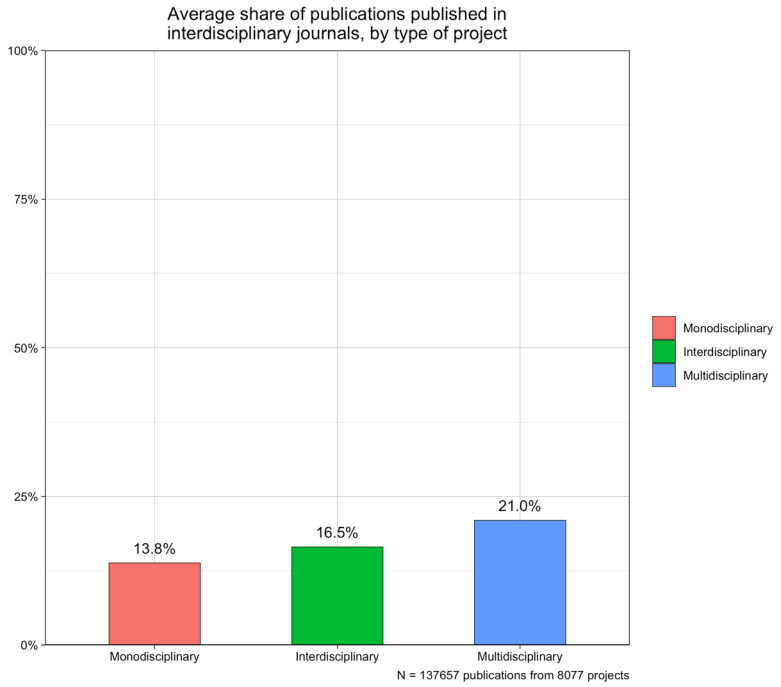

Figure 9: Average share of publications published in interdisciplinary journals, by type of project

Likewise, when we assess the share of projects that have published in interdisciplinary journals, we see the same pattern: Figure 10 shows that multidisciplinary projects seem to be somewhat more likely to publish in interdisciplinary journals

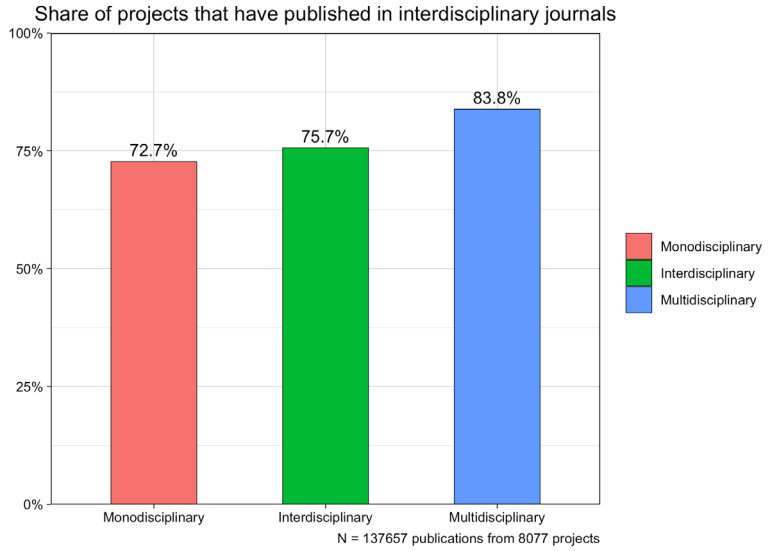

Figure 10: Share of projects that have published in interdisciplinary journals

In Figure 11, we show the distribution of unique BFI subjects per published article in Horizon 2020 projects based on the disciplinary nature of the project. As shown, the pattern from the above figure can also be identified here.

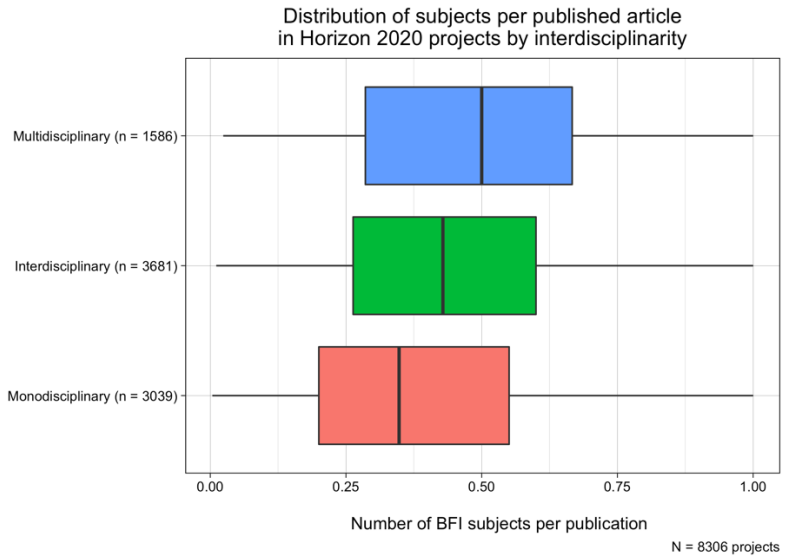

Figure 11: Distribution of subjects per published article in Horizon 2020 projects by interdisciplinarity

Finally, we show the average share of publications published in STEM-SSH journals for projects based on whether they have both STEM and SSH disciplines or not in Table 3.

	Average share of publications in STEM-SSH journals
Not STEM-SSH project	4.73 % (n = 5227)
STEM-SSH project.	10.8 % (n = 3526)

Figure 12: Share of publications publicized in STEM-SSH journals

In terms of rankings, Table 4 shows various measures related to the ranking of publications in projects based on their disciplinary nature. The empirical connection between the practice of rankings and interdisciplinarity has been studied by some scholars (Chen et al., 2015, 2021; Li & Yin, 2022; Rafols et al., 2012; Wang et al., 2015; Yegros-Yegros et al., 2015), and there is evidence that rankings might favour monodisciplinary research and even lead to scholars becoming more aligned with disciplinary cultures over long period of time, because allocation of funds often partly happen on the basis of evaluation through means of journals indicators (Rafols et al., 2012). However, in our data, there are no clear patterns in terms of

whether interdisciplinary and multidisciplinary projects have higher ranking publications in general, although those projects that combine two super disciplines have slightly higher proportions of publications in the world's best journals both in total and by subject as well as BFI 3 journals when compared to monodisciplinary and multidisciplinary projects.

	Monodisciplinary	Interdisciplinary	Multidisciplinary
BFI			
Any BFI indexed publications	99.61 %	99.33 %	99.5 %
Any BFI 3 publications	5.97 %	7.2 %	5.4 %
Any BFI 2 or 3 publications	91.51 %	91.58 %	87.33 %
Scimago			
Any Scimago indexed publications	99.8 %	99.78 %	99.81 %
Any Scimago Q1 ranked publications	97.8 %	97.98 %	97.62 %
CWTS			
Any CWTS indexed publications	99.84 %	99.89 %	99.87 %
Any publications in 15 best total journals (by IPP)	7.67 %	9.93 %	6.21 %
Any publications in 10 best subjects journals (by IPP)	48.44 %	56.56 %	49.56 %

Table 2: Various ranking measures for projects based on interdisciplinarity

3. Conclusion

Using EU data, we have examined various aspects of publications patterns of Horizon 2020 projects based on whether they are interdisciplinary. We have shown that, as one could expect based on the higher need for different competences, inter- and multidisciplinary projects tend to both have more participating institutions as well as generally more participating countries. Surprisingly, we did not find evidence that inter- and interdisciplinary projects are more prone to publish in open access journals. In terms of interdisciplinary publishing, we found that although most publications are still situated in single-disciplined journals, inter- and multidisciplinary projects publish somewhat more extensively in journals comprising more than one discipline, although the effect appears to be rather limited – many inter- and monodisciplinary projects have not published in interdisciplinary journals. Likewise, there appears to be a 'STEM-SSH' barrier seeing as very few projects – even those that have both super disciplines in the design – have published in STEM-SSH journals. In terms of rankings, we did not find any clear patterns in terms of how well various types of projects were placed.

4. References

Bento, F., Tagliabue, M., & Lorenzo, F. (2020). Organizational Silos: A Scoping Review Informed by a Behavioral Perspective on Systems and Networks. *Societies*, *10*(3), Article 3. https://doi.org/10.3390/soc10030056

Bul, L. J. B. (Née, & Oughton, E. A. (2006). "What Do You Mean?" The Importance of Language in Developing Interdisciplinary Research. *Transactions of the Institute of British Geographers*, *31*(3), 371–382.

Chen, S., Arsenault, C., & Larivière, V. (2015). Are top-cited papers more interdisciplinary? *Journal of Informetrics*, *9*(4), 1034–1046. https://doi.org/10.1016/j.joi.2015.09.003

Chen, S., Qiu, J., Arsenault, C., & Larivière, V. (2021). Exploring the interdisciplinarity patterns of highly cited papers. *Journal of Informetrics*, *15*(1). https://doi.org/10.1016/j.joi.2020.101124

European Commission. (n.d.-a). *Horizon 2020*. Research and Innovation. Retrieved October 28, 2022, from https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-2020_en

European Commission. (n.d.-b). *What is Horizon 2020?* Horizon 2020. Retrieved October 28, 2022, from https://wayback.archive-it.org/12090/20220124080448/https://ec.europa.eu/programmes/horizon2020/en/what-horizon-2020

Frodeman, R. (2017). The Future of Interdisciplinarity: An Introduction to the 2nd Edition. In R. Frodeman (Ed.), *The Oxford Handbook of Interdisciplinarity* (p. 0). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780198733522.013.1

Li, H., & Yin, Z. (2022). Influence of publication on university ranking: Citation, collaboration, and level of interdisciplinary research. *Journal of Librarianship and Information Science*, 09610006221106178. https://doi.org/10.1177/09610006221106178

Publications Office of the EU. (n.d.). *European Science Vocabulary (EuroSciVoc)*. EU Vocabularies. Retrieved October 28, 2022, from https://op.europa.eu/da/web/eu-vocabularies/euroscivoc

Rafols, I., Leydesdorff, L., O'Hare, A., Nightingale, P., & Stirling, A. (2012). How journal rankings can suppress interdisciplinary research: A comparison between Innovation Studies and Business & Management. *Research Policy*, *41*(7), 1262–1282. https://doi.org/10.1016/j.respol.2012.03.015

Wang, J., Thijs, B., & Glänzel, W. (2015). Interdisciplinarity and impact: Distinct effects of variety, balance, and disparity. *PLoS ONE*, *10*(5). https://doi.org/10.1371/journal.pone.0127298

Yegros-Yegros, A., Rafols, I., & D'Este, P. (2015). Does interdisciplinary research lead to higher citation impact? The different effect of proximal and distal interdisciplinarity. *PLoS ONE*, *10*(8). https://doi.org/10.1371/journal.pone.0135095